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The Southern African Journal of Environmental Education (SAJEE) is an accredited and internationally refereed journal. It is published online annually, by the Environmental Education Association of Southern Africa (EEASA) and Rhodes University. Continuous publishing via AJOL enables a group of papers to be published as an issue at different times during the year. SAJEE aims to publish and report on a wide range of aspects relating to Environmental Education, Ethics and Action in southern Africa and elsewhere, with a strong focus on research. The Journal seeks to further the academic study and the practice of environmental education by providing a forum for researchers, scholars, practitioners and policy makers. The Journal aims to carry papers reflecting the diversity of environmental education practice in southern Africa. It includes a variety of research genres; conference reviews and keynote papers; comparative studies; retrospective analyses of activities or trends in a particular field; commentaries on policy issues; and critical reviews of environmental education, ethics and action in a particular country or context. The Journal actively seeks out international dialogue in order to provide perspective on and for environmental education in southern Africa. SAJEE aims to provide southern African and other authors with a forum for debate and professional development. The Journal incorporates an author support programme to encourage new authors in the field to establish themselves as scholarly writers. All papers are double-blind reviewed by at least two peer reviewers.

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Special Issue:
Education for Sustainability in a Time of Crises

Editorial Part 1 – June 2020

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Setting the scene

There is an old and still popular saying that a crisis is an opportunity for change. The Chinese symbol for crisis is translated in Wikipedia as "danger at a point of juncture". In the year 2020, first China and then the rest of humanity have been presented with a monumental crisis: a new and lethal virus that spread fast and far, causing actions and reactions, with dramatic consequences for social and economic life around the globe.

Rebecca Solnit wrote of another crisis in her book *Hope in the Dark: The Untold Story of People Power*. In *Grounds for Hope*, a foreword to the 2015 edition (p.2), she stated: "This is an extraordinary time full of vital, transformative movements, that could not be foreseen. It's also a nightmarish time. Full engagement requires the ability to perceive both."

Sustainability educators, environmental activists and scholars have been noting multiple crisis dimensions in recent times: the economic crisis starting with the United States' financial meltdown in 2008; conflict in South America, the Horn of Africa, the Middle East; bush fires in Australia; increasing tropical cyclones hitting eastern-southern Africa; prolonged droughts and rising temperatures; water and food crises; deaths from polluted air and water. For many, the current moment in history is however characterised by much greater uncertainty, and herein lies both the trouble and perhaps also a turning point for the current moment in history. For hope, Solnit wrote, "locates itself in the premises that we don't know what will happen and that in the spaciousness of uncertainty, there is room to act" (ibid., p.4).

And many are motivated to act, by the visions of dramatic change broadcast around the world, and right outside our homes. If you lived in Venice, you would have noticed the cormorants return to the canals for fish they could see for the first time in years, and been reminded of the possibility of nature in harmony with people. In other places where factory furnaces were switched off, residents saw blue skies; and noted that pollution too kills thousands each year. As governments started weighing up 'lockdown' measures to save lives, versus the continuation of structured economic activity, we recall that they make such calculations all the time – with every approval of a mining licence, every new power station and every road that replaces forest. And when authorities told people to stay at home, we saw the poorest defiantly and desperately taking to the streets, demonstrating once again that their economic activity has no safety net, that lives and livelihoods are intertwined and that any economy should be in service of people, rather than the other way round.

Educators, scientists and activists are familiar with these issues. For decades we have been calling for system changes to replace development models and practices which damage the

environment and human health, and exacerbate inequality and vulnerability, even as some benefit from them. General agreements on the need to address poverty and environmental issues through new forms of development, are reflected in United Nations conferences and summits since 1992; in countless scientific reports before and hence; and in visions like the global Sustainable Development Goals. However, there has also been apathy and denial, and a resigned acceptance that while a different reality might be nice, actually 'there is no alternative' to existing, unequal and degrading forms of development. De Sousa Santos (2018) considered this latter view as a political position so powerful that it has become an epistemological position, taking away our ability to imagine or propose anything else without being made out to be wishful or irrational. He described this global hegemony of thought as a 'cognitive empire'. His cogent analysis is at least part of the explanation why, despite the benefit of being able to witness the ravages of conventional industrial development in China, America and Europe, African governments nonetheless embraced this as the best, indeed the only way in which to save their people from poverty.

Perhaps a crisis resulting in the collapse (and exposure) of multiple inappropriate systems, can force the possibility that there must be alternatives. Solnit argued that a disaster was akin to a revolution. Scientists point to the build-up of pollutants in our atmosphere and water; the acidification of the oceans; the loss of soil fertility and insects, as other looming disasters. These crises are slower in nature than Covid19 and unless one is personally caught in the floods, fires and droughts, they are easier to ignore, despite the efforts of young people like the Swedish climate activist, Greta Thunberg, and the Congo rainforest activist, Vanessa Nakate. The Covid19 pandemic and its consequences have been harder to ignore, but from it, many have drawn parallels to other social-ecological issues.

The UN Secretary-General, António Guterres, for example, argued that "recovery from the Covid19 crisis is an opportunity to tackle the global climate emergency, and build a better world for all" (2020). A former high commissioner for refugees, Guterres believes this is a time for leaders "to think big and more generously". He warns that "the world is on track for devastating climate disruption from which no-one can self-isolate" and that human health depends on planetary health. On Earth Day 2020 he called for "a response stronger than any seen before to safeguard lives and livelihoods", to build more sustainable and inclusive economies and societies and a more prosperous and resilient world.

There is no shortage of ideas on how to attempt such changes. System scientists like Daniel C. Wahl (2016) have called for regenerative and restorative actions to heal the land and societies' relationship to it; resource economist James Blignaut (2019) argued that shifts in accounting systems can unlock resources for a land restoration drive that is vital for food security, but would also create paid work for many who are without a livelihood. Raworth (2017) and Fioramenti (2017) have provided various case examples on how greater equality, wealth and well-being can be created by investing in regenerative activities and circular economies. These are some of the concepts now being considered as academic think tanks come together to advise governments on ways in which to 'build back better'. Radically new thinking is certainly needed; in the wake of the US 2008 financial collapse, which set off another global crisis, the recovery measures simply replaced the very conditions that led to the crisis in the first place.

Many are pointing out the importance of setting aside vested interests, of cooperation within and between countries, and of greater social solidarity with the poor in the spirit of *ubuntu* ('I am because we are'). This coalesces with a growing recognition that in many respects the Global North can learn from the Global South, where people have had to weather systemic risks for longer and with fewer resources. Ingenuity in the Global South often relates to local scale, doing more with less, living frugally but healthily and with a spirit of generosity and solidarity. De Sousa Santos argued that the "epistemologies of the South" are coming of age, that we are seeing the end of the cognitive empire which privileged one way of understanding civilisation and development to the exclusion of all others. He does importantly caution, however, that "in spite of resorting to the North-South dichotomy, the epistemologies of the South are not the symmetrical opposite of the epistemologies of the North, in the sense of opposing one single valid knowledge against another one" (2018, p.v). He noted that "struggle mobilizes multiple kinds of knowledge" (p.viii) and that the reinterpretation of the world that is needed before we can change it, cannot be done from one single source of knowledge.

What are the pedagogical implications? Many educators are familiar with the challenge and the value of working with knowledge that is, in the words of learning scientist Yrjö Engeström (2016), "not yet there". They have embraced an approach to education that involves processes of acquiring already available knowledge, but also learning to participate in the development of *new* knowledge (Sfard, 1998) that at times involves a critique and un-learning of unhelpful patterns of thinking and doing, what community educator Paulo Freire (2007) and other struggle icons like Steve Biko called 'conscientisation'. In relation to university education, Lotz-Sisitka et al. (2016) have spoken evocatively of "transformative, transgressive approaches to social learning [and] unlocking disruptive pedagogy and epistemic disobedience".

The work of De Sousa Santos warns scholars and educators to consider the adequacy of the epistemological framings within which we teach and research. Charting the way forward may thus also require us to look back, to consider the almost-forgotten wisdom from earlier times. We certainly need to think through how modern technology can be shared and shaped more collectively, rather than being the sole remit and in the interest of narrow economic interests. As schools and universities have been forced to teach remotely, educators have been confronted with digital divides among learners. How to reach students at home and in isolated communities have become key matters of concern.

"It doesn't come this far"
– Introducing the first papers of Volume 36

"It doesn't come this far" was an old man's assessment of the novel coronavirus, in rural Limpopo Province, South Africa, in May 2020. He was being interviewed by a reporter from the News24 channel, while masked health care workers moved down his street, screening and testing residents. They found him fit, despite his advanced age. "It can happen to those who are using the airlines and then come back," he explained about the Covid19 infection. "But here we don't use the airlines. We are travelling in taxis [a mini-bus for shared transport]."

Whereas the old man seemed well informed, if perhaps not cautious enough, many have struggled to make sense of the information that reached them in one form or another, while others have not been reached by any information at all. The need for educators with an ability to interpret uncertain scientific information, and apply social insights, in ways that enhance the decision-making of rural and peri-urban communities, has been patently obvious. It has also been obvious that in this particular crisis, the essential workers are the health workers and child minders, the farmers and food vendors, waste collectors and waste sorters, caretakers of people and planetary processes.

In a Think Piece first presented at the 2018 *Researching Work and Learning Conference* (RWL10) in South Africa, authors Jane Burt, Anna James, Shirley Walters and Astrid von Kotze open this Special Edition of SAJEE by reflecting on the community educator as a vital care worker. Burt and her co-authors walk in the footsteps of a community education activist, highlighting the exceptional motivation of these activists to create better conditions for their families and communities, in the face of many daunting challenges: pollution from the same industries that provide some jobs, lack of sanitation due to poor service delivery, water shortages exacerbated by climate change among many others. Communities need to take own action and to engage other role players for assistance.

The community educator that Burt et al. describe, is someone willing and able to educate community members from all walks of life, while also supporting them to engage through appropriate activism with the authorities, without whose support, individual awareness of problems of waste and sanitation, will have limited impacts. Community educators seem to play multiple connected roles, as educators and activists, which are particularly important in keeping alive alternative development options. As Solnit pointed out in her 2015 *Grounds for Hope*, "popular power has continued to be a profound force for change". If we are to build back, better and differently, the insights of on-the-ground networkers, caretakers and problem-solvers would seem to be vital in co-constructing a way forward – alongside and within those academic think tanks. De Sousa Santos (2018) talked of the need for scholarship from the rearguard, within the struggle.

If the governance of cities, community health, and therefore ultimately, economic sustainability, all depend on the actions of citizens who in turn benefit from community-based education, and if their lived experience is important in helping to chart a way forward to new forms of development, it is ironic that the work of the community educator is so deeply undervalued. Burt et al. point out that conventional ways of valuing work, through financial compensation, status and prestige, are not given to these care workers. Nina Hunter (2005) found that women's unpaid care work in South Africa was worth between ZAR585 and ZAR7 619 per month per person, with an estimated mean of ZAR4 395. This is much more than the social grants issued to mothers and grandmothers.

Ghosh (2017, in Burt et al.) postulated that "much of the work in the future will be within the care economy", which, Burt and co-authors argue, "raises major issues for the future of work and society" and the need "to understand more deeply what 'work and learning' mean within the care economy, particularly that which is concerned with socio-ecological justice". Raworth (2017) proposed that the economy is so much more than the market; along with

wise governance, the processes that sustain households and the commons (including nature) should be more highly valued for the ways in which they support market-based economic activity. It is for this reason that many have called for the post-Covid period to be one in which we 'build back better' by creating economic activities that will benefit all and not only those who are already in a powerful position to dictate the terms, while taking better care of our relationship to nature and natural resources.

Education will be vital in such efforts, including education that mobilises what is already known among people, and place-based knowledge that might be helpful in charting the way forward. In his research paper on indigenous knowledge, food security and the protection of nature in Chimanimani district of Zimbawe, Pindai Sithole demonstrates that farmers here still have considerable indigenous, place-based knowledge about crop management and storage practices that increase food security. He argues that these local practices are less likely than commercial products to cause health problems; they also make households less dependent on markets and thus, more resilient in the face of climate change and other challenges. Interestingly, Sithole found that social bonds are vital for the survival of this knowledge, which in turn also strengthens such bonds. While community educators are often the ones to surface, treasure and share such sustaining local knowledge and practices, Sithole calls for it to be formally recognised and supported with financial investments in research and dissemination, and included in formal education.

Sithole's paper thus echoes the calls in the 2019 Special Issue of SAJEE, which focused on a theme of 'Landscape, memory and learning to change in changing worlds: Contemplating intergenerational learning and traditional knowledge practices within social-ecological landscapes of change', the title of a curated collection of case studies from four continents by O'Donoghue, Sandoval-Rivera and Payyappallimana (2019). Several authors (including Sandoval-Rivera; Shava & Masuku; Mandikonza; and Ndlovu, James & Govender) argued that indigenous, traditional and intergenerational knowledge need to feature in school and post-school educational institutions.

But such a curriculum change is not without challenge, as is evident in the research by Maxwell Opuku and Angela James, who investigated the challenges that culturally-specific environmental ethics from Akan might encounter if introduced in schools in Ghana. Their findings (published here in Volume 36) include a sense among educators and young people that this context-specific knowledge, with a highly spiritual component (including beliefs in nature spirits) may be a step backward, in the face of the benefits of modern scientific knowledge. The Think Piece by Pesanayi, O'Donoghue and Shava in Volume 35 ('Situating Education for Sustainable Development in southern African philosophy and contexts of social-ecological change to enhance curriculum relevance and the common good') makes it clear that educators need a sophisticated approach to support learners in engaging with multiple knowledge forms in the face of uncertain futures. This most recent collection of indigenous knowledge related papers, started in 2019, is rounded off in Volume 36 with the papers from Ghana (Opuku & James) and Zimbabwe (Sithole) in this issue. Scholars interested in this topic are encouraged to refer back to Volume 35, and indeed to several other SAJEE issues over the 38 years of the Journal's existence.

Over the years but particularly in the past decade, authors have highlighted institutional challenges including structural issues, that make the educator's work that much harder. In this issue, Dianne Sennoga and Fathima Ahmed report on recent shifts that have taken place in businesses, in response to the legislation that requires them to report on environmental performance. On some levels the findings are very positive: 96% of the companies sampled in the South African city of Durban say that they are adapting to "mainstreaming environmental issues in business" and many have undertaken environmental training for staff. The carefully designed questionnaire survey on which the paper is based, also provides a deeper analysis: Sennoga and Ahmed found that only 68% of companies report that they are "proactive"; while only 38% allocate more than ZAR60 000 per annum to the environmental training they commit to. This training was found to be mostly linked to health and safety; to be of limited duration; and to be directed almost exclusively at entry-level staff, office workers and temporary staff, rather than management or senior management. The extent to which such training can therefore result in more profound shifts in how the companies do business – the kind of shift that might be part of the call for 'building back better' – will be limited and will certainly encounter challenges if business leaders are not part of a deeper conversation around sustainability.

In another paper on institutional changes, Wilma van Staden writes about curriculum change at South African agricultural training colleges in response to the climate crisis. Van Staden also paints a mixed picture that includes institutional inertia, despite agreement that 'climate smart' agriculture would be a good addition to the curriculum, given how many farmers face droughts, floods and unpredictable seasons. The author positions the sustainability educator as an institutional change agent, who introduces tools and processes to help the role players in the activity system recognise contradictions and work towards overcoming them. Her research shows that this careful attention to change processes can bring about small changes, around which bigger changes may follow. It is a method and process inspiring hope that more is possible.

This introduction to the first five papers of Volume 36, provides a snapshot of formal and informal sectors, schools, post-school and community education contexts, and workplaces, where educators and researchers are at work to understand better the need for and nature of social change and learning processes. All believe that education and training have vital roles to play; and each paper makes a unique and valuable contribution to better understanding how education and educational scholarship can help humanity live in greater, shared security and well-being on this precious planet.

This is the first part of a two-part editorial; the second half will be published with the next group of papers in Volume 36, which, unlike the first five introduced here, will have been written during the Covid19 pandemic. We look forward to further contributions to the various scholarly conversations introduced here, and those many pertinent topics not yet touched on. Submissions are still open, but please submit a full paper by 30 June 2020.

Research papers, including systematic reviews of existing research; short viewpoints; and in-depth think pieces, are welcome. SAJEE is an accredited academic journal and all full papers will be submitted for double-blind peer review. Find the Author Guidelines here.

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THINK PIECE

Working *for* Living: Popular Education as/at Work for Social-ecological Justice

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Abstract

Drawing on the working lives of popular educators who are striving for socio-economic and socio-ecological justice, we demonstrate how popular education is a form of care work which is feminised, often undervalued and unrecognised as highly skilled work. It is relational work that aims to forge solidarity with communities and the environment. Given the state of the planet, the radical transformations that are needed, and the future projection of 'work' as including the care economy in large measure, we argue that popular education is a generative site for further exploration of research into work and learning. However, to move popular education as work from the margins means to rethink the current economic system of value. Addressing the contradiction that undervalues work for life/living, popular education engages transformative action motivated by a deep sense of solidarity and a focus on imagining alternatives as an act of hope.

Keywords: *work and learning, popular education, care work, solidarity*

Start of a day for Nonkululeko, popular educator, environmental activist, mother

It's still dark, when Nonkululeko walks along the busy road past the shopping mall that recently mushroomed out of a wetland. The traders lost their livelihoods when this mall was built, and she misses the morning aroma of grilled chicken and mielies[1]. *Instead, the smell of sewerage seeping from the mall assaults her nose. Twice she has reported this sewerage to the municipality, and alerted them to children playing in it and getting sick. Nothing has been done.In the distance, an abandoned mine dump catches the rising sun. Nonkululeko thinks about her colleague, Bulelwa, who works in that area, teaching people about the dangers of the coal dust, and organising awareness campaigns. Yesterday, Bulelwa told her that the mine had offered her a job, again. This seems to be a common strategy to entice activists away from their commitments.*

*   Nonkululeko wonders about the meeting she is to attend today. She hopes it will not be another waste of time and expensive transport: last week, a provincial government minister addressed them and talked and talked without even asking about the local problems. People*

sang protest songs and chased him away. In preparation for that meeting they had spent two days studying air and water pollution. Thabo had taken them on a transect walk and they took photographs of the acid mine drainage streaming into the wetland. Nonkululeko had shared a film about coal mine pollution and they discussed why this happens; they talked about whose interests are served and who the main beneficiaries are from mining. Finally, Bulelwa had facilitated a role play in which they rehearsed how to address the minister with difficult questions and arguments for clean-up operations. They wanted their new knowledge to lead to direct action for change.

Introduction

Nonkululeko's life echoes that of many popular educator-activists. In other places, popular educators perform plays about stigmatised infectious diseases, women set up programmes in 'war zones' to keep children safe, others support the establishment of alternative economic activity. Much of their work emerges as they respond to immediate needs while keeping in mind the longer-term intent; while they engage locally, they also deal with the effects of global capitalism. When done well, their work is invisible as movements take hold of the struggles and speak up and out through their actions. Yet, spanning from dangerous environmental pollutants to the anger of people in power whose interests are being challenged, dealing with the insecurity of personal finances and the high expectations of people they work with, their work is very risky and difficult. Not least because it aims at transformation as it mobilises and galvanises solidarity action against a system that benefits the few. Globally, environmental activists are murdered every week, and many disappear without trace. In 2017 alone, by August, 117 had been killed (Ulmanu, Evans & Brown, 2017). In Latin America, many are women who work as full-time activists and educators for the survival of their households, communities and the environment on which all depend.

In this article we are responding, in part, to the suggestion by Willis, McKenzie and Harris (2009, p. 1) that policies, systems and programmes are failing "to adapt to the changing nature of work and society and are thereby missing a crucial opportunity to enable the growth of more sustainable and equitable communities". Instead of looking at work in the context of the formal economy, here, we focus on work undertaken in the interstices of societies. We argue that the activities of popular educators constitute highly skilled care work that can be deeply transformative. Their 'training' is often on site, involving a long process of apprenticeship through collective action with more experienced popular educator-activists.

We will first address our research approach, then outline the conceptual framework with a discussion of 'popular education' as a distinct approach to (adult) education, characterised by a radical belief in social justice. Next, we elaborate our understanding of work as oriented towards creating and supporting life. We do so by drawing on the sustainable livelihoods perspective and literature around 'care work'. We then elaborate popular education as work with examples of popular education as/at work. We focus particularly on that aspect of popular education which 'forges solidarity' which, we argue, makes the work of popular educators transformative. We close with an argument for why we believe understanding the work of popular educator-

activists, with its focus on building solidarity and its explicit outlook towards alternative futures, is relevant within the contemporary researching work and learning frame.

Research approach

This paper builds on our individual and collective involvement over several years as popular educators and scholar-activists. More specifically, we draw on our deep engagement with a research and publishing process which culminated in the book *Forging Solidarity: Popular education at work* (Von Kotze & Walters, 2017). Over an eighteen-month period, 26 popular educator-activists from eight countries participated actively in the co-creation of the book through two writing workshops, a public seminar and supported, collaborative and individual writing of chapters. The book was part of an research project that began in 2014, *Re-membering Traditions of Popular Education in South Africa*.[2]

Animating the book's narratives of popular educators at work was a two-fold question: in what ways are popular educators in the Global South, and particularly in South Africa, responding to various economic, political, cultural and environmental conditions? And in so doing, are they planting seeds of hope for and imaginings of alternative futures which can connect individuals and communities locally and globally to achieve economic, ecological and social justice?

Conceptual framework

What and why of popular education

Popular education thrives in times of heightened socio-economic and political contestation and in opposition to poverty, racism, misogyny, war, and climate injustice, amongst other injustices. This is precisely when activists and/as popular educators drawing on art (Clover, 2012; Von Kotze, 2017) and social movement learning (Hall et al., 2012) respond with creativity and decisiveness to re-create connection and solidarity. The work of social activists, artists and popular educators is an essential, but often forgotten, part of the ecology of work and learning.

Popular education means different things to different people.[3] We concur with Martin (1999, p. 4) who argued that popular education is "rooted in the interests, aspirations and struggles of ordinary people", "is overtly political and critical of the status quo" and committed to "progressive social and political change". It is both a theory and a practice of social action, underpinned by the following key principles:

- Socio-ecological justice, both in process and in proposed outcomes;
- Grounded in the daily social, economic, political and cultural reality of people whose experiences throw up the questions and contradictions they wish to examine and reflect on in order to change them;
- Dialogue: all participants engage in dialogue and analysis and in the process develop their 'voices' to 'speak up and out'; and
- Action and reflection – what Paulo Freire called 'praxis'.

Popular education is not about identifying skills deficits in order to better prepare individuals for the marketplace. Rather, it seeks to draw on the collective knowledge and experiences of life's struggles and activism, on historical understandings, in order to develop coherent theory and practice to challenge the individualised, commodified, socio-economic world. Here, economics is part of the lived realities of what Hart (2002, p. 199) called "the viewpoint of the 'survivors' of the war against subsistence".

Popular educators see one of their most important challenges as engaging people critically with the ideas and analyses of power that shape everyday reality in unequal, uncaring and unjust ways. Understanding this is the basis for joining a struggle to resist and effect change. The difficulty begins with making visible what appears normal and natural, then surfacing and naming interests and powers that shape and maintain those conditions. Structural and systems changes require collective struggle. The learning that occurs in struggle may alter people's understanding fundamentally, as they experience their own agency and collective power in affecting change. Cullors and Ross (2017), two of the founders of #blacklivesmatter, reflected on how being part of a movement that challenges oppression builds a sense of hope and belonging amongst the youth involved in the movement.

Forging solidarity

The vignette of Nonkululeko opening this paper exemplifies the work of popular education as work that builds solidarity and nurtures hope through imagining alternative futures. *Forging Solidarity: Popular Education at Work* (Von Kotze & Walters, 2017) offers an array of such examples where 'forging solidarity' is the primary focus of the educational endeavour. Many of the chapters reveal practices as conscious efforts to build more collective political praxis in contrast to the dominant ideology of competitive individualism in our society.

Solidarity has many possible meanings and can be idealised because, as Gaztambide-Fernández (2012, p. 46) suggested, it has been appropriated, diluted or substituted with concepts such as 'social capital' and 'social cohesion'. Kip (2016, p. 318) concurred: as a result of the tensions among different interpretations, invocations of solidarity "have been marked by ambiguity; descriptive and prescriptive aspects blur together". We agree with Waterman (in Landy Darcy & Gutiérrez, 2014) that "solidarity is a relationship forged through political struggle which seeks to challenge forms of oppression". Thus, what enables solidarity is a sense of common resistance. Deshpande (2017, p. 119) explained the collaboration between theatre groups in India and Palestine as solidarity that has nothing to do with charity or aid, nor is it an erasure of complicity. Rather, solidarity is a reaction to a condition which afflicts certain 'others' independently of their personal or social character. When we see our fate in the fate of the other, the reciprocal relation acknowledges "the possibility that one is or could be confronted with the same situation as the other, it means that his (sic) fate affects me in a significant way" (Grieves & Clark, 2015, p. 293).

However, solidarity cannot be simply declared a political relationship; it has to be created. This may involve, for example, taking an 'inventory' of who we are in relation to others, at a particular point. It means entering into an ongoing dialogue and negotiation that is mindful of power differentials and common or disparate purposes. This 'forging' process involves

being prepared to give (up) and be open to re-moulding as part of a solidarity grouping. It is a slow, sometimes painful, but also energising process that requires careful strategising, patient mobilising, critical engaging and active experimentation; nowadays this is often combined with savvy media campaigns. Robins (2014) called this 'slow activism'. He showed how much the media focuses on extreme forms of brutality, the politics of the barricades that often mirror the very violence to be rejected. Everyday oppression and suffering is not newsworthy; the structural conditions that lead to a protest do not make headlines. Education and learning are crucial parts of the slow, often invisible work of mobilising and organising, so that participants understand the causes of suffering as structural violence rather than individual deficits. What builds collective power, according to activist Zackie Achmat, is the work one does before a protest: "the leafleting, the poster work, the house meetings, the mobilisation that you do in the community, the media [briefing] leading up to it, the media posting that reinforces it, and the day-to-day work in the community" (cited in Robins, 2014, p. 100).

Work for living

A livelihood approach to work is people-centred; it acknowledges and values mutuality and interdependence and hence is oriented towards the collective. It focuses particularly on all the diverse activities necessary for daily living, including building relationships, caring for others and the earth, and mobilising for action (Von Kotze, 2009). Here, work is "work that is expended in the creation, re-creation and maintenance of immediate life" (Bennholdt-Thomsen & Mies, 1999, p. 20).

The care economy builds on conceptualisations of work for living (not *a* living). In a lecture, Ghosh (7 September 2017) elaborated that 'care work' concerns everything that helps others to function. It is primarily relational work that is essential to the functioning of families, communities and society as a whole. Because care work is highly gendered and involves emotional labour, there is potential for overwork and exploitation. It is often highly skilled and precarious, but these dimensions are seldom taken into account. It is work that refuses to polarise ecological and social well-being and therefore includes the work required for deep sustainability that is just and democratic in the face of changing socio-ecological systems.

Care work has a contradictory position with respect to the mainstream economy: it is central to the 'apparent' functionality of the capitalist system; however, it is marginalised in capitalist logic of value. It can therefore be referred to as an externalised cost: as with the exploitation of natural resources, care work is barely recognised in its contribution to the economy. We argue that it is this contradiction in the idea of work that popular education confronts at multiple levels. This makes it transformative, as we illustrate below.

Popular educators at work

Nonkululeko's environmental justice activism has many of the characteristics of care work as described by Ghosh. She is both 'the Earth's comrade' (Burt & Lusithi, 2017) and a caretaker for her family and community. Her work is grounded in the everyday socio-economic, ecological, political and cultural realities of people and it is deeply relational. She sends out a strong signal

that care work is not simply about concern for a messed-up present but involves the creation of an-other future. She is working to raise the consciousness of community members about the degradation of the environment, its causes, its effects on health and livelihoods as well as nature, with hope that there is another way to live – yet 'officially' she exists, at most, as part of the statistics of the unemployed (and unemployable).

Nonkululeko is an organiser and an educator with multiple and diverse capabilities. Given the 'slow violence' (Nixon, 2011) of environmental degradation, her knowledge and social practices are crucially important. The environmental crisis is directly linked to the current economic system where humans and the earth are little more than resources for a market, and a political system that props up this market, whose sole logic is based on the criteria of efficiency to maximise growth. Here, suggested De Sousa Santos (2006), only the criterion of efficiency is seen to have any value. Environmental justice activists who are struggling for food security and access to clean water and energy are needed in their droves to reveal this slow violence, and they need courage and agency to imagine different livelihoods based on a value of caring for ourselves and the earth. Nonkululeko works long hours against many odds, in solidarity with members of the community, and her family; yet she is most probably viewed by many in the formal economy as 'unskilled'. Importantly, her knowledge emerges from the struggles she engages in and is nurtured directly through precipitating and responding to particular challenges within specific contexts and power relations. Her practices show the ability to adapt and innovate, negotiate and support, where necessary, in response to rapidly emerging new conditions and needs. She demonstrates what Chambers (2017, p. 153) has demanded:

> More and more we have to think, live, work, and learn in and through the paradigm of complexity, adopting and adapting its words and concepts, values and principles, methods and procedures, behaviours and attitudes, relationships and mindsets. This means countering and transcending much current practice. The new professionalism of practice has to combine knowing better with doing better.

Grandma Jane is another activist. She was introduced to us by Makan (2017, p. 95) who told of the struggles in Blikkiesdorp (a real place name, meaning 'tin can town' in Afrikaans). Grandma Jane lives in an emergency housing site on the outskirts of Cape Town which began with forced removals for a global sporting event that took place in 2010 in South Africa. Rows and rows of one-roomed tin houses stretch as far as the eye can see, with not a tree in sight. Grandma Jane is a leader in the Joint Committee, an organisation fighting for decent housing. Years after the famous soccer tournament, residents feel unsafe in the face of limited police security, unemployed youth being recruited into gangs, and the common occurrence of gender-based violence. Dysfunctional sanitation systems and compromised health are the norm.

Struggles escalated in 2015 when residents were told that Cape Town International Airport planned to build a new runway and the residents of Blikkiesdorp might have to move. The questions arose: where were they to be moved to now, would it be more or less decent,

and why was their move only in response to infrastructural development demands? Grandma Jane invited a local activist organisation, Right2Know, to support the building of leadership capacity in the Joint Committee. Through Right2Know they met with other activists, learnt how to structure press releases and to participate critically in the environmental impact study for the proposed airport development. The collective decided on a process of engagement with all stakeholders, moving methodically up the decision-making ladder until they got answers from the local municipality about their future.

Like Nonkululeko, Grandma Jane is an organiser and educator. In the process of struggle, she and the committee learnt the value of sharing technical information so that it becomes useful knowledge for local people, and to use such knowledge in negotiations with powerful officials and interests. This process resonates with Freire's (1972) argument that knowledge is a dialogical act; a political act of knowing (Makan, 2017, p. 103). Grandma Jane's story also highlights the solidarity that is possible between educators and activists from different geographical and social class locations where everyone is learning 'on the job' through a slow process of listening deeply and compassionately, learning from others' perspectives, and producing meaning together. Here, solidarity is expressed as a social justice NGO accompanies community-based educators and activists, with each bringing their expertise and experience, working dialogically as political allies in the interests of greater socio-economic and ecological justice.

Pulling threads together

The vignettes of Nonkululeko and Grandma Jane show that popular education is work for dignity, for justice, and for living, even if it is largely unrecognised as work and mostly unpaid. We suggest that this work can be seen as part of the care economy: "Care is the pillar of the well-being economy", run by all caretakers, such as parents, garbage collectors and environmentalists (Fioramonti, 2017, p. 208). Ironically, much of this work is undertaken by those who can least afford to expend time and energy on education and activism, being preoccupied with concerns and actions for daily food security. Yet, these workers are driven by an understanding of the interdependence of people and the environment and the conviction that they must lead actions to confront the abuse and exploitation, the violence and destruction, for the sake of survival for all.

Ghosh (7 September 2017) has argued that much of the work in the future will be within the care economy. This raises major issues for the future of work and society. It also emphasises the importance of trying to understand more deeply what 'work and learning' mean within the care economy, particularly that which is concerned with socio-ecological justice.

'Futures work', or exploring possibilities in potential futures, is another arena of popular education as work that is transformative. Activist educators kindle anticipatory hope, imagining different ways of organising and being together. As De Sousa Santos (2006) argued, in the face of capitalism's rejection of alternatives, it is more important to affirm the possibility of alternatives than to define them. Part of activists' responsibility is to light the fire of resistance to injustice and to keep it burning. For this, they require an ever-evolving

idea of what that alternative might look like. Gorz (1980, p. 4) asked: "Will it be a capitalism adapted to ecological constraints; or a social, economic, and cultural revolution that abolishes the constraints of capitalism and, in so doing, establishes a new relationship between the individual and society and between people and nature?" There are many ways of imagining radically different futures. Gorz (ibid., p. 8) projected a wishful picture of people spending no more than 20% of their time in necessary employment, and the rest in constructing their world. Popular education is arguably more strongly focussed on critical analysis and collective struggle against the status quo, than on the work of imagining and future-building. But utopia is perhaps best viewed not as a place and time, but as a process of becoming – we make the road by walking (Horton & Freire, 1990), looking for emergent possibilities and opportunities and harnessing those, with others, towards constructing alternatives.

Popular education as/at work?

In summary, we argue four main points. Firstly, that popular education is a form of work that is highly skilled but undervalued and rarely recognised and remunerated accordingly. The essence of this work is relational; it is revealing as transformational praxis. As a form of education it is about learning for living and not only for upskilling to make a living; it is work that nurtures hope by keeping alive an ever-evolving yearning for alternative futures.

Secondly, we argue that given the state of the planet, the radical socio-economic-ecological transformations that are needed and the future projection of 'work' as including the care economy in large measure, popular education is a generative site for further exploration of research into work and learning. We have argued that the work of popular education is not widely acknowledged. However, to move popular education work from the 'margins' means to rethink the current system of value. Through addressing the contradiction that is the undervaluing of work for life, popular education implies transformative action that comes with care work that is motivated by a deep sense of solidarity and a focus on imagining alternatives as an act of hope. The transformational nature of this work mirrors back onto other categories of work and asks: how does this work contribute to living? It implies that care work is embraced by all as citizens of the planet not only those majorities who are primarily bearing the cost of the de-humanising effects of capitalism, while contributing much less, in comparison, to the degradation of our world.

Thirdly, it is essential to shift how educators in further and higher education think about work in the context of our socio ecological crisis and how we support, recognise and learn from those who do work for living. Instead of only focusing on cognitive and technical knowledge, we need to acknowledge the importance of relational and emotional knowledge mobilised by care workers (environmental activists, justice activists, popular educators, mothers, carers) towards human survival within a sustainable planet.

Fourthly, any environmental work is political work. Popular education has a long history of unearthing and challenging power relations and systems that maintain and support the status quo and mobilising and organising struggles for collective change. Within ecological movements we can learn from spaces described by Salleh (in Pellow, 2018, p. 481). as "the

breath-taking spectrum of ecofeminist social movement actions, movements, protests, conferences, artistry, research, writings, and myriad publications by women from all corners of the earth…"

In particular, environmental work can become more attuned to pedagogies that have long existed: embracing 'heads, hearts and hands', acknowledging and incorporating realities of trauma, working across all phases of life. This is about acknowledging popular education as work and bringing the work of popular educators to the service of environmental workers.

Endnotes

1. South African word for 'corn'.
2. The research for this article was supported by the South African based National Institute for Humanities and Social Sciences (NIHSS). The research was located at the University of the Western Cape and worked across universities and civil society organisations. The project aimed to uncover and recover forgotten traditions of popular education that generate knowledge within oppositional social movements and other civil society organisations. See www.populareducation.co.za for further background information.
3. Definitions of popular education range from employing participatory methods for individual development, often referred to as 'empowerment', to acting as part of overtly political anti-capitalist projects (Von Kotze, Walters & Luckett, 2016). Increasingly, as Liam Kane (1999, p. 56) lamented, "it has been reduced to a de-politicised, if not outright reactionary technicism in which 'popular' simply means that the target group is the poorest sector".

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Percentage contribution

Areas of contribution	Author	Percentage contribution
Conception or design of the paper, theory or key argument	Burt	25 %
	James	25 %
	Walters	25 %
	Von Kotze	25 %
Drafting the paper	Burt	25 %
	James	25 %
	Walters	25 %
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Critical review of paper	Burt	25 %
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Indigenous Knowledge Systems in Crop Management and Grain Storage in Chimanimani District of Zimbabwe

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Abstract

This study explored the indigenous knowledge systems (IKS) in the Chimanimani District of Zimbabwe and how they are used in crop management and grain storage. Also examined were the effects of IKS use on community food security and integrity of the environment. A qualitative interpretative research design was employed through the use of detailed in-depth interviews and focus group discussions with traditional leaders and community elders. The choice for these groups of people was informed by the general belief that they are often regarded in the community as a reservoir of indigenous knowledge systems. Phenomenological underpinnings anchored the study because it was vital to bring to the fore the various related IKS phenomena and links to food security and environmental management in the community. A socio-ecological lens was used to establish links and interrelations of factors that contribute to food security and environmental management. Major findings include that ashes and leaves from some indigenous trees are used to enrich soil quality, preserve food, and treat livestock. In addition, ashes and leaves are applied as organic pesticides for a variety of crops grown in the district. The study established that these local knowledge systems and practices contribute to low farming costs, high crop yields and good environmental management. The indigenous trees used for this purpose are held in high regard and conserved through the practice and enforcement of socio-spiritual prohibitions like taboos. The study concluded that the body of local knowledge firmly rooted in the Chimanimani people's culture and traditions is relevant to and consistent with the national and global agenda towards strengthening and sustaining community food security and environmental management. Furthermore, the local knowledge systems found in this study have policy implications for environmental management and climate change strategies as well as knowledge management from a socio-ecological perspective.

Keywords: *indigenous knowledge management systems, environmental management, food security*

Introduction

This paper builds on the current wave of realisation that indigenous knowledge systems can play a crucial role in sustainable livelihoods as extensively discussed in Hammersmith (2007), Mapara (2009), Chiwanza et al. (2013), Muyambo and Maposa (2014) and Sithole (2014), as well as the 2019 Special Issue of the Southern African Journal of Environmental Education. It has been noted that there is a direct link between community socio-cultural erosion and depletion of natural resources or environmental destruction (Makamure & Chimininge, 2013; Rim-Rukeh, Irerhievwie & AgbozuI, 2013; Risiro, Tshuma & Basikiti, 2013). This link is explained through socio-ecological perspectives which illustrate the intimate interconnection between livelihoods of human beings and their surrounding environment which has endured over many generations.

In Africa, IKS suffered a great deal from colonisation and its twin cousin, racism. From a socio-ecological perspective, when the natives were removed from their indigenous communities, this resulted in a detachment from their familiar ecology and a loss of environment-linked indigenous knowledge for sustainable livelihoods. Thus people had to build knowledge of their new environments. During the transitional period, some IKS were lost and environmental livelihoods were disrupted to some extent. Studies elsewhere have also shown that indigenous knowledge systems play a positive role in Africa's development but there is not much traction to mainstream them in sustainable food security and environmental management (Emery, 1996; Mohamedbhai, 2013). Despite the long history of relegation and marginalisation of African indigenous knowledge systems in terms of the mainstream national and community livelihoods development discourse, IKS can be relatively resilient to externally induced socio-political vulnerabilities because of cultural and spiritual rootedness in communities (Mararike, 2003; Mutema, 2003; Hoppers, 2005;). Thus, Muyambo and Maposa (2014, p. 24) concluded that IKS in Africa "failed to die despite the racial and colonial suffering Africa went through in the past" which confirms an earlier assertion by Ramose (2002) that a people's IKS anywhere in the world is 'immortal' and inseparable from their socio-cultural compass. Unfortunately, the socio-ecological approaches to livelihoods development in the post-colonial era in Africa is more Eurocentric than Afrocentric (Mulwa, 2004; Matunhu, 2011). At this point, it is crucial to discuss briefly the phenomenon of indigenous knowledge from an epistemological perspective.

Cosmology and attributes of indigenous knowledge systems

Roots for the word 'indigenous' can be traced back to French (*indigène*) and Latin (*indigena*) (Amaro & Watson, 2016). In both languages and culture, it means 'sprung from the land', a native or literally 'in-born'. Thus, it can be deduced that indigenous knowledge refers to the way of knowing and application of the resultant knowledge associated with a particular group of people in their native socio-geographical location. While Denison and Wotshela (2009) argued that IKS is not technically the same as 'local knowledge', there is no doubt that it is localised knowledge ingrained in people's culture, beliefs and practices with an inter-generational connectedness and endurance.

To date, the term 'indigenous knowledge systems' or IKS has been defined in various ways, depending on the social context and/or disposition of the author. Some have broadly described it as both a concept and practice of a specific body of knowledge of the indigenous or local people (Shutle, 1990; Mapara, 2009; Muyambo & Maposa, 2014). Chiwanza and others (2013, p. 2) viewed it as durable local knowledge which is the "adhesive that binds society" while Mararike (1999) and Sithole (2014) posited that IKS are community-based livelihood survival strategies especially in the rural areas. What is common in these descriptions is that indigenous knowledge systems are unique to a given culture or society and they are a vital part of the community's social identity and heritage. On this aspect of IKS being part of the social identity of a community, Chiwanza and others (2013, p. 2) observed that "indigenous knowledge is indeed the cornerstone for building of our [community] identity and ensuring coherence of social structures within communities". Thus, from a socio-anthropological perspective, IKS forms part of the socio-economic wealth of a community and it is generally understood that it has be passed down from one generation to another.

Furthermore, it is clear that for knowledge to qualify as indigenous knowledge, those using it should have survived on it for a considerable length of time. It is further apparent from the literature that IKS forms part of the bed-rock of a community's socio-cultural framework (values, beliefs, norms and practices). It should also be noted that there are generally agreed factors which seem to threaten survival of IKS in communities. These include urban-rural migration, globalisation, and changes to population structure due to factors such as famine, epidemics, displacement and war, among others (Mugabe, 1998; Chiwanza et al., 2013). However IKS is defined or described, it is a constantly evolving knowledge discourse (Denison & Wotshela, 2009).

Concept of food security

The United Nations Food and Agricultural Organization (FAO, 2010) states that food security is when a household or community has reliable availability and access to sufficient, affordable and nutritious food. It is estimated that the world requires 70% increase in food production by 2050, especially in developing countries in view of exponential population growth (Bruinsma (2009). This increased demand for food is compounded by the current undernourishment challenges in most developing countries. As discussed in the preceding sections, there is value in understanding local knowledge systems, and this includes how they are potentially used in enhancing food security and environmental management. There is a strong relationship between how the environment is managed and the ability of a community to be 'food secure' (UNEP, 2009). Macro dynamics at policy level, meso processes in the form of human-environment connections and micro process at individual and household sub-levels are interwoven contributing factors to food security. These sociological dynamics and intertwined relationships require socio-ecological explanations in an iterative process. In the context of Chimanimani district, availability, access and utilisation of environmental resources, farmed crops including indigenous ones make up a large proportion of what constitutes a food secure household between ecological seasons.

Study objective

The objective was twofold in that the study sought to establish what IKS are found in the Chimanimani District and how the people use that knowledge for their livelihoods and environmental management.

Methods

A qualitative interpretative research design was applied to explore IKS in the Chimanimani District, including its application to food security and co-existence with the environment. Phenomenological underpinnings anchored the study in order to bring to the fore the various IKS-related phenomena and links to food security and environmental management. For this reason, detailed in-depth interviews and focus group discussions were conducted with traditional leaders and community elders. The choice behind these two groups of people was informed by the fact that they are strongly associated with the reservoir of indigenous knowledge systems, beliefs, socio-cultural history, socio-ecological history and practices in a community.

The other group of study participants were agricultural extension officers and leaders of development organisations who had been working in the district with a focus on food security and environment. A combination of purposive and snowball sampling techniques were used for the selection of the study participants.

A total of 39 people from the three municipal wards participated in the study and their ages ranged between 30 and 90 years. Of the 39, 29 (74.3%) were aged between 60 and 90 and 10 (25.6%) were between 30 and 60. In terms of gender, 22 (56.4%) were male and 17 (43.6%) were female. The three wards studied were relatively representative of the socio-ecological make-up of the district. Wards 18 and 21 are at the edges of the district thereby providing localised insights on IKS and food security, while Ward 15 is in the middle where the town is located thereby providing somewhat cosmopolitan views on IKS. As is often the case, a diversity of socio-cultural beliefs, norms and practices converge in urban centres. Therefore, although the other 20 wards in the district were not studied, Ward 15 represented differentiating factors that could be found in any ward, particularly given the close proximity of the wards in the district. It is worth mentioning that even though the study participants were selected from different sub-municipalities with unique ecological patterns, they all shared a common socio-cultural history, language and environment.

Findings

The findings are presented in two broad categories, namely food security and environmental management. Within the food security dimension, seven themes emerged: (a) the local crops and livestock; (b) IKS used in land preparation; (c) IKS used in crop management; (d) IKS used in crop harvesting; (e) IKS used in the storage of grain; (f) IKS used in the preservation of grain and meat; and (g) IKS used in livestock health. The findings have demonstrated that people in

Chimanimani have a rich body of indigenous knowledge which they use for food security and unique environmental management.

The local crops and livestock

The study found that the most common crops grown in Chimanimani are maize, sorghum, millet, *rapoko*/finger millet and bananas. Others not as widely grown include groundnuts, roundnuts, sunflowers, beans, cowpeas and sesame seeds (known as *uninga* in the local Ndau language). In Ward 18, which is a dry section of the district with low levels of rainfall, drought-resistant crops such as groundnuts and *rapoko* are grown and livestock production includes goats, cattle, traditional chickens and donkeys. In contrast, due to their relatively high rainfall and rich soils, Wards 15 and 21 grow maize, bananas, oranges, sugarcane, sweet potatoes and indigenous yams *madhumbe*), among other crops. It was noted that the growing of small grains is increasing in the area as a response to climate change conditions, particularly droughts. Goats, cattle and traditional chickens are the main forms of livestock found in almost every household in the district. Other types of less common livestock in these two wards include sheep, pigs, quails, donkeys and rabbits. The crops and livestock mentioned are both for subsistence and to generate household income, especially bananas, small grains, cattle, goats and traditional chickens at local and national markets.

IKS used in land preparation and planting

The study found five traditional methods used in Chimanimani to prepare land for agricultural activities, namely digging of basins, slash and burn, spreading of manure, spreading of ashes and farrowing. The study participants claimed these traditional methods contribute to improved crop health as is evident in this point made by one of the elders (aged 82): "*Zvinobatsira kuti shakura rinoita shoma* [weeds are greatly suppressed] and crops will not be affected by diseases... *Zvirimwa zvedu zvinokura zviine utano wakanaka, sometimes kurega kushandisa nzira dzechirungu kunobatsira zvakanyanya* [Our crops grow healthy and not using the contemporary farming methods helps greatly in improving food security]." It was reported that digging of basins keeps moisture for longer periods while spreading of ashes and manure adds nutrients and quality to the soil for farming. Also, ashes are believed to have a pesticidal effect on crops and have some type of chemical that supresses some weeds. This was corroborated by the agricultural extension officers interviewed.

The IKS used in planting crops include broadcasting, planting seeds/seedlings in lines and *kuparira*. Broadcasting is mainly used for small grains like sorghum, millet, *rapoko*, *uninga* and cowpeas, while maize is planted in lines. *Kuparira* involves planting seeds when rains are imminent so that seeds germinate quickly. The land preparation and planting is combined with the local people's use of their indigenous knowledge to interpret weather conditions and predict rainfall patterns.

Use of IKS in crop management

The study found that the indigenous knowledge systems for crop management in Chimanimani largely involve organic pesticides processed from indigenous trees and shrubs found in the local

environment. Juice from the *Munyambanje* tree (*tagetes minuta*) or *Mukonde* (candelabra tree) leaves/ashes are sprayed onto crops to prevent pests like *zvipumbununu*. To prevent and control stalk borers (*mbunga*) and aphids, the study discovered that people spread *Zumbani* (lemon bush/*lippie javanica*) leaves or *mutoronga* (hot pepper) solution or animal urine (especially from cattle and goats) in the affected fields. As is the common practice elsewhere in the world regarding application of ecological indigenous knowledge systems (Berkes, 2008), the use of the trees and shrubs discussed here are sanctioned by traditional leaders in accordance with environmental protection practices like taboos.

It was found that indigenous methods are fundamental in the area studied in the prevention and control of weeds, pests and aphids and they have been proven to enhance crop health and yield. Respondents stated that traditional methods such as crop rotation and minimum tillage help to improve and maintain soil quality. Generally, these methods can be labour intensive. The study noted that communities sometimes use collective actions like the *nhimbe/humwe* practice to voluntarily assist each other at the household level with a range of farming activities. Sithole (2014) described *nhimbe* as a collective community-based work practice used historically by most Zimbabweans in rural areas particularly for farming related activities. It should be noted that the *nhimbe* practice is now rare and has taken various forms over the centuries. For instance, a *nhimbe* targets mostly beer drinkers in the community for labour for a development initiative and then beer is served after the work is finished as a form of appreciation. The practice of *nhimbe* is one of the manifestations of the African worldview linked to the respect of humanity, commonly known as *ubuntu*, and it is based on mutual trust, enthusiasm to help each other and nurturing reciprocal relationships in a community. On the aspect of early planting, one community elder (aged 77) emphatically stated its advantage: "For *Rutiti* (a devastating weed) we plant early so that it doesn't affect the maize". *Rutiti runonyanya* [worsens] in January so if you plant early in December, the crops won't be affected". It was also revealed that the use of organic pesticides helps to maintain and balance water concentrations in crops.

Local knowledge and traditional practices in crop harvesting and storage

Maize is commonly harvested in stacks. Stalks of grain are cut and heaped usually in the middle of the field. The grains are harvested after stacking. The rationale behind stacking is to ensure that no crops are left in the field; a complete harvest is achieved through this method.

For storage of crops, a *tsapi* (traditional granary) is used in Chimanimani like in many other rural communities in the country. One of the advantages of a *tsapi* is that it maintains the right temperature for the grain throughout the year as it is constructed with natural materials including poles, thatch grass and mud, materials with temperature regulatory mechanisms. Construction expertise is passed on through generations in the communities and materials are locally found, making the *tsapi* storage method generally inexpensive.

Traditional methods in preservation of grain

The study discovered that the indigenous trees and shrubs found in the area also play a crucial role in the preservation of grain. The scent from leaves of certain indigenous trees

and shrubs applied to grain repels insects. The poles obtained from *changa*, *mukute* (*Syzygium cordatum*), *mutsungunu* (*Bridelia micrantha*) and *munguraurwe* (tonic root) trees used for the *tsapi* construction have a repellent effect on termites. In addition, a mixture of mud, cow dung and ash are used to clean the tsapi in preparation for grain storage and this prevents weevils, aphids and rodents. Some of the leaves which are crushed and placed in the packaged grain or in a *tsapi* include those from *mushani/zumbani* and *munyambanje* bushes. It was also reported that goat droppings are mixed with the mud used for the construction of the *tsapi* floor and this prevents weevils too as well as snakes from getting into the granary. This finding is similar to that of Stathars and others (2000) in the district of Chikomba in Zimbabwe. The other method mentioned involves the application of ashes (dry or in liquid form) to the grain. Ashes can come from maize cobs, any wood or leaves. It was learnt that small grains are usually not affected by weevils. On this aspect, the study findings revealed that people in dry areas of Chimanimani (especially in Ward 18; Biriri) are encouraged by government, traditional leaders and civil society organisations to grow small grains like *rapoko* and sorghum. In doing so, the communities in this part of the district are likely to benefit from the twin advantage of drought-resistant crops which are not prone to weevils and aphids.

The study found that the crop preservation methods, if properly applied, are effective for six to 12 months and in some instances, even up to 24 months. A 56-year-old woman interviewed stated that "it normally lasts for about 6 or even 12 months but you can add some more leaves or ashes when you see that they are about to expire". It was noted that these methods are not hazardous to people or livestock. In fact, they play a dual role of preserving grain and providing medicinal benefits to people who consume the grain. *Mushani/zumbani* and *munyambanje* are further used as herbs for various ailments.

Discussion

The indigenous knowledge systems used for food security and environmental management in the communities studied in Chimanimani are based on the local indigenous trees and shrubs. The materials are locally and naturally available and thus inexpensive. A close examination of this socio-ecological dimension reveals inseparability of indigenous knowledge systems from the natural environment. The colonial period in Africa and other parts of the world led to distortion, dilution or loss of indigenous knowledge systems. Chiwanza and others (2013), Mapara (2009), as well as Muyambo and Maposa (2014) have noted a resurgence of indigenous knowledge systems in developing countries. The resilience of indigenous knowledge systems can be explained by their cultural and spiritual rootedness (Mbiti, 1990; Mararike, 1999; Mbigi, 2005). Another explanation for the distortion or peripheral view of Zimbabwe's IKS is the type of education system which is still largely biased towards Eurocentric pedagogical approaches and worldviews (Matunhu, 2011).

It is clear from the findings presented here that the Chimanimani communities value and work with indigenous knowledge systems. This is evident in the active use of IKS in crop management and grain storage. These practices are part of a social ecology trajectory as seen in how communities weave their livelihoods into the natural environment. As is characteristic

of indigenous knowledge around the world, IKS in this study are passed down via an oral tradition. The absence of formal documentation frameworks increase the risk of IKS loss over generations, an aspect which has been extensively discussed by Chiwanza and others (2013). One aim of this study thus was to document these indigenous knowledge systems; perhaps future studies could go beyond what has been covered here.

While the local people in Chimanimani appreciate and apply their indigenous knowledge systems in agricultural practices, there is still an element of inferiority or social stigma attached to IKS from the Ministry of Agriculture, the Department of Meteorology as well as community development partners in the district. This is evidenced by the fact that very little of what has been shared in this study has been incorporated or integrated in mainstream strategic information or in the knowledge base for sustainable food security and environmental management. This finding confirms earlier observations that Africa's vast indigenous knowledge systems have been suppressed or diluted by the triple effects of colonisation, racism and a Eurocentric education system (Ramose, 2002; Hammersmith, 2007; Matunhu (2011); Chiwanza et al., 2013). These three effects have undeniably left indigenous Africans with little confidence or motivation to document their own knowledge systems even decades after independence from colonisation. Notwithstanding this, there is now a recognition of the vital role African indigenous knowledge systems can play in sustainable development as recently noted: "Africa may be an ideal continent to learn about and begin seriously integrating indigenous knowledge with development planning techniques" (Lalonde, 1991). Asia has made tremendous progress on this dimension of development (Savage, 2012).

Dense and durable social networks in a community facilitate IKS sharing through generations (Sithole, 2014; Mararike, 2016). As noted in this study, the practice of *nhimbe* in its various forms is in itself a community social network which enables sharing and application of IKS within and between generations. If this was not so, the study would have found only a few people with the knowledge within the sample and limited application in crop management. As the study discovered, the *nhimbe* practice, though reportedly not as popular as it was in the past, is evidence of strong inter-household bonds that exist in the communities and this is why one of the key informants said that "*nhimbe* is a family fibre". Figure 1 below attempts to demonstrate the centrality of social bonds in the community in terms of IKS sharing, its application for livelihoods and ultimately, its durability or resilience across generations.
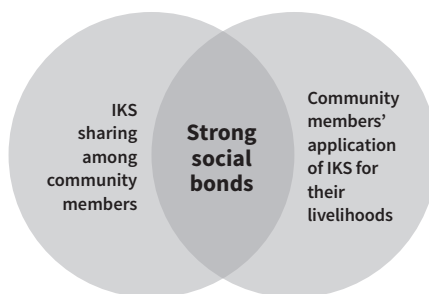
Figure 1 *Fertilisation and durability of IKS in communities*

The use of the indigenous knowledge is consistently in harmony with the natural and the spiritual world. This confirms Muyambo and Maposa's (2014, p. 22) assertion that "indigenous communities in Africa were quite conscious of the significance of environmental protection and management even before the advent of colonisation". Thus, community socio-spiritual sanctions (taboos and sacredness) exist to deter people from destroying water sources, trees and bushes, especially those used for human and animal medicine as well as for fruits, crop production and environmental conservation/management. Such trees or bushes are highly respected in the communities studied with sanctions enforced by community leadership, thus the environment is protected. The use of cow dung and animal urine, among other aspects discussed in this study, demonstrates community innovation for livelihoods using locally available natural resources.

Although the indigenous trees and bushes used for crop management for livelihoods are fairly abundant in the communities studied, the use of leaves and bark threatens their existence and resilience of the practice. In addition, the slash and burn method used for land preparation obviously diminishes the integrity and quality of soil for farming and environmental conservation. The use of manure from livestock droppings and urine helps to restore soil integrity and fertility.

Conclusions

The indigenous knowledge systems found in this study evidently contribute to crop and livestock production and management. While the study did not undertake a comparative analysis of farmers using IKS techniques and those not using them in terms of food security, the study attempted to outline IKS in the studied communities of Chimanimani District and how they are used in crop management, grain storage and to a certain extent, environmental management. Also apparent from the findings is that the use of IKS techniques in crop management and grain storage is economically cheaper than the use of contemporary/ conventional pesticides and grain preservation chemicals. Furthermore, the study highlighted the human-nature relationship within the social ecology discourse for sustainable community livelihoods.

The study established that social bonds and social reproduction (quality of relationships) are key enablers for sharing and learning about indigenous knowledge systems among community members. It remains an issue that IKS still suffers from marginalisation in the mainstream community and national development.

Recommendations

The following three recommendations are made to the government of Zimbabwe:

1. IKS in education curricula
It is strongly recommended that the education system be reviewed with the view to deliberately incorporate indigenous knowledge systems in education and development curricula. This

can be designed to fit all levels of the education structure in the country, that is, from early childhood development level to tertiary institutions.

2. National IKS research and development institute

The study has illustrated an endowment of indigenous knowledge systems in the communities studied but there is little evidence of scrutiny and documentation of that body of knowledge elsewhere in the country. For this reason, it is highly recommended that the government of Zimbabwe establishes and supports a dedicated national institute whose mandate is to conduct interdisciplinary research and develop indigenous knowledge systems across the country. The key aim will be to integrate IKS in the mainstream national development trajectory and concurrently build and sustain national identity and pride.

3. IKS national fund

In order to motivate and increase appreciation of IKS among both students, academics and industry, it would be important to create a national scholarship for IKS and sustainable development studies. This would encourage IKS-related research in academic institutions and industry. This fund can also be used to sponsor IKS-related workshops and conferences to increase intellectual debate, sharing and learning on the subject.

Notes on the contributor

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Pindai Sithole is a development consultant (social research and project/programme evaluations) and a university lecturer (humanities and social sciences) with key research interests in indigenous knowledge systems and academic specialisation in mixed methods research, governance and development.

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Challenges of Teaching Akan (Ghana) Culturally-specific Environmental Ethics in Senior High Schools: Voices of Akan IK-holders and Biology Teachers

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Abstract

Indigenous cultural groups have lived sustainably with their natural resources (land, water bodies, forests, wildlife animals and plants) by employing particular culturally-specific environmental ethics. These include spiritual perceptions about natural environmental resources, totemic beliefs and taboos. Consequently, many scholars in the country have recommended the integration of these culturally-specific environmental ethics in environmental policies and formal school curricula. The purpose of this research was to explore the views of Akan indigenous knowledge (IK) holders and senior high school Biology teachers on challenges they predicted could confront the teaching of Akan culturally-specific environmental ethics in the senior high school Biology curriculum. An interpretivist paradigm with an ethnographic, naturalistic research style, using in-depth conversational interviews was employed to explore the views of research participants. The perceived challenges included stigma attached to culturally-specific environmental ethics; requirement of proof and experimentation; the use of a foreign language in schools; formal education; loss of the fear for the gods and spirits in nature; centralised curriculum; democracy and political biases. The research concluded that being aware of the possible challenges to the teaching of the Akan culturally-specific environmental ethics can influence policies related to these ethics as well as guide Biology curriculum developers and stakeholders.

Keywords: *culturally-specific environmental ethics; Akan cultural group; Akan nature conservation; Ghana Biology curriculum*

Introduction

For centuries, many indigenous cultural groups have sustainably conserved biodiversity, land and water resources by means of their cultural values, care and respect for nature without being pressured and persuaded by government agencies (Freitas, Kahn & Rivas, 2009; Zeppel, 2006). These values of care and respect for nature are gradually being eroded through modernity, Western culture, Christianity, Islam, urbanisation, overpopulation and economic improvement. Meanwhile, there is a global outcry for conservation of biodiversity in light of the alarming loss of species and habitats (Awuah-Nyamekye, 2014; Horsthemke, 2009).

Teaching a curriculum infused with indigenous peoples' value and care for nature may be crucial to the sustainability of the environment, both locally and globally. Also, it may enhance general educational goals and objectives regarding nature or environmental studies (Arhin, 2008; Shava, Krasny, Tidball & Zazu, 2010; Shava, 2016).

The relevance of integrating culturally-specific environmental ethics in formal school curricula and environmental policies has been advocated in Ghana (Awuah-Nyamekye, 2009; Eshun, 2012). This study is an exploration of the challenges of teaching these Akan ethics from the perspectives of Akan IK-holders and senior high school Biology teachers. The phrase 'culturally-specific' adopted for the study was drawn from descriptions of indigenous knowledge (IK) as a culturally-specific social practice (Fien, 2010; Kaya, 2015).

Theoretical underpinnings: African Environmental Ethics

African Environmental Ethics as a philosophical discipline embraces various human values and care for nature (Ojomo, 2011; Shava, 2013, 2016; Workineh, 2014). In the context of these ethics, which can be considered an African Indigenous Knowledge System, people, animals, and spiritual entities are inextricably interconnected with their natural environment; consequently the African environment is based on a three-way interrelationship between people, animals and spiritual entities (Ojomo, 2011; Mawere & Awuah-Nyamekye, 2015). Bujo (2009) proposed that in traditional African culture, the sacred and the secular are not clearly separated as in western cultures. For the traditional African, absolute consciousness of self is impossible without harmonious co-existence with plants, animals, minerals, land, water-bodies and spirits. Similarly, Tangwa (2004, p. 392) posited that African environmental ethics involves a harmonious tripartite interrelationship and described this as ethics of 'eco-bio-communitarianism'. Ogungbemi (1997, p. 208) described this as the 'ethics of nature-relatedness'. Kimmerle (2006) contended that the traditional African perceives nature to be infused with spiritual powers and this perception is the basis for the traditional African respect for natural ecological resources, and consequently sustainable utilisation. Awuah-Nyamekye (2009) suggested that African environmental ethics have deific dimensions. Mangena (2013) maintained that the spiritual relationship is signified through the use of totems. Arhin (2008, p. 94) described African environmental ethics as upholding the 'sanctity of life'. Bujo (2009) considered these ethics to be what the African person believes to be the basis for ecologically responsible behaviour: respect for creation, recognition of sacredness of all life forms and ecological rationality. Consequently, the importance of IK for the value and care for nature has been proposed for integration into formal school science curricula (Owuor, 2008; Muchenje & Goronga, 2013a).

The call to integrate African Indigenous Knowledge Systems in school curricula

The importance of infusing indigenous knowledge systems (IKS) into education has been highlighted by the New Economic Plan for Africa Development (NEPAD), the World Bank, the

United Nations Educational, Scientific and Cultural Organization (UNESCO) and the United Nations Development Programme (UNDP), Local and Indigenous Knowledge Systems (LINKS) programme (Gorjestani, 2001; Odora Hoppers, 2002a, 2002b; UNESCO, 2005; Nakashima & Nilsson, 2006; Muchenje & Goronga, 2013b). Taking into consideration the Eurocentric nature of the African curriculum, there is a need for a paradigm shift with IKS recognised as a legitimate form of knowledge. Policy makers in Africa are therefore called upon to examine the general significance of IKS and its inclusion in the educational curriculum. Education is an ideal means of making IKS a comparable knowledge form that exists alongside Western forms of knowledge and technology (Odora Hoppers, 2009; Muchenje & Goronga, 2013b). Kimmerer (2002) asserted that a variety of intellectual modus operandi is needed to handle the multiple environmental sustainability issues which includes integration of indigenous knowledge (IK) on natural environment in formal school curricula. Presently, several countries have upheld the relevance of IK education and have included it in policy and formal education, notably Caribbean nations, India, Australia, and countries in Africa (Kesamang & Taiwo, 2002; Taiwo & Tyolo, 2002; Stears, Malcolm & Kowlas, 2003). Aikenhead and Ogawa (2007) contended that formal educational programmes are one of the key approaches to preserving, revitalising and maintaining indigenous environmental ethics embedded in the indigenous knowledge of local communities. Shava (2016) and Van Wyk and Higgs (2011) posited that the integration of African Indigenous Knowledge Systems into formal school curricula would be a way to remedy the epistemological imbalances in the curriculum for the development of twenty-first century citizens who are culturally aware. Ameyaw and Amankwah (2014), studying the inclusion of IK into school curricula in Ghana, proposed that the integration of IK would boost interest in student learning and enhance student comprehension of subject matter as well as lead to an appreciation of culture and the natural environment. The Ghana Education Service (GES) syllabus for senior high school Biology does not specify in its objectives that teachers are to integrate the indigenous knowledge of the students in what is taught in the curriculum. However, some examples on methods of conserving natural resources, under the topic of Humans and their Environment, include the use of "sacred groves and specific days of farming, fishing and hunting" (GES, 2012, p. 67). Thus, examples are given as indigenous cultural ways of conserving natural resources (Awuah-Nyamekye, Sarfo-Mensah, Amisah, & Owusu-Bi, 2014). Moreover, the syllabus includes local food preservation and local brewery production (GES, 2012).

Research design

This study employed an interpretivist paradigm with a qualitative approach, using an ethnographic naturalistic research style to explore the challenges of teaching culturally-specific environmental ethics in senior high schools from the perspectives of Akan IK-holders and Biology teachers. The choice of an interpretivist paradigm was premised on the belief in multiple realities from the responses of the Akan participants (Quaye, 2007; Bertram & Christiansen, 2014). Rich, detailed, in-depth qualitative data was collected from the custodians of the Akan culture, within their indigenous communities.

Research participants

The Akans represent 47.5% (over eleven million people) of Ghana's population (Ghana Statistical Service, 2012). The study participants were fifteen IK-holders and six senior high school Biology teachers who were purposively selected from some indigenous Akan communities within the Ashanti region of Ghana. The IK-holders included three chiefs, three traditional priests, three herbalists, three elders, three youth, six Biology teachers (three from urban and three from rural areas). This number of participants was considered large enough to provide data for the study and small enough to handle in terms of the qualitative interpretive nature of the data collected (Creswell, 2014). Data was generated in the following areas within the Ashanti region: Ejisu, Asaman, Agona, Paakoso, Gyakye, Asantemanso, Owabi and Bonwire. Participants were chosen based on their knowledge on Akan culture. The selection was guided by literature (Ntiamoa-Baidu, 2008), recommendations from informants working at the National Cultural Centre, Kumasi (Ashanti Region) and from other research participants using a snowball technique (Creswell, 2014).

Research instruments

The main instrument for data collection was an open-ended conversational interview which gave the participants the opportunity to express themselves unrestrictedly and to talk at length in a comfortable, relaxed manner (Burgess-Limerick & Burgess-Limerick, 1998; Denzin, 2008). Denzin (2008) and Knowles and Cole (2008) contended that interpretivist researchers mostly employ interviews in their quest to explore and describe people's perceptions, worldviews and understandings about a peculiar phenomenon. Kaya and Seleti (2014, p. 33) indicated that "an interview is a good and useful data collection instrument for discovering what a person thinks in terms of attitudes and IKS beliefs". Participants expressed themselves unhindered, during the unstructured interviews (in the local Akan Twi language).

During, the interview process, which was tape-recorded, questions asked of participants were rephrased for clarity, where necessary. Participants' responses are presented in the findings. The main conversational **interview questions** were:

> Now, that you (the participant) have expounded to me the various ways you think your (Akan) cultural group's understandings, perceptions and practices for the value and care for nature (lands, plants, animals, waterbodies) should be taught at senior high schools, what challenges do you perceive would confront the teaching of your cultural values and care for nature in senior high schools and why do you have those views?

Data analysis

The tape-recorded interviews were transcribed verbatim and the transcripts were analysed using thematic coding based on the inductive approach. Bamberg (2012) contended that data analysis is under way as soon as transcription starts. Firstly, the transcripts of each participant were read and I detected the patterns, regularities and commonalities in the responses of all other participants, which were then put into categories and colour-coded. The general

categories were based on participants' responses that were linked to the social, cultural, economic, political, religious, technological, biophysical aspects of the phenomenon under study (challenges of teaching Akan culturally-specific environmental ethics). I then identified themes by sorting and re-categorising the initial general categories into more in-depth and specific categories. I read the transcripts repeatedly to identify responses that were divergent, atypical or dissenting. Finally, the themes that were identified were discussed, revised, and supported with relevant literature (Miles & Huberman, 1994; Attride-Stirling, 2001; Bertram & Christiansen, 2014). Furthermore, to enhance the identification of themes, the texts that were not previously linked to themes identified, were re-scrutinised to search for any new themes in those texts that had not been colour-coded (Miles & Huberman, 1994). The findings of the study are presented and discussed based on the identified and established themes. Both trustworthiness and limitations of the study were taken into consideration as the research reported in this article is part of a larger study – PhD titled 'An Exploration of the Akans (Ghana) and Zulus (South Africa) Culturally-Specific Environmental Ethics: Implications for Culturally-Specific Senior High School Biology/Life Sciences Curriculum Development and Teaching' (Opoku, 2019).

Findings and discussion

The findings and discussions are presented here based on themes that had been established. Table 1 summarises the themes, the number and categories of participants who reflected the themes. These themes are discussed in detail after the table. Participant codes highlighted (**C1** for chief 1 for example) indicate which of the chief's statements were considered most important. Where the statements were similar, one quote was selected and presented, to reduce volumes of data presented and for reasons of data saturation (Miles & Huberman, 1994; Saumure & Given, 2008).

Table 1 *Key findings: Iterative curriculum innovation*

Themes	Categories of Participants and Number	Percentage of Participants reflecting this theme
Stigma attached to culturally-specific environmental ethics as archaic and old-fashioned	All participants	100
Demand for proof and experiments	All participant except E2	95
Use of foreign language in our schools	All participants	100
Formal education and modernism	All participants except H2 and Y3	90.5
Loss of the fear for the gods and spirits in nature	All participants except Tc3	95

Themes	Categories of Participants and Number	Percentage of Participants reflecting this theme
Considered a sociocultural belief that has outlived its relevance	All teacher participants and E2 only	33
Centralised curriculum and more Westernised curriculum	All teacher participants and E2 only	33
Democracy and political biases	All participants	100

Stigma attached to culturally-specific environmental ethics as archaic and old-fashioned

All participants indicated stigmatisation as part of the probable challenges in teaching of their culturally-specific environmental ethics in high schools.

Chief: *They do not respect our traditions and our culture … they keep saying these are age old stuff…* (**C1**, C2, C3)

Traditional priest: *People make us even feel ashamed of our culture … they keep telling us, that is idol worship and archaic practices…* (TP1, **TP2**, TP3)

Herbalist: *Even our own medicines they don't want to accept them in the pharmacy shops … make you look like you don't know what you are about…* (H1, H2, **H3**)

Elder: *People make us feel some kind of shame when they talk about our cultural environmental practices as though they are not modern…* (E1, E2, **E3**)

Youth: *They can argue with you and be telling you, you are living in stone age era, that's why you are following such things…* (Y1, **Y2**, Y3)

Teacher 1: *People feel that you are not modern and don't even know what computers are about …*

Teacher 2: *Even now Ashanti history they are phasing them out of our curricula at the basic and secondary schools because of the Western inclination of our political people…* (**Tr2**, Tr3)

Teacher 3: *If there is anything that you can easily feel like you are getting outmoded about it, it is our culture now…* (**Tc1**)

Teacher 4: *People still feel that the cultural practices for conservation by our forefathers which kept the environment like sacred groves is now looked down upon with gross impunity but the hope of restoring such is not lost…* (Tc2, **Tc3**)

Some participants bemoaned the fact that some people stigmatise the Akan cultural values, as well as the knowledge and wisdom embedded therein. Participants indicated specific sources of denigration of their culture: Westernised educated persons, Christians, Islam, as well as

students whose parents and guardians disdain local cultural practices. Some researchers have pointed out that African traditional thoughts and worldviews are considered inferior to modern science-oriented thought in many respects as African intellectual capacity is looked down upon by the Western world (Wiredu, 1997; Semali & Kincheloe, 1999; Odora Hoppers, 2001; Hountondji, 2002; Kincheloe & Steinberg, 2008).

Demand for proof and experiment

Almost all participants expressed the likelihood of students demanding experiments to prove the validity of some of the Akan ethical practices and perceptions. Only Y2 did not agree with the other participants.

> **Chief:** *We never asked why and said statements like 'what shows that a spirit will pounce on me when I go into that forest, that river or the other forbidden places' … but today's children would ask that we show them something to prove that this or that would happen if they go to some of the places we ask that they don't go…* (C1, **C2** C3)

> **Elder:** *The children would demand that we conduct some form of experiment to prove some of the claims and this may be very challenging…* (**E1**, E2, E3)

> **Traditional priestess:** *The way our current young people are very inquisitive, it is too much … they want to know everything but many of the things are not physical for us to explain to them…* (TP1, TP2, **TP3**)

> **Herbalist:** *If any of the children you are teaching ask deep spiritual questions about the way we do our things and the fact of spirits in plants and forest and so on to show them whether these can be real or not…you can come for consultation…* (**H1**, H2, H3)

> **Youth:** *There are a lot of things that are not well explained, we are only told to obey them… you cannot ask any of the elders to do something to show you whether what they say about some trees and rivers are true or not…* (Y1, **Y3**)

> **Teacher 1:** *One of the major challenges is the spiritual connotations that cannot be easily proven but our students are living in a scientific world and would want an experiment to prove almost everything but how would you prove the spirit aspect?*

> **Teacher 2:** *The demand for proof and experiment from students about such cultural practices would be a big challenge to handle…* (**Tr2**, Tr3)

> **Teacher 3:** *Science students have deep inquiry minds and would ask many, many questions… specifically demand that we make some experiments to prove them (cultural environmental ethics) and this will be very challenging…* (Tc1, **Tc2**)

> **Teacher 4:** *Surely students would ask us to prove what we teach (like spirit in water bodies) and, this is where there will be some difficulty…* (**Tc3**)

Participants indicated that since several Akan culturally-specific environmental ethics have spiritual links to water bodies, forests, wild animals and so on, students would be likely to

demand experiments to prove such claims and the reality of spirits and deities inhabiting certain natural components. Horsthemke (2008) contended that for 'indigenous scientific knowledge' to be ascribed as 'science' there should be laws or hypotheses to prove this (pp. 338-339).

Use of foreign language in schools

All participants indicated the use of foreign language (English) in the schools as another challenge that would confront the teaching of Akan culturally-specific environmental ethics.

> **Chief:** *How could we develop if we should keep using other people's language? … Even when we are having traditional council meeting, they will be speaking English…* (C1, **C2**, C3)

> **Elder:** *The value and standard of the local language is even being lost now … if not used in schools it will be lost completely … when that happens all the deep meaning embedded in our proverbs and wise saying would all be lost.* (**E1**, E2, E3)

> **Traditional priest:** *Why is it that in many countries they speak their own language and use the same language in school but when you come to Ghana they say that if you cannot speak English then you are dull in school and they look down on you?* (TP1, **TP2**, TP3)

> **Herbalist:** *A lot of our children have wisdom to do certain things but the English language that is compulsory is a problem for them … I have made a lot of medicines that even professors in universities have not done but they still don't respect us because we cannot speak English.* (H1, H2, **H3**)

> **Youth:** *Using the English language is good but sometimes it looks like it is becoming too much … even if you are science student and you don't pass English you cannot further your education.* (**Y1**, Y2, Y3)

> **Teacher 1:** *Using the local language during the teaching of such cultural practices of environmental conservation would make it more interesting…* (**Tr1**, Tr3)

> **Teacher 2:** *It would be very interesting to teach such cultural things with the local language … if not the import of it would even be lost.* (**Tr2**)

> **Teacher 3:** *Language will be a bigger challenge to teaching such cultural environmental ethics in schools because currently most of the teachers don't even know and understand some of the deep words and proverbial sayings in the local language.* (Tc1, **Tc2**)

> **Teacher 4:** *The local language is even stigmatised meanwhile that is the best language for teaching such cultural things.* (**Tc3**)

Participants bemoaned the central place of a foreign language like English in the schools; students look down on their own local languages. Discontinuous use and preference for the foreign language somehow 'adulterates' the local language and gradually 'waters down' deep-seated knowledge and in-depth Akan wisdoms. The IK-holders may not be able to communicate accurately in English as Akan words and phrases do not always have direct English equivalents.

Several decades ago the colonial government insisted on the sole use of English in Ghanaian schools (Awoniyi, 1975) and Wiredu (1997) maintained that the situation has not changed. Additionally there has been gross disrespect and disregard for the vernacular language in the schools. Dei Ofori-Attah (2006) contended that the students would perform well academically if they are taught in their indigenous language.

Formal education and modernism

A total of 19 of the 21 participants (90%) reflected that issues of formal education and modernism were also likely to pose a major challenge to the teaching of the Akan culturally-specific environmental ethics.

> **Traditional priest:** *All they do in our schools today are white people's lifestyle … they don't do anything that is from here (Ghana) and that is why the children don't respect us … and they tell us that our time has passed…* (TP1, TP2, **TP3**)

> **Chief:** *Every other thing you do that doesn't look like European or American seem to be of no value … in the so-called modern times lifestyle.* (C1, C2, **C3**)

> **Herbalist:** *Some people see the practices as old fashioned…* (**H1**, H3)

> **Youth:** *Since we live in a modern society and schools now have many technological facilities… and these cultural practices do not sound modernized … it will be a challenge teaching it…* (Y1, **Y2**)

> **Elder:** *The way people see the world now and especially because what they learn in school are all white man's things … it will make the teaching of our cultural things difficult…* (**E1**, E2, E3)

> **Teacher 1:** *I have noticed that we usually don't have respect for things that are from our own culture and it is worse in our schools.* (Tr1, **Tr2**)

> **Teacher 2:** *The effect of the modern technology and Westernised education system poses a threat to survival…* (**Tr3**)

> **Teacher 3:** *Weighing cultural things as against our modern schooling system … the way our people love to look and behave as Westernised people … will pose a challenge to the teaching.* (**Tc1**)

> **Teacher 4:** *Many Ghanaians seem to think that anything from abroad (Europe, Asia and America) is the best compared to the indigenous stuff … it will be a challenge to teach them…* (Tc2, **Tc3**)

Participants expressed their concern on how modernity, technological advances and formal education have led to the current generation denigrating Akan culturally-specific environmental ethics. Millar, Kendie, Apusigah, and Haverkort (2006) indicated that the formal educational system of Ghana is predominantly Western and Eurocentric and that making attempts to infuse local traditional practices would be a challenge. Govender (2012) shared similar findings with Onwu and Mosimege (2004): in Africa's formal schools, Westernised education has a central place; valuable IKS of the indigenous communities is neglected.

Loss of the fear for the gods and spirits in nature

All participants except one (Tc3) expressed this theme as a teaching challenge.

> **Chief:** *The fear that was in us when we were young, now you can't see it again … people don't even believe there are spirits in the forests and our water-bodies anymore…* (C1, **C2**, C3)

> **Elder:** *The Christian prayers have removed the fear that there are spirits in forests, water-bodies and in some wild animals and plants … the people have no fear in them …* (**E1**, E2, E3)

> **Traditional priest:** *As for now, what is called 'fear' that made people not to touch things in nature anyhow and destroy our water-bodies, forests, lands and even killing certain wild animals is almost lost from people…* (TP1, **TP2**, TP3)

> **Herbalist:** *Years before, when you say that we don't enter this particular forest no one would dare enter because the gods and spirits would definitely arrest you…but now people seem to have no such fears…* (**H1**, H2, H3)

> **Youth:** *I can see that now people don't fear our elders and what they say much because they don't respect them, but I still fear those spiritual things about nature because I have seen mad people that I was told ate fish from one of the rivers that they said no one should…* (Y1, Y2, **Y3**)

> **Teacher 1:** *When I was growing up I used to fear certain places (like deep forest) because of what I was told … but students fear nothing these days…* (Tr1, **Tr2**)

> **Teacher 2:** *… currently people don't have 'fear' like the old times…* (**Tr3**)

> **Teacher 3:** *A bigger challenge to these cultural environmental conservation practices will be the issue of students and people in general who have thrown away the fear of destroying any natural resource…* (**Tc1**)

> **Teacher 4:** *Fear for the gods and spirits are being lost from people lately so it makes them even spoil things (natural resources) more…* (**Tc 2**)

Participants indicated the apparent loss of fear for the gods and spirits in natural components would pose a challenge to the teaching of Akan culturally-specific environmental ethics that have spiritual connotations. Some researchers have contended that the fear of the spirits and 'gods' in nature has helped reduce the alarming loss of biodiversity among the Akans (Oduro & Sarfo-Mensah, 2010).

Considered an irrelevant sociocultural belief

The teacher participants and one elder (a retired teacher) claimed that Akan culturally-specific environmental ethics are considered sociocultural beliefs that have outlived their relevance in society. Although only 33% noted this theme, it is likely that the phrases expressed would be commonly used by many teachers.

> **Teacher 1:** *The cultural environmental practices are seen as a sociocultural belief and a superstition…* (**Tr1**, Tr2)

>**Teacher 2:** *The practices are currently seen as sociocultural beliefs … and [regarded as] superstitious…* (**Tr3**)

>**Teacher 3:** *In these days the cultural aspects of most ethnic groups are considered sociocultural beliefs that will not help the world now…* (**Tc2**)

>**Teacher 4:** *The beliefs and practices of our cultural group are being castigated now as sociocultural beliefs that have outlived their relevance…* (**Tc1**, Tc3)

>**Elder:** *Our educational system has looked down on our culture and just embraces foreign cultures … and label our cultural practices as sociocultural beliefs…* (**E2**)

Evident in these excerpts are teachers' Western interpretations of the cultural practices of many African communities and their view that culturally-specific environmental ethics might be simply regarded as outdated sociocultural beliefs that have outlived their relevance. Wiredu (1997), Kincheloe and Steinberg (2008) as well as Awuah-Nyamekye (2014) all proposed that traditional thoughts and worldviews are becoming considered inferior to modern science-oriented thoughts.

A centralised and Westernised curriculum

All teacher participants claimed that the Westernised nature and the centralised curriculum system used in the country would pose a challenge to the teaching of the Akan culturally-specific environmental ethics.

>**Teacher 1:** *We would have to decentralise the curriculum and then we could bring those aspects into them…* (**Tr1**)

>**Teacher 2:** *The teaching will be feasible in small communities and rural areas … because our curriculum is centralised and inclined more to the Western curriculum patterns…* (**Tr2**, Tr3)

>**Teacher 3:** *The major issue with the curriculum now is the fact that it is centralised, and this will make it challenging in the teaching … because of the diversities of cultures…* (**Tc1**, Tc2)

>**Teacher 4:** *The centralised curriculum will pose a challenge … because most of the aspects have spiritual connotations…* (**Tc3**)

>**Elder:** *The school curriculum would have to be decentralised to make this feasible…* (**E2**)

According to the teacher participants therefore, decentralising the curriculum would make the teaching of the Akan culturally-specific environmental ethics more feasible. Berkvens (2009) and Muchenje and Goronga (2013b) posited that curricula lacking the local context of the people lead to cultural discrepancies.

Democracy and political biases

All participants made references to democracy and politics as strong forces that could thwart the teaching of Akan culturally-specific environmental ethics.

Chief: *The so-called democracy has affected us so much … political leaders will remove it (our cultural value and care for nature) and put western things there…* (C1, C2, **C3**)

Elder: *Everything is politics now … even if the government make them teach the cultural environmental ethics in the school … another government will come who will not agree and this will make it very difficult to continue it…* (**E1**, E2, E3)

Traditional priest: *Even our job here, there is politics in it … the same thing that will happen in the schools if people don't stop politics…* (TP1, **TP2**, TP3)

Herbalist: *Because of democracy even if something will benefit everybody, someone who has more political power and hate such cultural things could fight it so much that they will remove it from schools…* (**H1**, H2, H3)

Teacher 1: *They have been changing the school curriculum every time there is a new government … this is pathetic, it's like there's no national goal; it is all political goals!…* (Tr1, **Tr3**)

Teacher 2: *How can we move forward if we throw away our own culture and go to take another country's culture? It is only politics that can cause this…* (**Tr2**)

Teacher 3: *I only hope that the teaching could be sustained looking at the fast pace at which governments come and keep changing the curriculum…* (**Tc1**)

Teacher 4: *Our democracy and political biases are not helping us achieve a common national goal and this I think will pose a challenge in this new wave in an attempt to teach cultural environmental ethics in schools…* (**Tc2**, Tc3)

Dei (2000) also contended that indigenous knowledge, despite its relevance, might be confronted with socio-political biases.

Conclusions

This study's findings have highlighted the key challenges to teaching culturally-specific environmental ethics in senior high schools using the Akan cultural group as a case. The challenges are presented to inform Biology curriculum developers, curriculum implementers and other stakeholders on matters they would need to address or be conscious of in their quest to teaching indigenous or culturally-related environmental ethics.

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Percentage contribution

Areas of contribution	Author	Percentage contribution
Conception or design of the paper, theory or key argument	Opoku	50 %
	James	50 %
Data collection	Opoku	100 %
	James	0 %
Analysis and interpretation	Opoku	70 %
	James	30 %
Drafting the paper	Opoku	50 %
	James	50 %
Critical review of paper	Opoku	30 %
	James	70 %

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The Practice of Environmental Training: A case of ISO 14001 Certified Businesses in Durban, South Africa

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Abstract

Environmental management has moved from a policy concept to a proactive strategy defining business responsiveness to stakeholder and market-related pressures towards improved environmentally sustainable business practices. There is increasing business responsiveness through corporate sustainability and environmental management practices. A growing number of environmental regulations make the adoption of environmental management systems such as ISO 14001 more common and this necessitates training. While environmental training is receiving international attention, it is seemingly less prominently investigated in the South African context. In this article, results from an empirical study into the environmental training practices of Durban businesses are presented. By applying the ISO 14001 certification criterion, 24 businesses were identified as research participants. The practice of environmental training was investigated considering three themes i.e. environmental attitudes and culture, training resources and commitment, and impediments to environmental training. In exploring these themes, the main questions of the extent of environmental training and its effectiveness are determined. It was found that environmental training is widely practised across all businesses sampled, with impact-focused training topics supported by positive environmental attitudes. However, other areas emerge as problematic, including limited organisational prioritisation of environmental training as well as insufficient further training topics which can limit the efficacy of training activities.

Keywords: *environmental training; environmental education; ISO 14001; Environmental Management Systems; corporate sustainability*

Introduction

A learning organisation is an effective and innovative organisation that can successfully adapt to changing operational demands (Easterby-Smith & Lyle, 2011). This is particularly important in environmental management in the business arena, as businesses are at the forefront of economic activity in a context of environmental change (Lu, Marais & Zhang, 2014). Businesses are required to adapt to change as demanded by climate change impacts (Ziervogel et al., 2014), demand for production efficiencies (Bernardo, 2014) and growing public and

legislative pressures for environmentally sustainable and ethical business operations. One of the important ways to adapt is introducing and maintaining environmental management systems, and training employees for new ways of doing sustainable environmental business, thus deviating from 'business as usual' (Arimura, Hibiki & Katayama, 2008; Gotschol, De Giovanni & Vinzi, 2014).

With the changing environmental legislative and regulatory context in South Africa, it is imperative that adequate capacity building investment within business occurs (Kidd, 1997; Nel & Kotze, 2009). Businesses are at the forefront of environmental impact, necessitating the engagement of employees and company management in environmental training and awareness to effect meaningful change in promoting environmental best practice (Mentis, 2010; Sakr, Sherif & El Haggar, 2010). Though somewhat sparse nationally, there are research examples of organisational learning processes and education in non-ISO 14001 company-specific contexts (Price, 2007; Ward, 2012; Lindley, 2014). This research presents an opportunity to elaborate on the extent and nature of environmental training specifically within ISO 14001 certified businesses in the economically active metropolitan city of Durban. This paper is therefore a unique empirical study of how Durban businesses are taking up the challenge to implement environmental training in their ISO 14001 certified organisations. Specifically, three themes of environmental training are investigated in this study to explore the extent of training in organisations and the effectiveness of its application.

Conceptual framework

Sustainable development is the overarching discourse within which environmental training is positioned (see Figure 1). Sustainable development is encouraged through various mandatory regulations and voluntary mechanisms. The interpretation and evolution of environmental management in corporate greening has grown significantly. The appropriation of the ecological modernisation approach by companies can maximise environmental opportunities inherent in cleaner production and integrate environmental management with wide ranging benefits to the environment and to corporate bottom lines through resource efficiency and competitive advantage. Integrating environmental management (IEM) into business is considered a change management challenge and environmental management systems (EMS) are implemented to streamline adherence to environmental regulatory compliance and enhance proactive corporate risk management. Environmental training is an imperative cog in the machinery of environmental corporate change and is an integral element of ISO 14001 which is implemented in an effort to engage proactively with the environmental crisis and challenges of environmental regulations.
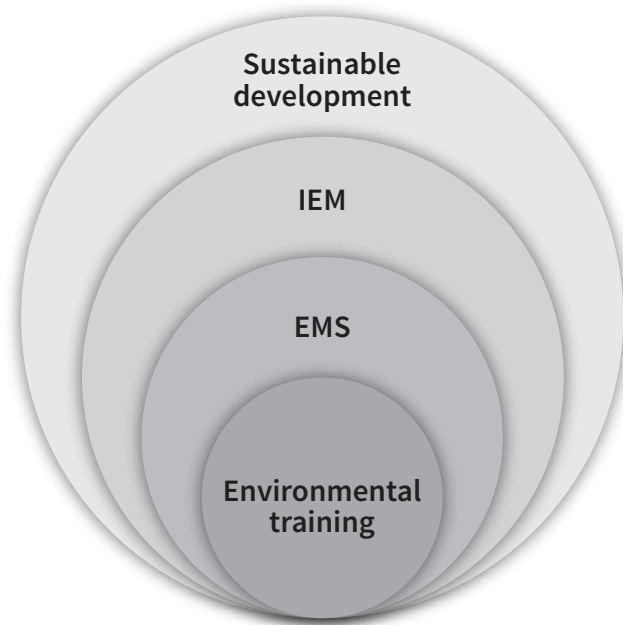
Figure 1 *Conceptual framework for environmental training*

Theoretical Background

Growing pressures for environmental performance

Addressing the challenges between economic growth and environmental sustainability have been the subject of much debate and discourse in recent decades (Elkington & Burke, 1989; Owen & Unwin, 1997). Much of the debate has focused on reconciliation between environmental sustainability and capitalist corporate growth, under the term 'ecological modernisation' (Hajer, 1995; Poncelet, 2004). Practically, this has led to optimistic understandings of the beneficial interactions between business and environmental sustainability, wherein reformist as opposed to radical action is envisaged (Dryzek, 1997). In this way business can benefit in terms of risk reduction, profit widening, brand improvement, and competitive advantage (Pojasek, 2010). More recent discourses of ecological modernisation often dispute the environmental sustainability of green capitalist growth (Ewing, 2017). It has been argued, however, that adopting green or cleaner technologies does not reverse global trends of environmental destruction sufficiently, and rather a rethink of capitalism as we know it is required (Bond & Downey, 2012). Reformist ideas such as those of conscious capitalism have grown in popularity for green economies (Mackey & Sisodia, 2014). Despite the disparate discourses that underpin clean and green technologies, businesses of varied types can no longer avoid the call to adapt to environmentally sustainable business operations.

A further impetus for change is voluntary self-regulation of companies, where companies have been encouraged to adopt environmental management systems (EMS) as part of

establishing an integrated environmental management tool (Department of Environment and Tourism [DEAT], 2004). In so doing, a systematic process for meeting minimum legal requirements and addressing broadly the necessary steps to achieving an environmentally sustainable business becomes seemingly more achievable. The widely adopted International Standards Organisation, namely ISO 14001, is a prominent example of such an environmental management system, comprising various iterative stages, within which environmental training and awareness is an important focal point (World Bank, 2000; Darnall, Henriques & Sadorsky, 2008).

Furthermore, Porter and Van de Linde (1996) have asserted that environmental issues have historically been dealt with as an outsourced, end-of-pipe strategy to meet minimum compliance requirements and this is counterproductive to meaningful and effective environmental change required of businesses. Creating value for business, society and the environment are not mutually exclusive as expounded by proponents of creating shared value (Porter & Kramer, 2011). Greater integration and transparency of environmental performance reporting with traditional business reporting is strongly promoted in South African businesses through sustainability reporting initiatives such as King III, the United Nations (UN) Global Compact and the Global Reporting Index (GRI). This is a compelling challenge to employers to recognise that a financial focus alone is a limited view of business performance (Fourie, Roux & De Jongh, 2012; Roberts, 2012). The notion that environmental management is considered change management and is negotiated through concerted environmental training such that the entire company embraces a learning organisation culture towards environmental management, is also supported by several studies (Davis, 1991; Pall & Welford, 1997; Welford, 1998; Jimenez & Lorente, 2001).

Role of sustainable development

Sustainable development has proved both an elusive and indispensable construct in bridging the gap between economic development and environmental protection (O'Riordan & Voisy, 1998; Mukhurjee & Kathuria, 2006). As business is the main agent for bringing about socio-economic change, it consequently carries substantial responsibility for environmental change (Rivera-Camino, 2011). Ultimately, a sustainable planet is one that develops economically and socially within the limits of the environment, balancing priorities of people, planet and profits (Hammer & Pivo, 2016).

Business controls much of societies' technological and productive capacity therefore change and innovation are within its grasp (Jimenez & Lorente, 2001; Muller, 2007). A company's EMS is a starting point in achieving environmentally sustainable business performance. As Giles (2008) pointed out, no management system however well designed can be effective without improving the ability of its employees and management to reduce the impacts of its operations. A company's EMS is only as good as the people that implement, innovate and internalise environmental action, and according to Sakr et al. (2010), necessitates the inclusion of the various tiers of corporate structure, including executive tiers. Several authors have confirmed the urgency to conduct business sustainably and it is therefore necessary that businesses are capacitated and informed to innovate and adapt to the contemporary

pressures imposed by the environment (Vidal-Salazar, Cordón-Pozo & Ferrón-Vilchez, 2012; Jabbour, 2013).

Environmental training in the context of an EMS

An EMS, initially a voluntary mechanism to ensure compliance to legal requirements and public and corporate competitive pressure, has in recent years become mandatory (Pojasek, 2010). South African business has responded to the call for environmental sustainability evidenced by the adoption of voluntary ISO 14001 certification and is among the top three African countries with significant certification (World Bank, 2000; To & Lee, 2014).

Researchers consider environmental training as an emerging environmental field of study and have credited ISO 14001 for formalising its inception and progress in corporate environmental management (Unnikrishnan & Hedge, 2007). Other researchers have also correlated effective environmental management positively with environmental training activities within ISO 14001 certified companies (Jabbour, 2013). In support of ISO 14001 as a systems approach, there is integral synergy linking environmental performance through a formalised EMS system process utilising environmental training and top management commitment (Tung, Baird & Schoch, 2014).

Environmental training is encompassed in the relatively new concept of environmental education as a form of problem-specific training within the business context (Ben-Pretez, 2013). Environmental training is one of the key stages in a robust EMS as it forms part of the iterative process of improvement and increased environmental performance. Environmental training supports Proactive Environmental Strategies (PES) that are characteristically voluntary in nature (and includes ISO 14001) and provides a corporate response to increasing environmental regulation pressures for compliance and stakeholder demands for sustainable products and services (Vidal-Salazar et al., 2012). Furthermore, it is firmly positioned with an environmental management approach as "environmental management is the incorporation of concern and environment-related opportunities in a business context, making production processes and products more environmentally suitable" (Haden et al., 2009, cited in Jabbour, 2013, p. 2).

Environmental training is established as a means to mitigate identified organisational environmental risks, which are minimised when employees are trained with relevant knowledge and skills (Lu et al., 2014). Mentis (2010) recommended that employees directly participate in risk mitigation in the identification and control of environmental risks. While Proactive Environmental Strategies are supported by company-specific environmental training emphasising operational implementation, the role of vocational or tertiary environmental education is not excluded in this effort (however the latter is not the focus of this particular study).

ISO 14001 prescribes the undertaking of environmental training by incorporating relevant legislation and standards into the design of the EMS objectives and training material. Environmental training is also a legislative requirement which is undertaken as a reasonable measure for companies to integrate environmental management into business functions for the mandated protection of the environment.

Methodology

The city of Durban (eThekwini) in KwaZulu-Natal, South Africa, has a large business sector comprising an estimated 2 796 businesses registered as members on the Durban Chamber of Commerce and Industry (DCCI, 2014). The DCCI is a formally constituted body under the Companies Act 71 of 2008, representing registered business interests (ibid.).

This was an exploratory study into relatively unknown environmental training phenomena in the regional context. The study utilised purposive sampling, selecting only ISO 14001 certified businesses to ensure that respondents were able to provide knowledgeable input on their organisational environmental training activities. The total number of ISO 14001 businesses in Durban is unknown. An approximation was determined using the South African Bureau of Standards website, where a total of fifty ISO 14001 certified businesses were identified within Durban. A criterion based purposive sampling strategy for a mixed method approach is used by researchers for understanding similarities and differences in a fairly unknown context of enquiry (Palinkas et al., 2015). Of the 50 businesses contacted for this study, a total response number of 24 businesses (48%) agreed to participate in the study. The study located respondents across Durban, particularly in the industrial heartland in the south and west of Durban.

For the purpose of this paper, selective results of a broader study are used focusing on the business respondent sample. The research instrument comprised a questionnaire survey, investigating the following three themes of enquiry in particular, which inform the results and discussion that follows:

1. Environmental attitudes and culture
2. Environmental training: Commitment and resources
3. Impediments to environmental training

Although this study makes use of a qualitative approach, a quantitative method of data collection through a survey method was used which was complemented by qualitative sampling and analysis strategy. Quantitative and qualitative forms of research are synergistic allies in allowing an explanation to emerge from data. This research which represents a mixed method strategy is explained further by Layder (2013, p. 12): "Qualitative analyses directly complement quantitative studies by providing data on the dynamics of encounters and lived experiences that quantitative information cannot directly supply. In other cases, qualitative studies explore areas about which little is known and which may then be enhanced by quantitative data and evidence". In support of mixed method studies that employ a qualitative approach, "the operational point is that data collection and analysis can be done in both modes and in various combinations, during all phases of the research process" (Strauss & Corbin, 1998).

The survey data gathered was analysed through the use of coding which organised the data into "meaningful patterns or segments and makes them practically manageable" (Layder, 2013, p. 139). These descriptions were generally void of specific interpretations or judgements

but aim to give a picture or context of the sample respondents. It was considered best to represent the data graphically and in table formats.

Research findings

The business respondents consisted of management or supervisory level staff with designated environmental competencies. The following business activities are represented in the sample: manufacturing (50%), business services (i.e. non-industrial), petrochemical and industrial services account collectively for 38%, agricultural (4%) and transportation industries (8%).

Environmental attitudes and culture

All respondents (Figure 2) agreed to strongly agreed to positive personal attitudes towards the environment outside the workplace with strong positive behaviours shown in the use of energy efficient lighting, waste recycling and carpooling.

Personal values and environmental attitudes of managers and staff are an important causal link to favourable environmentally-conscious behaviours and decision-making in the workplace (Papagiannakis & Lioukas, 2012). Personal values of managers are shown to be effective predictors of environmental adaptability in the workplace as commented by Papagiannakis and Lioukas (2012, p. 44) who stated that "managers are more likely to change the way their firms operate, if that change is in line with their personal values". The responses therefore correlated with this idea positively as management level responses show high personal environmental values and attitudes.
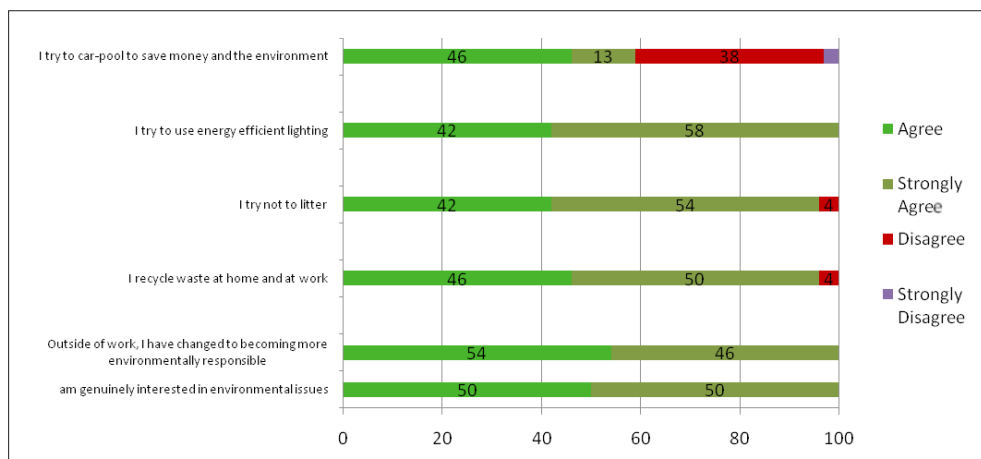
Figure 2 *Business respondents attitude and behavioural responses (%) (n=24)*

Attitudes toward considering the environment in business decision making

The extent to which personal values are transferrable in the business context in environmental decision making was examined (Figure 3). Respondents strongly agreed to understanding

the impacts of their business activities (83%) and to the importance of environmental issues in business (83%). This shows an environmentally aware attitude towards corporate environmental sustainability. A trend to prioritise environmental decisions was evident from 79% of respondents strongly agreeing to consider environmental issues in decision making. Furthermore, respondents indicated an awareness of business impacts (100%) and that business resources and finances must be prioritised for effective environmental management. This indicates that these businesses could undertake critical decision making in terms of resources and finances. Such decision making is important as Lesourd and Schilizzi (2001) explained that managing environmental impacts is costly and includes acquiring high-tech equipment, technical expertise, training resources and time.
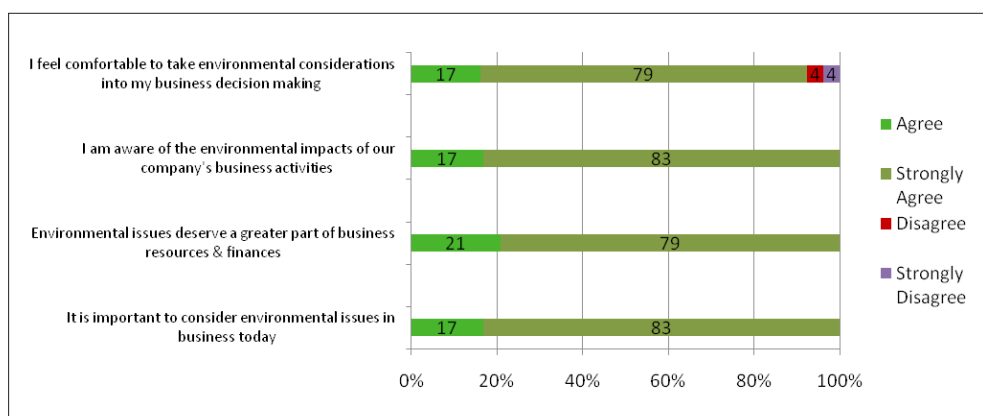
Figure 3 *Business respondent's environmental decision making responses (%) (n=24)*

Perceptions of the environment in company culture

The culture of the company indicates whether there is a tendency to embrace environmental change in decisions and strategy that is informed through environmental training. Hutchinson (1996) and Baird and Henderson (2001) emphasised that creating an environmentally aware culture is an important business strategy to accomplish adaptable and sustainable business practices and behaviours. The responses (Figure 4) indicate strong agreement (96%) that mainstreaming environmental issues in business is a change to business as usual while 96% of respondents agreed to strongly agreed that their companies are adapting to this change accordingly. Further, 71% of respondents strongly agreed that leadership plays a strong role in promoting environmental issues in their companies. Fourie et al. (2012) emphasised that responsible leadership is critical to promote a learning culture in the workplace by encouraging skills development that gives employees the confidence to integrate environmental decisions in their daily work routines. As the respondents represented management level competencies, these responses also indicate their willingness to lead a decisive culture of environmental learning in their companies. The responses further showed a positive perception of the environment is being promoted in their business culture.
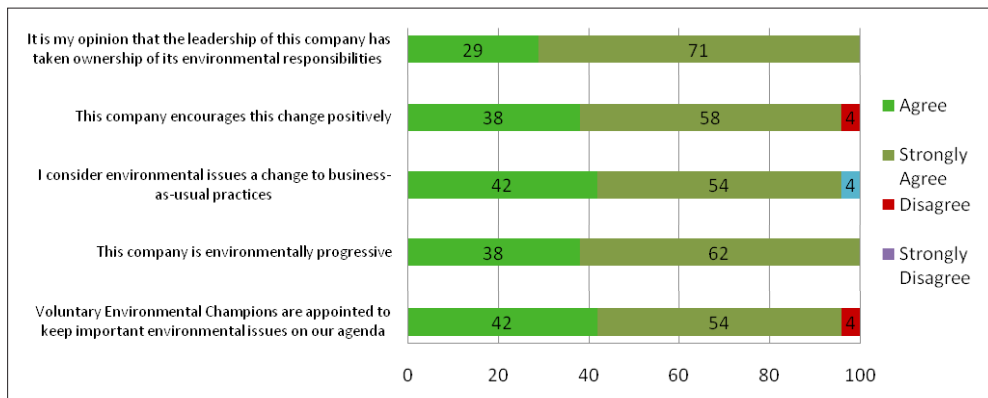
Figure 4 *Business respondents perceptions of environmental culture (%) (n=24)*

Proactive environmental strategies

Figure 5 shows awareness and level of agreement with implementation of proactive environmental strategies. These strategies are not end-of-pipe and part of an approach to environmental management that goes beyond compliance (Vidal-Salazar et al., 2012).

Respondents predominantly agreed (68%) that their companies were proactive in environmental management. Results revealed that environmental auditing (in keeping with the ISO 14001 prescription) and proactive resource planning are prioritised. Proactive resource planning includes reducing water use (79%) and energy consumption (83%). Environmental impacts appeared to be proactively managed as indicated by 88% who agreed that their companies have a waste recycling programme, use renewable energy (46%) and plan their energy consumption (71%).
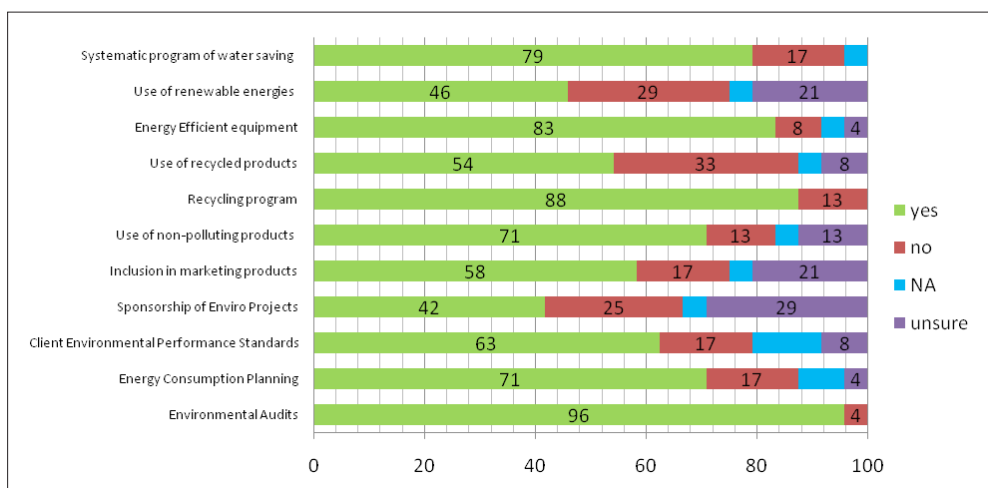
Figure 5 *Respondents' perceptions of implemented proactive strategies (%) (n=24)*

Environmental training: Commitment, resources and methods

Commitment to environmental training was indicated by frequency of training, resources committed in terms of cost and expertise as well as company-wide exposure to environmental training. Respondents predominantly agreed (83%) that environmental training is an important priority. The details of how this was prioritised are inferred from how training is conducted and what resources are committed to training.

Financial and human resource commitment for environmental training

While 83% of respondents asserted that environmental training was a priority, only 38% committed over R60 000 per annum to environmental training. The inability to confirm an environmental training budget by 37% of respondents indicates that budget allocations are not routinely prioritised for environmental training. There are no South African environmental training budget benchmarks; however, according to the National Skills Accord, companies should commit 1% to 5% of their annual payroll to skills development (Department of Economic Development, 2011). Considering the latter national impetus to develop environmental skills, a sizeable portion of this percentage for environmental training is justifiable. Given this, the training budget allocation of respondents is considered low.

Table 1 *Business respondents' environmental training budget per annum*

Training budget (R)	Percentage of frequency (n=24) %
0–20 000	17
20 000–40 000	4
40 000–60 000	4
Over 60 000	38
Unsure	37
Total	100

Frequency of training across the various tiers of company structure

There is a consistent call for all levels of an organisation to get involved in environmental training especially company leaders to motivate employees to embrace the changes and new paradigm of environmental sustainability (Kashmanian, Keenan & Wals, 2010; Sakr et al., 2010). The results show that there is an uneven frequency of training across the company tiers indicating that executive levels are undertaking training significantly less than the lower tiers of staff. Table 2 reveals the most frequent training duration reported by 31% of the respondents is 1 to 10 hours per annum.

Table 2 *Total collated responses for duration and frequency of undertaken training per annum*

Duration of training (hours/year)	1-10	10 -20	20-40	>80	None	As needed	No specific time	N/A	Total
Business responses (%)	31	8	6	5	6	25	11	8	100

However, 25% of respondents could not confirm the hours of training received by the different company tiers and indicated that training is attended as needed. Overall, the responses show that training occurs predominantly in under 80 hours/year.

It is apparent that training is most frequently attended by lower tiers of company structures. Respondents (67%) confirmed that factory level staff and temporary working staff have most frequently received training. Office workers are also reported by respondents (63%) to frequently attend training. A concerning trend shows that CEOs, CFOs and directors are reported to attend training least frequently (8 to 13%) (Figure 6).
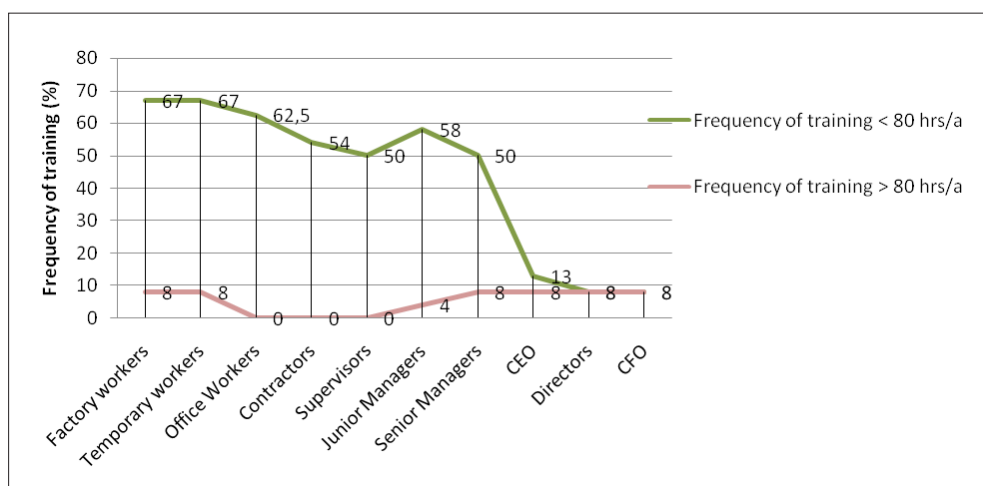
Figure 6 *Frequency of training per company tier*

Training methods

It is further important to assess the types of training methods frequently used to train the different tiers of the company structures. Figure 7 show the various training methods used across all the tiers with the exception of field trips which are used exclusively by supervisors, junior managers and senior managers. Correlating with the previous finding that factory and temporary workers undergo the most frequent training, these tiers also receive the highest frequency of onsite training and video training methods. Online training is used least frequently across all tiers; however, it is most prominently and equally used among the directors, CFOs,

and CEO tiers as shown by 23% frequency for each respectively. Furthermore, supervisors, junior managers and senior managers mostly received training via workshops, onsite training and through the use of company publications. Interestingly, the company tiers of CFO, CEO and directors are most commonly reported to not receive any environmental training via any of these methods as confirmed by 26%, 14% and 17% of respondents respectively.
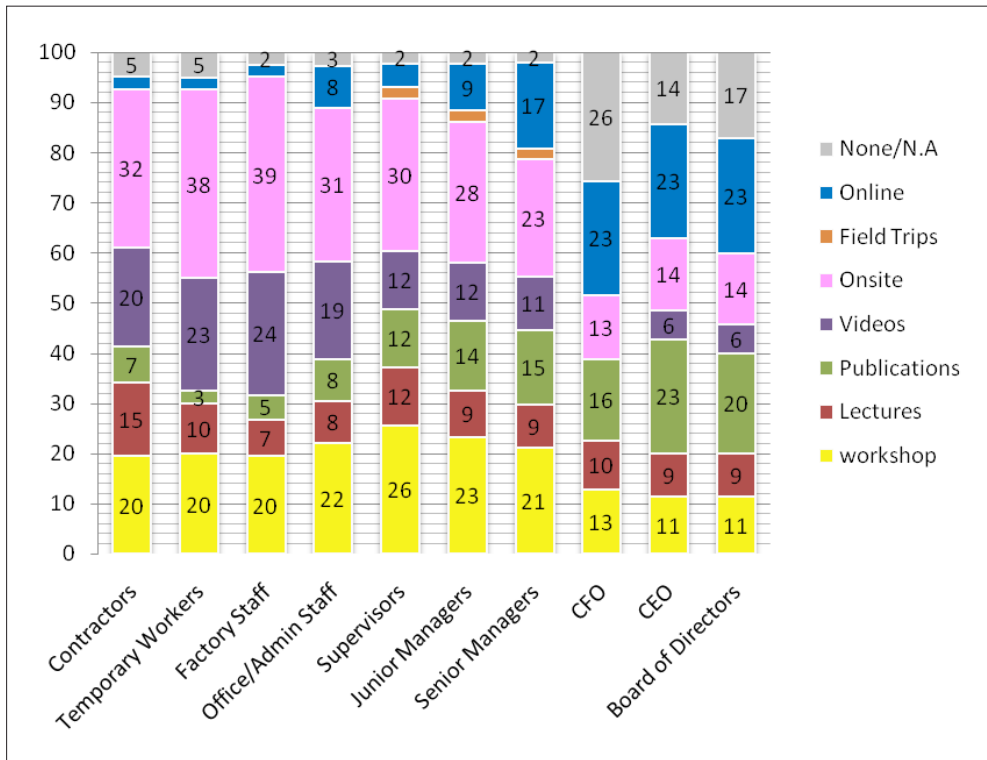
Figure 7 *Frequency of training methods used per company tier (%) (n=24)*

Environmental training topic coverage

One of the main goals of environmental training is to reduce environmental impacts of business operations by providing employees with the necessary skills to understand and reduce the company-specific environmental impacts (Jabbour, 2013). Figure 8 presents 14 environmental impact training topics. There are seven high frequency responses (over 90%) apparent for various impact training topics and these are ranked as follows: waste management, hazardous chemicals, general environmental awareness, energy efficiency, accident/spillage, water use and conservation and environmental legal liability and risk management. Waste management remains a topic covered most frequently as stated by 100% of respondents. This correlates positively with the results shown previously regarding proactive environmental strategies, which show the highest frequency of responses (88%) in accordance with an implemented

waste recycling programme. The least frequently reported (42%) environmental training received is production and manufacturing eco-efficiency. Incidentally, this was also the highest expressed need for further training by 50% of the respondents.

In terms of the respondents' need for environmental impact training, the findings also indicated the following training needs: environmental sustainability best practice in business (38%), environmental performance and systems training (29%), supply chain eco-efficiency (29%), emission permits (25%), and EIA and auditing methodologies (25%).
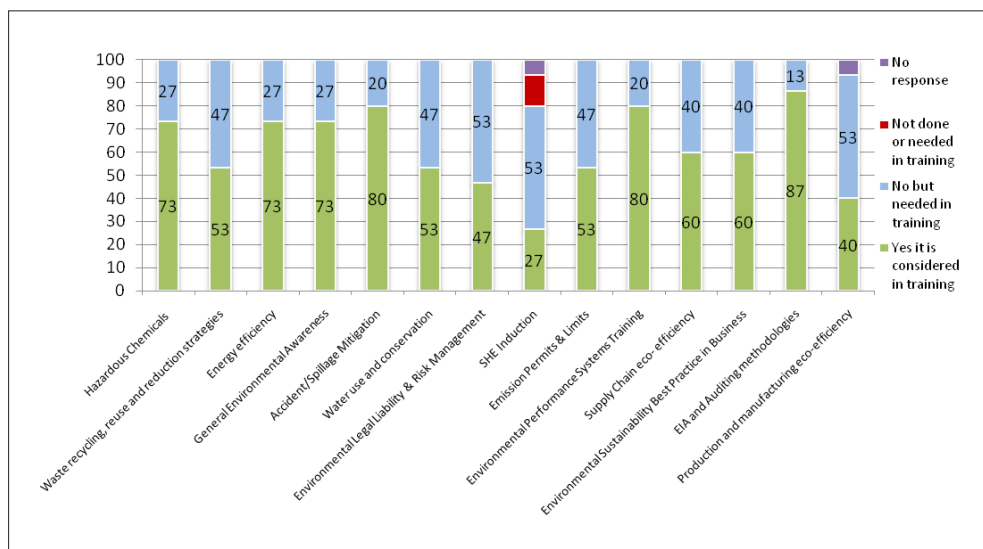
Figure 8 *Frequency of environmental training topics covered (%) (n=24)*

Environmental training methods and integration

It was important to explore the degree of integration of environmental training with other training needs as ISO 14001 EMS is commonly integrated with other Safety, Health, Environment and Quality (SHEQ) management systems (Table 3). The respondents predominantly agreed (66%) that environmental training was integrated with other training. Further, only 11% of respondents agreed that environmental training was offered as a separate course.

It is found that the integration of environmental priorities with other Safety and Health competencies is commonplace from the survey sample, indicating that these companies are challenged by the pressures to make their workplaces both safe and as environmentally compliant as possible. This sharing of training portfolios partly explains the low management and executive involvement in environmental training and inconsistently prioritised environmental training budgets. Prakash and Potoski (2006) confirmed the common practice of linking of Safety and Health with Environmental Management as this is considered a way of streamlining disparate management systems and resources such as is the case with ISO 14001 and ISO 9001.

Table 3 *Integration of environmental training*

Is environmental training conducted with other training? (%)				
	Yes	No	Sometimes	Total
Business respondents (n=24)	66	20	14	100
Responses on how training is conducted in relation to other training (%)				
	Business respondents (n=24)			
Part of SHEQ training	24			
Integrated with other training	18			
Part of induction training	29			
Part of Environmental Health training	18			
As a separate course	11			
Total (%)	100			

Impediments to environmental training

Impediments included management commitment and organisational cultures as well as the practicalities of cost, time and expertise in conducting environmental training. The impediments to training, though not exhaustive, give an indication of the potential for improvement of environmental training practices.

Figure 9 may reflect the respondents' optimism regarding their environmental training experience as there is a higher frequency of disagreement with the impediment statements than agreement. However, the highest response in agreement was 67% of respondents to the impediment statement 'require expert knowledge'. Another important impediment (71%) was 'high costs'. 'Difficulty in evaluating the outcomes' was also agreed to by 42% of respondents. These impediments were similarly identified by Vidal-Salazaret al. (2012), underscoring the role of training evaluation which increases the value perception of environmental training by managers, thereby allowing them to invest in environmental training more readily and confidently.

The statement 'too technical to understand' received the highest disagreement response of 83%. This indicates a general high level of understanding of environmental training content and a positive attitude towards learning new and likely unfamiliar environmental information.
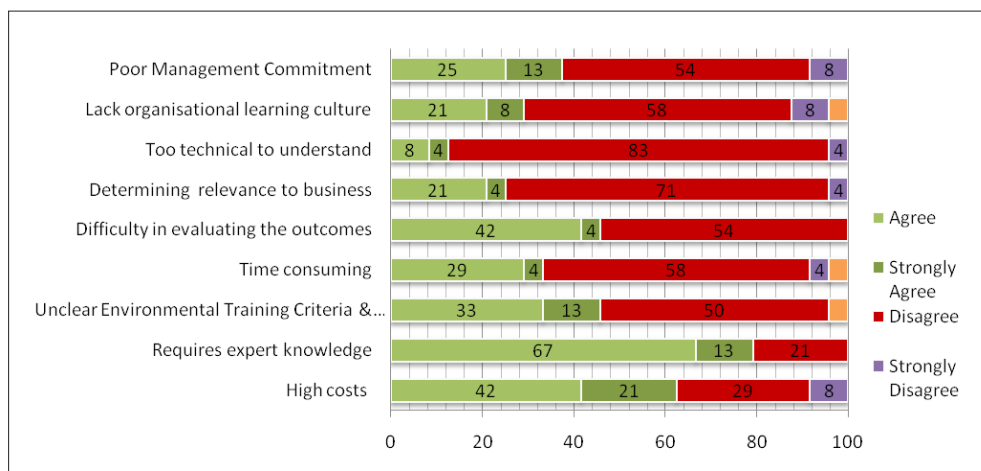
Figure 9 *Impediments to Environmental Training*

Discussion of findings

Extent of environmental training and awareness

The extent of environmental training within the businesses investigated was significant. Over 80% of respondents agreed to implement environmental training activities. Most of the respondents understood the role of ISO 14001 EMS in reducing environmental impacts and also indicated greater knowledge of their company's environmental policy. It is evident the ISO 14001 certified businesses in Durban prioritise environmental management and training competencies predominantly within the SHE and SHEQ occupational roles. There is a high level of commitment to training indicated, however the training frequency indicated by 50% of respondents confirmed predominantly one to two training courses are undertaken annually. Involvement of the executive tiers of organisation in environmental training is significantly lacking and there is a need to focus further attention in this area.

Positively, there was extensive topic coverage on environmental impacts. The focus of environmental training courses shows a particularly high focus on waste management. Other frequently reported training topics by 95% of respondents included hazardous chemicals and general environmental awareness.

Considering the extensive topic coverage, respondents indicated further relevant environmental training needs in production and manufacturing eco-efficiency. While environmental training is mostly integrated with other SHEQ training it does not appear to hinder relevant environmentally impact-focused training topics coverage as discussed in reference to findings in Figure 8. Bernstein (cited in Perron, Côté & Duffy, 2006, p. 553) argued there is a strong connection between change and employee participation where "managing change is impossible without employee participation … participation is impossible without understanding". Environmental training therefore presents the opportunity to operationalise the voluntary compliance effort across a company by raising environmental

awareness and skills of its workforces to effectually stay ahead of regulation requirements and reap the benefits of competitive advantage offered through environmental sustainability (Blackburn, 2008; Mammatt, 2012). However, what becomes critical is adapting the workforce to these changes, which present specific organisational challenges that are addressed within environmental training practices (Perron et al., 2006; Vidal-Salazar et al., 2012). Knowledge management and organisational learning are also interdisciplinary organisational discourses that influence environmental training (Vidal-Salazar et al., 2012).

Effectiveness of training activities

Vidal-Salazar et al. (2012) confirmed that effective training should fit with organisational goals and strategy. This is supported by the ISO standard where the environmental policy directs the aim of the training activities. Furthermore, effective training is ideally a company-wide activity and should be embraced in an organisational culture of learning. This is often best indicated by how widespread the environmental training reach is within a company. For example, the extent of proactive environmental strategy activities, in reducing water, energy and waste is significant in showing that training is contributing to increased environmental performance. This is supported by the purported benefits of ISO 14001 which are categorised broadly as environmental, reputational and organisational. The adoption and assimilation of ISO 14001 has been shown to correlate positively with environmental performance targets in managing air emissions, waste management and the use of resources, not surprisingly mediated through environmental training activities (Testa et al., 2014).

Further, all tiers of company structures were reportedly exposed to environmental training; however, the duration of the training was focused predominantly on the lower tiers of company structures such as factory, temporary and office staff. Middle management and business executives spend less time in environmental training. This may be problematic in sustaining long-term effectiveness of the training.

The impediments to environmental training indicate areas of improvement that can enhance the effectiveness of the activity. The impediments of high cost, for example, can be improved by greater buy-in from executive tiers in allocating more financial resources to environmental training. Lack of organisational culture was also frequently identified as an impediment, which indicates that environmental training has the potential to be more than a rubber-stamping exercise and can have far-reaching impacts in business operations. The effectiveness of training therefore can be seen as an area requiring greater organisational prioritisation from executive management. Importantly, the positive environmental attitudes and the proactive environmental strategy activities embraced by the respondents was an indication that improvements to environmental training activities are welcomed by managers.

There is an established link between top management commitment to company environmental issues and the allocation of sufficient resources to enable environmental performance (Tung et al., 2014). Researchers have indicated that financial commitment improves the chances of positive environmental performance and environmental training outcomes (Perron et al., 2006). However, environmental training can sometimes be falsely

perceived by managers as a risky investment compared to other training needs (Vidal-Salazar et al., 2012).

With reference to the conceptual framework for this research, the predominance of manufacturing business types in this sample confirms the prioritisation of implementation of ISO 14001 EMS. Similarly, this correlates with the eThekwini IDP which identified that the 22% provincial GDP contribution is supported through Durban's manufacturing activities located within the petroleum, fuel, rubber and chemical industries (eThekwini-Municipality, 2014, p. 30). As Van der Linde (2009) indicated, environmental impacts are stringently regulated specifically aimed at controlling emission and pollutants in industry. The focus on clean production and developing the requisite skills for this is indicated in these Durban sample results. This is similarly supported by Unnikrishnan and Hedge (2007, p. 428) who stated that "cleaner production requires new attitudes, knowledge and skills for all professionals to ensure that preventive environmental strategies are integrated into planning and development activities across society".

Conclusion

This paper reveals results on the environmental training activities in selected Durban businesses. Firstly, environmental training is promoted within ISO 14001 certified companies. While the extent of ISO 14001 certification in Durban companies appears limited, the extent of environmental training activities is significant within the organisations investigated. There is room for improvement, however there is sufficient progress shown in growing company cultures, attitudes and environmental training activities to conclude an effective training paradigm is present.

The findings confirmed that a range of environmental training practices are widely practised in the selected Durban businesses. The perception of management and employees positively link environmental training to improved environmental management and performance. However, the following needs for further improvement have been identified for the selected Durban businesses:

- Greater involvement of executive tiers of company structures in environmental training activities.
- Further training topic coverage in production and manufacturing eco-efficiency; environmental legal liability and risk management.
- Prioritisation of environmental training in financial budgeting allocation separate from other Safety and Health priorities.

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Percentage contribution

Areas of contribution	Author	Percentage contribution
Conception or design of the paper, theory or key argument	Sennoga	80 %
	Ahmed	20 %
Data collection	Sennoga	90 %
	Ahmed	10 %
Analysis and interpretation	Sennoga	80 %
	Ahmed	20 %
Drafting the paper	Sennoga	80 %
	Ahmed	20 %
Critical review of paper	Sennoga	70 %
	Ahmed	30 %

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Climate Responsive Innovation within the Agricultural Curriculum and Learning System

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Abstract

The purpose of this paper is to outline the climate responsive innovation process within the agricultural innovation system of the North West Province, South Africa. The focus was on the embedded curriculum and learning activity system and its responses to social-ecological and earth system changes influenced by climate change. It outlines the barriers and processes hampering curriculum and learning innovations towards climate-smart responsiveness, and also examines the processes required to initiate micro and macro innovations. This paper focusses on how actors within the system can initiate curriculum innovation and climate responsiveness through micro innovations when supported and how this can lead to macro innovations. The system experienced various barriers during the innovation process and overcame many challenges during the journey towards climate-smart responsiveness through the identification of contradictions within the system, developing tools to assist in the transitioning process and expansion in the social-spatial dimension by establishing a learning network within the surrounding communities. The research indicated that the catalysing of the curriculum and learning system required specific tools, time and the understanding of the importance of micro-level innovation.

Keywords: *curriculum innovation; climate-smart agriculture; agricultural training institutes*

Introduction

This paper explores the types of innovation and significant innovation processes associated with development of the seemingly abstract 'climate-smart agriculture' concept into a concrete curriculum-incorporated approach. This paper is part of a study that emerged during a time when the agricultural training institutes of the North West Province, South Africa, were striving towards new solutions in response to climate change and inclusion of climate-smart agriculture within the agricultural strategic plan of the province. The North West Department of Rural, Environmental and Agricultural Development (READ) stated in its 2014/2015 Annual Report that climate-smart agricultural systems need to be promoted within the province (READ, 2015, p. 82). This was to be undertaken through curriculum innovation and alignment of the teaching and learning practices within the wider Agricultural Innovation System (see Figure 1). However, the approach was not fully conceptualised. Related

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discussions and strategic plans were in place but only at a provincial level, while no clear plan for educational integration was yet established. The Department of Agriculture (DoA, 2008, p. 16) recommended that the agricultural training institutes develop specialist knowledge relevant to local farming practices. What is not included in these recommendations is what support should be provided to the training institutes for cross-cutting issues such as climate change responsiveness including the climate-smart agriculture approach, and how they manifest in the areas of specialisation in the training institutes (DoA, 2005a, p. 5; Department of Agriculuture and Fisheries (DAF), 2008, pp. 107-116; Department of Agriculture, Forestry and Fisheries (DAFF) 2010, pp. 31-35).

Taung Agricultural College (TAC) realised that the agricultural system had evolved new training needs shifting towards climate-smart agriculture (Serage, 2015). This responsive approach was then identified by the College as a means to address agricultural problems such as climate change adaptation, water scarcity, poverty and food insecurity, within the curriculum. However, the process was only in the concept phase and the implementation process was unclear. The concern for change and alignment was an opportunity for formative intervention research to support the training institute's staff during the curriculum and learning innovation process.

At the beginning of this study, 2015, there was little evidence of any formal integration of climate-smart agriculture into the agricultural training institutes' curricula (DAF, 2008, pp. 107-116; Potchefstroom College of Agriculture (PCA), 2009, pp. 5-29; DAFF, 2010, pp. 17-19; TAC, 2014a, pp. 10-54). However, some of the recommended climate-smart responsive topics were included as part of a subject or as an informal practical component within the national diploma. climate-smart agriculture topics recommended for integration into the agriculture curricula included climate change, principles of climate-smart agriculture, rural health creation, food security, sustainable agricultural practices, renewable energy and energy management, agro-forestry, soil and water management, sustainable irrigation systems, sustainable crop and livestock production, and rain water harvesting and conservation practices (DAF, 2008, pp. 107-116; DAFF, 2010, pp. 31-35; Food and Agriculture Organisation (FAO), 2013, pp. 27).

This paper will show that curriculum innovation towards climate responsiveness is a specialised process. It requires specialist research support while taking into consideration the agricultural innovation system and how the system is structured. This study was initiated as a doctoral thesis, but the research continued thereafter and formed part of the Amanzi [Water] for Food Project (WRC Project No. K5/2271) supported by the Environmental Learning Research Centre (ELRC) of Rhodes University and the Water Research Commission. The project implements a course-activated social learning network approach, which focusses on knowledge dissemination of sustainable water use and food security within the agricultural learning system (Lotz-Sisitka et al., 2016, p. 1).

Initiating innovation within a stable system, in theory, should be relatively easy. However, studies have shown that often innovation is not a straightforward process (Chakeredza et al., 2009; DAFF, 2010; Agbedahin, 2016; Engeström, 2016). This paper outlines how Taung Agricultural College worked with challenges during their journey towards climate-smart

responsiveness through the identification of contradictions within the system, developing tools to assist in the transitioning process and expansion into the social-spatial dimension by establishing a learning network within the surrounding communities.

Theoretical framework

A theoretical framework founded on systems thinking was developed to support the research on systems innovation and the process of implementing climate responsive policies to initiate climate-smart innovations in the curriculum and learning practices. An innovation system is structured by the actors involved in the process of innovation. The behaviours, practices and values of these actors are shaped through their engagements and actions within the system's socio-economic environment (Spielman, Ekboir & Davis, 2009). An innovation system is defined by the generating of new knowledge, interactive learning and the sharing of knowledge. Innovation and learning have always been part of agricultural practices. An Agricultural Innovation Systems framework was developed to facilitate these processes, joining various sub-systems within the agricultural sector as actors participating in the larger organisational learning processes (Spielman et al., 2009). This framework focusses on behaviours and practices that influence institutional innovation (Sumberg, 2005).

By means of this framework, the innovation process was perceived as the outcome of collaboration between actors, or agents, within the agricultural system. Actors exchange information and learning processes as part of engaging with climate-smart agricultural knowledge. Through the Innovation Systems framework, the iterative research process could support and track the innovation process and the emerging complexities of systems innovation.

Cultural Historical Activity Theory (CHAT) elaborates the application of system thinking approach and it was applied to support the research into curriculum and learning innovation. The theoretical framework enabled the research participants to review the context, identify matters of concern and contradictions and to initiate change before examining how their initiatives were developing an expansive learning and innovation process within the system. Cultural Historical Activity Theory is based on Vygotsky's theory of learning and development (Vygotsky, 1978, p. 40) which the researcher drew on to understand knowledge building and innovation developing around contradictions. This provided a perspective for examining and discussing opposing ideas to find a solution while studying the relationships between cause and effect within the system (Engeström, 1987, pp. 188-201).

The first generation of Cultural Historical Activity Theory is based on Vygotsky's concept of mediated action as the unit of analysis and focused on individual or singular activity systems (Zinchenkon, 1985 cited in Engeström, 2016). This study focused on the third generation activity system approach that is centred on social transformation. It incorporates the system structure within a wider range of system interactions analysis, considering the conflicting nature of social practice. Through Engeström's approach, the researcher and participants could identify the complexities, tensions and contradictions outlined through mirror data within the system, but also between their activity system and other activity systems located within the

wider agricultural innovation system in which they were embedded (see Figure 1; Engeström, 1999, pp. 25, 30).

Margaret Archer's morphogenic social theory (Archer, 1995) provided a valuable lens through which to study innovation from a transformative change perspective. The theory orientated the study to the central problems and challenges surrounding curriculum alignment within the provincial system and the integration of climate-smart agriculture. Sayer (2000, p. 11) noted that the morphogenic framework is a good complementary framework to support social theories such as Cultural Historical Activity Theory. Both theories make an important contribution to the understanding of relationships between the individual and the system. Through the complementary theoretical approach, the study could isolate and identify the activity system work while also analysing the agency-led change. Thus, the theoretical approach enabled the researcher and participants to explore the key research question:

How can college staff involved in the offering of the National Diploma in Agriculture engage through formative intervention to explore practical options for curriculum innovation utilising climate-smart agriculture as a mediating tool?

Methodology

Between 2015 and 2019 a total of 27 staff members from Taung Agricultural College participated in this study. If participating staff members relocated, the newly appointed staff joined the study. A case-study research design (Yin, 2003) was adopted as this allowed for in-depth investigation, identification and exploration of the initial, transitioning and existing curriculum situations, while uncovering contradictions and possible expansions towards a climate-smart responsive curriculum. The research design also allowed for the determination of the transformation challenges within the agriculture curriculum and learning innovation process.

The project was initiated when the Director of READ, Mr Serage at that time, approached the researcher during an Amanzi [water] for Food related interview about providing support during the curriculum innovation process towards climate change integration within the agricultural training institutes, also known as colleges in South Africa (Serage, 2015). The researcher started working with college staff to compile a contextual profile. Through a systems approach, the contextual profile reflected a clear picture of the complexity of the North West Province agricultural innovation system (see Figure 1). The research participants interviewed identified the need for institutional realignment and curriculum innovation due to the recent changes within the system.

The identified need for alignment and innovation led to the decision to invite all the lecturers and those involved in management of the agricultural training institutes' curriculum and learning practices within the North West Province to a meeting to discuss climate change challenges and curriculum innovation solutions. The preliminary consultative workshop was conducted at Potchefstroom College and 26 lecturers and representatives of the management team from Potchefstroom College of Agriculture and Taung Agricultural College attended.

The aim of the workshop was to orientate participants to the central problems and challenges surrounding the curriculum alignment with the provincial policies and the possible integration of climate-smart practices within the curriculum.

Through questions and discussion, the participants brought their own experiences into the conversation and collaboratively reviewed, analysed and developed a picture of each college's specific National Diploma curriculum. Together, participants explored how the curriculum was operating and considered what needed to be changed and updated. This allowed them to become aware of problematic aspects and challenges associated with moving towards a climate-smart informed and responsive curriculum, as well as to consider curriculum and learning innovations. A three-day curriculum innovation workshop was held at Rhodes University as part of the Amanzi for Food programme and representatives of both colleges attended, thereby initiating the formative intervention process.

Formative intervention research took the form of tracking and iterative innovation support at Taung Agricultural College. It consisted of intervention-innovation workshops with expansive learning cycles of reflexive innovation. The workshops took a format adapted from the expansive learning process. Each workshop initiated the questioning phase of the expansive learning cycle with participants working with mirror data to question, examine and identify problems within their systemic practices. Participants continued to discuss progress and during each intervention-innovation workshop, they questioned and analysed the system, surfaced contradictions within the system, and mediated an intervention plan towards developing a responsive climate-smart system. Tools developed to assist the innovation process included rainwater harvesting and conservation techniques as a practical component of climate-smart agriculture and curriculum review tools to track the integration of climate-smart agriculture into the curriculum and specific subjects (van Staden, O'Donoghue & Lotz-Sisitka, 2018, p. 4). Through the formative intervention process (from 2016 to the beginning of 2018), an understanding of the challenges hampering innovation and identification of the innovative processes that led to change during a time of institutional flux were identified.

The feedback process including the identification of the challenges and limitations towards a climate responsive curriculum allowed the agricultural training institute to reflect and build successfully on their progress during 2018 and 2019. An Amanzi for Food workshop held in October 2018 was attended by 22 students and lecturers and many enrolled in a training (level NQF 6) course to access research material on rainwater harvesting and conservation information through Rhodes University and community project networks were built during this time.

Results

The review and tracking of the supportive innovation process enabled the research participants to shape a picture of the complexities of systems innovation and challenges of the transitioning process to a Climate-Smart responsive system. The Cultural Historical Activity Theory approach allowed the research and research participants to map out the Agricultural Training Institute as a curriculum and learning activity system undergoing Climate-Smart

curriculum innovation. The curriculum and learning activity system, Figure 2, is embedded in the Agricultural Innovation System of the North West Province. Figure 1 illustrates the Agricultural Innovation System of the North West Province indicating the system drivers, stakeholders and the sub-systems. The system drivers and responses affect the functioning of the curriculum and learning system. In this context, Chakeredza, Temu, Yaye, Mukingwa and Saka (2009) argued that the educational system is the foundation of society's responsive knowledge, competencies and the future ability to cope with social and environmental challenges. The curriculum and learning system, as seen in this study, play a key role in responding to the complex web of issues surrounding climate change responsiveness.
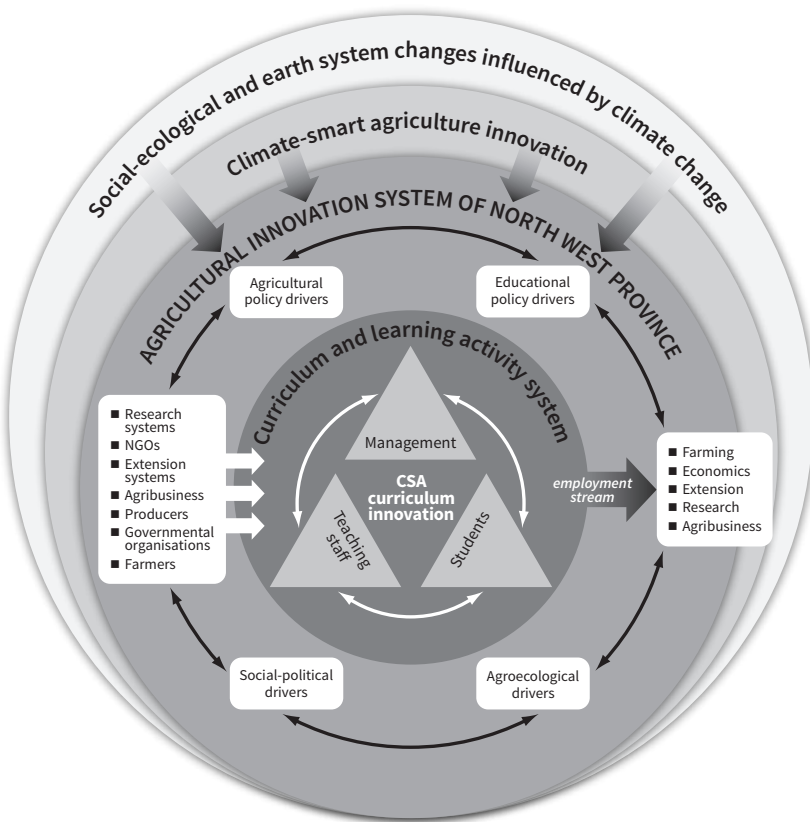
Figure 1 *The Agricultural Innovation System of the North West Province, South Africa* (adapted for this study from Aerni, Nichterlein, Rudgard & Sannino, 2015, p. 834)

Figure 2 represents the curriculum and learning activity system embedded within the Agriculture Innovation System without details of history, culture, contradictions or boundary crossings based on second generation Cultural-Historical Activity System as the primary unit of analysis. A clear picture of the system was developed with the help of the research participants during the study to assist with its analysis.

Instruments:
Infrastructure and facilities. Prospectus. Curriculum content. Practical and learning sites. CSA concepts. Curriculum Innovation Tool. Hartswater Irrigation Scheme.

Outcome:
Graduates become valuable components specialising in irrigation within the AIS as farmers, entrepreneurs, extension officers, researchers, educators and working in the Agribusiness sector.

Graduates equipped with skills and competencies required by the Agricultural Sector specialising in irrigation.

Object

Division of labour:
Lecturers innovate and adapt curriculum to needs of students. Students learn and acquire skills. Farm managers provide practical sessions for students. Students are assessed.

Community:
College staff not participating in research. Students. Hartswater Irrigation Scheme. Agricor. Commercial farmers. Small-scale farmers. Farming community. Extension services.

Rules:
Syllabus of the Diploma in Irrigation. Regulatory policies and institutions, such as Agriculture Education and Training Strategy, AgriSETA Norms and Standards, and North West Agriculture Strategic Plan.

Figure 2 *Taung Agricultural College Curriculum and learning activity system seen as part of the North West Agricultural Innovation System depicted in Figure 1*

During the study, reflexive tools were developed that aided lecturers and management in reviewing the Climate-Smart responsiveness of their curriculum (Van Staden, O'Donoghue, Lotz-Sisitka, 2018, pp. 7-9). Rainwater harvesting and conservation practices were utilised as a practical component of climate-smart agriculture and a way to implement this concept (Lotz-Sisitka et al., 2016, pp. 69-72). These tools were also utilised to analyse the relationship between transformative learning and transformative agency. Thus, the tool was not only used to support the expansive learning cycles, but also to track innovation and emergence of transformative agency. Through this analysis, the research participants could surface and examine the tensions and contradictions within the system. This in turn enabled the innovation process. These contradictions are listed in Table 1 with the associated drivers of innovation, absences, modelled outcomes, tools developed to assist in the innovation process and the innovations themselves. The micro innovations are based on individual innovations, macro innovations that are institutional and network-based innovations.

Table 1 *Key findings: Iterative curriculum innovation*

Curriculum and learning system drivers (Figure 1)	Shift or change in driver	Contradiction	Revised outcome (new solution)	Tools developed and used in innovation process	Micro processes of innovations by individuals	Macro processes of innovations by the group, network or institution
Agricultural policy driver Agro-ecological driver	Climate-smart agriculture adapted at policy level as a responsive approach to climate change challenges	Climate-smart agriculture as an abstract concept versus climate-smart agriculture as a climate responsive curriculum process	Develop climate responsive curriculum and learning practices. Develop lecturers' climate responsive knowledge and practical competences	▪ Climate-smart innovation tool – curriculum review tool ▪ Online climate-smart innovation tools ▪ Applying RWH&C as a practical component of climate-smart responsive-ness	Lecturers utilised the curriculum review tool for self-evaluation of climate-smart responsive-ness. Incorporate RWH&C practices in practical student assignment	Lecturers completed a Amanzi for Food course (Level NQF 6) using RWH&C material. Lecturers graduating in 2019
Social-political drivers	National diploma, student purpose and career needs are not aligned	Student aspirations and purpose of the programme and lecturers' development of the programme	Incorporate climate-smart topics such as food security, homestead gardening, small-scale farming, entrepreneur-ship, gender equity and poverty eradication	RWH&C practices included in teaching programme. Teaching garden development of network to ensure needs of sector are always clear and up to date.	Starting community-based projects with students	Students were invited to attend the RWH&C workshop and students completed a Amanzi for Food course (Level NQF 6)
Agriculture and educational policy driver Agro-ecological drivers	College practices and policies need to reflect climate responsive and environ-mentally friendly approaches	College management practices versus the practical application of climate-smart initiatives within these practices	Make campus a green campus with climate responsive and environ-mentally friendly practices on campus including hostels and gardens	RWH&C techniques Climate-smart innovation Online management review tool Development of a teaching garden	Green campus initiative	Teaching gardens were developed to 'practise what we preach'. Rainwater harvesting on campus

Curriculum and learning system drivers (Figure 1)	Shift or change in driver	Contradiction	Revised outcome (new solution)	Tools developed and used in innovation process	Micro processes of innovations by individuals	Macro processes of innovations by the group, network or institution
Social-political drivers Agricultural drivers	Need for more practical component in curriculum	Demands of the academic programme versus inclusion of relevant practical components	Focus more on practical components and allow students to be more hands on	Using RWH&C techniques in practical classes Referring to teaching garden	RWH&C practical projects developed on campus. Student project planning a garden using RWH&C techniques	Students are involved in the Amanzi for Food project on campus
Agriculture and educational policy drivers Drivers influenced by climate change	System required the curriculum and learning practices to support adaptive change to the climate-smart responsive approach with a solid relevant object and outcomes.	Current state of flux: institutional development versus institutional innovation	Policy shift to include climate responsive practices. Integration of climate-smart responsive topics into the curriculum.	Online climate-smart innovation tool – Management	Integration of climate-smart responsive topics into curriculum	Training of staff in climate-responsive agricultural practices Development of a social learning network within the Taung irrigation area

The contradictions contribute to enabling the innovation process (see Table 1). However, the continued modelling of the activity system allowed the research participants to discuss the barriers hampering innovation. This initiated an analysis of the barriers to innovation within different levels of the curriculum and learning practices at provincial levels. Some of these barriers are discussed below.

Challenges to and opportunities for innovation

Policy and practice (Table 1, Section 1)

The innovation pathway of the system was influenced by the policy shift within the Agricultural Education and Strategic plan in order to move from the almost exclusive focus on commercial agriculture to a more rural development and poverty eradication orientation (see Figure 1; DoA, 2005a, 2005b; AgriSETA, 2014; READ, 2015). At the provincial level, policies are in place. However, implementation of these policies at a sub-system level is not clear. Even though the research participants were initiated and actively engaged in the process of climate-smart innovation, the means for adequate alignment at policy level were unclear (see contradiction 1 in Table 1). The online climate-smart innovation tool, policy (van Staden, 2018) was developed during the innovation process to assist.

Innovation and development of learning networks within an institution in flux

It was noted that the college activity system is undergoing both structural change (an anticipated change from agricultural college to agricultural training institute) and rule change (the policy shift to include climate-smart agriculture as a climate response) which affected the character and relevance of the object of the system. The system required the curriculum and learning practices to support adaptive change to the climate-smart responsive approach with a solid relevant object and outcomes. The proposed object of innovation stood in contrast with the existing ways of developing curriculum in an institutional context that was in continuous flux. The activity system had undergone various changes in the last five years. The entire national diploma programme changed in 2014. The North West Agricultural Strategic Plan introduced new strategies and policies that required implementation and adaptation in all sub-systems across the provincial Agricultural System. The head of campus has changed three times since 2013 (TAC, 2014b, p. 3) and the principal of the agricultural training institutes in the North West was replaced in 2017. Many staff changes occurred (six new lecturers joined the team in 2017) during the study.

The institutional changes have created a situation of flux so synergies and coordination are essential between the provincial imperative to innovate climate-smart approaches and the college-based imperative to adapt to a climate-smart curriculum. These changes in the management and academic staff made following the initial innovation plan developed by the research participants difficult, thus affecting the ability of the system to function and strive towards innovation. Innovation firstly occurred at a micro level. For example, through the development of the climate-smart review tool, the lecturers developed a better understanding of the value of climate responsive competencies and concepts. They were able to see the application of climate responsive concepts within their field of expertise. However, as the situation stabilised, more people became actively involved in the project, and as time passed, innovation occurred at a macro level with the development of a social learning network and online innovation mediating tools (see contradiction 5 in Table 1).

Taung Agricultural College was utilised as an agricultural learning site to establish a social learning network to ensure knowledge dissemination within the agricultural community. Social media groups were also established to assist and share knowledge between the college and other community members. The aim of establishing a learning network was to connect people and organisations within the Taung and Hartswater irrigation scheme to make climate responsive information more accessible to encourage the use of information in a collaborative way. The learning network supported the establishment and use of demonstration sites and activities within Taung Agricultural College.

Knowledge and competencies of actors within the system

Over the years, the needs within the curriculum have developed and changed. For the implementation of new knowledge and practice within the curriculum and learning practices, the educators within the system need to be trained in the new learning and teaching topics and practices (DoA, 2005a, 2005b; DAF, 2008, pp. 107-116). The academic staff do not always

have access to or time for the new agricultural developments and research, as the colleges are not research institutes. Newly appointed staff do not necessarily have an academic background in agriculture nor practical experience, a finding also reported in the Eastern Cape, especially when it comes to new areas of study that have not previously been included in the agricultural college curricula, such as rainwater harvesting and conservation practices (Lotz-Sisitka et al., 2016, pp. 69-72) and climate change. To observe transformative agency processes in learning, agents need to be fully engaged in the action of learning (Archer, 1995). However, if the lecturers and curriculum developers do not have the necessary competencies, knowledge and tools, transformative agency to initiate innovation towards a climate-smart system is not possible or at best very difficult, as also reported in studies on sustainability in Higher Education by Togo (2009, pp. 128-143) and Agbedahin (2016, p. 178). In such a context, professional development programmes for academics become extremely important, but there are often too few, especially in new areas of study such as climate-smart agriculture. As time continued, research participants utilised the climate-smart innovation tools to review their own climate-smart responsiveness and this assisted in knowledge dissemination (van Staden, O'Donoghue, Lotz-Sisitka, 2018, pp. 4-9). A long ongoing knowledge and competency innovation process extended 2015 to 2019. This included 22 lecturers and students attending the Amanzi for Food Training of Trainers course focused on the access to and use of information on rainwater harvesting and conservation in a number of publications, and an introduction to climate-smart agriculture in October 2018. Three of these participants achieved Rhodes University NQF level 6 certificates and six participants achieved NQF level 5 certificates in May 2019. In 2018, rainwater harvesting and conservation practical projects became part of the student curriculum. In 2019, a teaching garden was established where rainwater harvesting and conservation methods were implemented by the students.

Time and space configuration

Lack of time was identified as one of the most central constraints in determining the curriculum innovation and integration of climate-smart responsive concepts. At the beginning of the study, lecturers indicated that they did not have time to incorporate the practical side of climate-smart agriculture such as rainwater harvesting and conservation practices into the curriculum. A key and repeated issue raised across this study was that there was not enough time for students to master the practical techniques and understand other practical aspects in an already overloaded timetable (see contradiction 4, Table 1). This is also reported in other agricultural education contexts (DAF, 2008; DAFF, 2010; Lotz-Sisitka et al., 2016; ASSAf, 2017). Time was also needed for micro innovations to lead to macro innovations (see Table 1).

Discussion: Process of innovation

Through interaction with the research participants during workshops, interviews and informal feedback discussions, it became clear that to integrate a climate-smart approach into the system is a challenging process. The implementation of innovative practices did not occur as quickly as expected due to a combination of structural and institutional historical and cultural

factors, reflecting the complex process of agentive action described by Archer (1995). This study demonstrated why it takes time to change attitudes regarding the incorporation of climate-smart responsive components into the curriculum (see Table 1). It takes time to build relationships with communities and to participate in community projects. It takes time to incorporate the concepts and competencies into the curriculum and it takes time to train the trainers to incorporate the concepts into the curriculum (see Table 1).

Mukute's (2010) research showed that micro innovations are important 'steps' on the pathway to transformative agency and with continued support over longer periods of change, more complex forms of change can occur. The Eastern Cape Amanzi for Food case study began to show more substantive institution level impacts in terms of curriculum innovation and practice in the fourth year of its implementation, having started with the smaller steps found in this study's expansive learning process (Pesanayi, 2018).

Thus, expansive learning processes allowed the research participants within a system of institutional flux to analyse the system and model solutions. They allowed the research to focus on long-term change and micro innovations regarding knowledge engagement, network building and tool development instead of focussing on institutional change at a macro level (see Table 1). They allowed the workshop participants to focus on what they could change, how they could develop their own competencies and how to work around the continuous changes towards macro innovations. Through this, macro innovations occurred in the fourth and fifth year of the process (see Table 1).

The research indicated through the expansive learning cycles that catalysing the curriculum and learning system required specific tools, time, development of social learning networks and the understanding of the importance of micro-level innovation (see Table 1). Thus, in a fluid context, support of the innovation process should focus on developing tools and should provide sufficient time for developing and implementation of innovation plans at a micro-level as an important starting point for more macro-level changes that occur over longer time periods (Table 1).

Conclusion

Micro innovation was more likely to take place than institutional change within the curriculum and learning system and, as shown in this research, this process required substantive support and ongoing reflexive engagement. Thus, while people are part of society and ideologically framed concepts such as climate-smart agriculture within an agricultural innovation system are part of this reality, people also need to initiate their own individual innovations within the system to make sense of these wider concepts and benchmarks (Popkewitz, 2017). Archer (2007) suggested that structures cannot be reflexive per se, arguing that reflexivity is a property of humans not structures. Even though the curriculum review tool (climate-smart innovation tool) and the use of the practical component of rainwater harvesting and conservation supported the research participants during the curriculum innovation process, it was the gradual learning, reflexivity and emergent agency of the participants that led to the innovation beginning to happen or to be realised in practice. It is important to realise the power of the individual agent (Archer, 2007,

p. 38) but it is also important to note Agbedahin's (2016, p. 178) finding that while innovations are linked to individual agents, innovation is less likely to be initiated and sustained without the necessary support from the institution and society. The development of a social learning network is essential to create a supportive system. The established social network strengthened the climate responsive learning and teaching practices within the system.

It is evident that to initiate institutional change, the agents need to be supported by management and other institutional structures in striving towards change. Through the analysis of the data, it has become clear that specialised support is required for any innovation processes within the curriculum and learning system during a time of institutional flux. This study showed that a climate-smart agriculture approach can be a functional response to climate change and can lead to engagement within the agricultural curriculum and learning system.

Catalysing innovation within the curriculum and learning system requires specific tools. These tools were, in this case, a curriculum review tool; climate responsive practical applications such as rainwater harvesting and conservation practices; time (the study started in 2015 and was ongoing in 2019); and, the understanding of the importance of micro-level innovation to initiate actual change at a macro level. Thus, even though the systems thinking approach provides a functional framework to support innovation, the agents (individuals) within the system also need to be recognised and supported for innovation to occur. The development of a social learning network is an important step towards innovation.

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Education in Times of COVID-19: Looking for Silver Linings in Southern Africa's Educational Responses

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Abstract

Coronavirus Disease 2019 (COVID-19) has disrupted socio-economic activities, including formal and non-formal education, across the world at lightning speed. By mid-April 2020, it had interrupted the formal education of nearly 1.6 billion students in 192 countries. COVID-19's disruption of education in Africa, and especially in southern Africa, has been severe for several reasons. However, educational responses to COVID-19 suggest that it has stimulated the appetite for developing educational innovations – silver linings to the COVID-19 cloud. This paper is based on interviews conducted with 56 parents, students and educators involved in formal and non-formal education in Botswana, Malawi, Namibia, South Africa, Zambia and Zimbabwe. We identified the main educational challenges in these countries as being concerned with adapting to: (i) online education and learning, (ii) continuity of education from home, and (iii) community-based learning in small groups. The silver linings that we identified are: (i) putting greater emphasis on finding context-specific solutions to education and health problems (improvisation), which is important for educational relevance and reveals the value of local actors, (ii) making linkages between social and ecological systems clearer, which is making the value of education for sustainable development (ESD) in this century more explicit, and (iii) revealing structural inequality and justice issues in education, which draws attention to the need for urgently addressing them as part of transformative change in education and sustainable development.

Keywords: *COVID-19, southern Africa, educational responses, transformative change, education for sustainable development*

Introduction

The emergence and rapid spread of the novel coronavirus disease 2019 (COVID-19) has disrupted education systems in southern Africa and beyond. By mid-April it had interrupted the school, college and university-based learning of nearly 1.58 billion students, comprising about 91.4 % of the world's enrolled learners in 192 countries (UNESCO, 2000a). In Africa, 262.5 million pre-primary and secondary school children, about 21.5% of the continent's population, are out of school because of COVID-19-related school closures (Save the Children, 2020). Consequently, the pandemic has affected students' rights to quality, safe

and inclusive education and social engagement with peers and educators (INEE, 2020; UN-Zimbabwe, 2020).

In Africa, COVID-19's most consequential impacts on education have been identified as the widening of inequalities, increase in marginalisation, and the inability of the most disadvantaged students to pursue their studies and acquire knowledge and skills that support a healthy transition to adulthood (UN, 2020; UNDP, 2020; UNESCO IESALC, 2020). The most affected students include those whose foundational learning was not strong: girls, children and youth with disabilities, and refugee, migrant and displaced children (Education Cannot Wait, 2020; Save the Children, 2020). In southern Africa, where we conducted this research, digital learning challenges are more acute in rural communities with low levels of material resources, lack of internet infrastructure and information and communications technology (ICT) illiteracy.

Many educational responses, which include virtual and traditional forms of learning, are being developed. For example, the Southern African Development Community (SADC) and the United Nations Education, Scientific, and Cultural Organisation (UNESCO) have entered into an agreement to ensure that 'Learning-Never-Stops' in the 16 SADC member states. Under the agreement, SADC countries will be assisted to mobilise resources, implement context appropriate and equitable solutions on distance education and learning remotely (SADC & UNESCO, 2020). SADC member states, including Botswana, Malawi, Namibia, South Africa and Zimbabwe, have developed Education Sector COVID-19 Response plans or strategies. In general, a phased educational response to COVID-19 has been adopted: (i) continue to provide education through distance learning during the pandemic, (ii) re-open the schools and resume face-to-face teaching when the pandemic is over, and (iii) restructure the organisation of teaching and learning to benefit from the lessons learnt in the first phase, especially concerning quality of services and equity (UNESCO IESALC, 2020). In line with this phased approach, the Zimbabwe Education Cluster COVID-19 Preparedness and Response Strategy (2020) has the following objectives, to:

- Ensure continuity of learning through the implementation of key activities aimed at quality of learning and well-being of teachers, learners and school communities during the COVID-19 emergency;
- Support teachers, learners and school communities to prevent the transmission and spread of COVID-19;
- Facilitate the safe return to quality learning for teachers, learners and school communities after the COVID-19 emergency (Zimbabwe Education Cluster, 2020, p. 3).

The response plan, which is similar to those across the SADC region, appears to be anchored in strengthening linkages between the school and its community, formal and non-formal education, as well as tackling COVID-19 as a health issue with serious educational repercussions. Against this background, this paper seeks to: (i) surface the educational challenges being faced in southern Africa; (ii) highlight some of the context-appropriate

innovations; and (iii) reveal the silver linings for education researchers, educators and education evaluators. Our third objective was inspired by Allen, Rowan and Singh (2020) who said: "We are in this together, this just might generate one of the silver linings that emerges from the current crisis – a reconnection with those around us and a stronger sense of shared empathy and kindness for one another, as well as a greater appreciation for our beautiful planet" (p. 233).

Methods

In order to address the objectives of this paper, we conducted interviews, made observations of relevant developments in and around our respective communities, and analysed relevant documents. We interviewed a total of 56 people comprising primary and secondary school students, parents with children in schools or colleges, and teachers. The detailed composition of the interviewees can be found in Table 1 below. The interviews were conducted online, by phone or using WhatsApp voice notes (if the signal was a problem) with interviewees based in Botswana, Malawi, Namibia, South Africa, Zambia and Zimbabwe.

Table 1: *Interviewees who participated in the study*

	Parents	Primary & secondary school students	Tertiary students	Primary & secondary school educators	Youth who completed matriculation	Tertiary educators	Non-formal educators	Totals
Botswana	1	1	1	1	0	1	0	5
Malawi	0	6	6	2	0	1	0	15
Namibia	1	0	2	2	0	1	0	6
South Africa	4	3	0	2	2	0	4	15
Zambia	0	0	0	0	0	0	1	1
Zimbabwe	5	1	3	1	0	2	2	14
Totals	**11**	**11**	**12**	**8**	**2**	**5**	**7**	**56**

All interviewees responded to the following four core questions:

1. What educational challenges are you facing as a result of COVID-19 and its impacts?
2. What explanations or structural issues underpin the challenges you are facing?

3. What local, traditional and/or indigenous responses to similar crises can be utilised developing effective educational responses to COVID-19?

4. What creative and innovative ways have you found useful to address COVID-19 challenges in learning and education?

Responses led to the development of several themes which are discussed in the results below. Firstly, several COVID-19 related **challenges** emerged which required adaptation by all involved, including online learning, education at home. In response to these challenges, context-appropriate **improvisations** are emerging, resulting in what can be regarded as several **silver linings** for educators.

COVID-19 related educational challenges being faced in southern Africa

Several COVID-19 related challenges emerged from the interviews that require significant adaptation by all teachers, learners and their parents. These include adapting to online learning and learning via radio and television programmes, the continuity of education from home, facilitated community-based learning, as well as the new costs of learning.

Adapting to online education and learning

Educators, educational researchers, community-based popular educators and education evaluators in southern Africa are facing challenges associated with using online facilities as a primary means for carrying out their duties. For example, a respondent in the non-formal education sector of Zambia who has been facilitating a 'Building resilience in the road sector train-the-trainer' course faced challenges using online facilities. This is partly because the educator and participants have varying degrees of online-based facilitation and learning experience. Another educator in Zimbabwe faced a similar challenge in conducting online training in permaculture (a practice-based sustainable agriculture approach). A laboratory technologist and lecturer in fisheries (freshwater and marine) and aquatic sciences at a university in Namibia was challenged to conduct practical demonstrations and fieldwork to develop students' practical competences. Group-based learning has also been disrupted as a result of the shift to online learning and the need for observing social/physical distance to manage the spread of COVID-19. As lockdown eased in some countries, the convenors of informal educational activities faced unexpected costs to ensure the safety of participants and facilitators. For a small permaculture NGO in South Africa, these unexpected costs included purchasing masks and hand sanitisers as well as running more workshops than originally planned (due to the planned number of participants per workshop being higher than what was permitted under COVID-19 regulations). An NGO in Zimbabwe, which works with schools and teacher colleges in permaculture, incurred additional costs having to train its facilitators (teachers) on COVID-19.

Many educators, learners and parents in southern Africa have inadequate or no access to computers, laptops and cell phones, which are necessary for online teaching and learning.

Some lack money to buy data bundles, while others do not have radio or television. Families with too few computers have to compete for the limited resource, with parents needing to use the computers for work and adult learning, and children needing to use them for school and college work. To add to this, frequent power outages in the region further limit the time that is available for working on shared computers. For example, a university student in Malawi explained, "I do not have a laptop. When I am given an assignment, I go and borrow a laptop. I depend on my parents for data bundles." Parents in Zimbabwe described how their children were struggling because of limited connectivity as outlined by this parent of primary school children:

> Kids' school opened a virtual class but are having the challenge to use interactive classes like Google class, and end up using WhatsApp, sending voice notes and also assignments. The kids … need constant supervision and help. In my situation, it was difficult as both of us [parents] [go] to work. Then the lessons and even assignments have not [been] consistent, and also the quality of delivery was poor. The classes for zero grades were also discontinued – probably because of lack of content.

In another example from rural South Africa, a sibling attempting to help younger brothers and sisters had to rely on what had been learnt at school due to no internet connectivity to access teachers' emails or online resources.

All educators interviewed in this study stressed how their workload had increased due to virtual learning. They were also finding it difficult to get across new and difficult concepts to children via non-interactive virtual lessons. The shift to online learning is reshaping an accustomed pedagogy as well as the quality of learning across the region. For example, a primary school teacher in South Africa was finding it difficult to ensure coherent lessons due to limited interaction, and could not find adequate teaching methods to cater for different learning abilities and she struggled with evaluating the learning. A primary school student in South Africa said she avoided online lessons for subjects she did not like, was disturbed by pupils who posted jokes during online lessons, felt cyberbullied by pupils who wanted to attend all lessons and was irritated by teachers who called her when she did not attend virtual lessons.

The number of students who have access to online learning but are not willing to use it is another challenge. This is illustrated by the experience of a 15-year old girl at a well-resourced secondary school in South Africa, who got up late and quickly lost interest in her work due to lack of support. She attended Zoom classes but felt they were not working for her. By the end of a particular Zoom-based Chemistry lesson, all but two learners had left the class. Although the teacher could see the dwindling numbers, she kept on teaching the class and conducted another Zoom-based lesson session the following week with two learners only. The 15-year old girl concluded that her teacher did not care how students felt or coped. Her teacher was equally frustrated for different reasons: the school was not investing enough resources to address the new educational challenges, and teachers could not adjust the implemented curriculum to address COVID-19 educational challenges.

Another South African teacher also felt that too much attention was being paid to the 'correct curriculum' in a time of crisis. He felt that the attempt to stick to a pre-COVID-19 curriculum indicates how the education system is not seriously adapting to the current existential crises. He said, "We should be engaging our students in what is happening to them right now and helping them to make sense of this, increasing their ability to adapt rather than reading Shakespeare because it is in the curriculum." An issue of vocabulary was raised when WhatsApp platforms are used for online teaching. Students are using shorthand such as "L8r" for "later", and "plz" for "please", as common conventions in informal WhatsApp conversations. The teacher felt that using this convention in formal communication was undermining the curriculum standards in language subjects.

Adapting to the continuity of education from home

The closing of schools and banning of public gatherings has shifted student and adult education and learning from the schools and other non-formal education sites to their homes. This has made the home a place for continued education and learning. But not all homes in southern Africa are suitable for student and adult learning. At a very basic level, many families do not have the space for both parents and students to work from home, which leads to competition for the use of limited home space for teaching, learning and work. For example, university lecturers from five South African universities collaborating on a climate change education research project, reported competing with spouses and children who also need space and privacy to do their work.

For students, homeschooling also surfaces educational quality and equity issues, which arise from differential access to digital devices to work and learn online. A parent in Zimbabwe shared how her four children in different classes have to compete for one digital device to support their online learning. Many parents were either unwilling or unable to provide the necessary enabling learning environment and support in the home. Learning from home is done online and through radio and television programmes, which is creating new learning and work challenges. These teaching modalities are not suitable for all students. For example, in Malawi learners with disabilities such as hearing and visual impairments have to depend entirely on family members to help them with home-based learning. Yet, some of these learners live with family members who do not have basic knowledge of sign language for using with those with hearing impairments, for example (Muchanga et al., 2020).

A parent in Zimbabwe emphasised that she, like most parents, was not an educator and was not in a good position to support and supervise her students to learn from home. This was echoed by a parent in South Africa who said education institutes have unrealistic expectations about home support. Parents' educational support to their children has been identified as a key challenge for single parents, especially if they are from the working class. Parents whose homes are in remote areas face different challenges with child education. For example, in Botswana, some parents sent their children to herd cattle in remote grazing

lands where children would be safe from the pandemic. Consequently, the children were cut off from the possibility of home schooling.

Women and girls are facing greater workloads when learning and working than their male counterparts. A woman in South Africa explained how COVID-19 and working from home had increased her burden of work. Her working day started at 5:30 am and ended around 5:30 pm, as she had to perform her usual duties as well as conduct several meetings online. In the evening she helped her child with homework. She found it stressful when she was not able to help her daughter as much as she would have liked and then received a call from the school concerning work that had not been submitted (with no concern for the struggles she and her child had trying to do the work). A Zimbabwean lecturer at a South African university says COVID-19 has redefined the meaning of being a breadwinner: it no longer simply means being able to fend for one's family through providing money to spend but includes being able to work in localised and creative ways. This is creating new challenges for breadwinners working in the diaspora, especially men.

Adapting to facilitated community-based learning

COVID-19 has also pushed face-to-face teaching at educational institutions to migrate to distance and virtual learning. This presents a new challenge to high-quality education as a social experience requiring routine human interaction (Béteille et al., 2020). The chlenge has been particularly intense because educators have had no time to prepare "to adapt to the modalities of virtual and distance teaching, managing virtual spaces and classes, engaging students in new and innovative ways of learning" (ILO, 2020, p. 2). Transforming face-to-face classes to a virtual mode has created a steep learning curve for many educators, undermining the quality of learning in some cases (UNESCO IESALC, 2020). The situation is worsened by the fact that, for the learners, pedagogical continuity under these circumstances favours the digitally literate, with physical and financial access to virtual learning. In Africa, the proportion of households with internet connectivity is very low, at 20% (UNESCO IESALC, 2020). The proportion of learners with internet access in sub-Saharan Africa is even lower, at 18%, while those with access to household computers is a mere 11% (UNESCO, 2020b). At the same time, parents, whose technical, technological and academic capacities vary considerably, are also having to play greater roles to support their children to learn through distance and virtual education (ADEA, 2020). These digital divides have prompted student bodies such as the South African Students Congress (SASCO), the University of Malawi Students Union (UMSU) and the Zimbabwe National Students Union (ZINASU) to reject e-learning as the educational solution in Africa (Mukeredzi, Kokutse & Dell, 2020).

The travel restrictions have made it difficult for some planned educational activities to be implemented. The restrictions in the number of people who can gather at a place as well as the health standards that must be adhered to, such as washing hands using sanitisers, and wearing masks, is created other challenges. For example, a CBO operating in Limpopo

Province to facilitate the learning and implementation of permaculture to increase food security and protect the environment, is having to train fewer people at a time. This is because they have to observe social distance requirements, provide masks and sanitisers. This has created the need for raising extra funding for masks. When the training was implemented, and the participants wore masks, they also found it psychologically hard to adjust to not seeing each other's faces. In Zimbabwe, COVID-19 has disrupted community-based research and learning on the impact of Cyclone Idai in Chimanimani District of Zimbabwe. Travel restrictions made it impossible for researchers from outside Chimanimani District to visit and complete some aspects of their planned research work with the district communities. The participatory action learning oriented research is intended to increase community adaptive capacities and improve community livelihoods. Such delays in the implementation of facilitated community learning have been undermining much-needed development in the southern African region. In some cases, facilitated community learning has been encountering online learning challenges as highlighted earlier and illustrated by Zimbabwean and Zambia experiences. The challenges include lack of capacity to do online learning, and lack of necessary equipment and infrastructure to support online learning. This has meant that community members who cannot access online learning are being left behind.

We also established that many community members who would like to participate in facilitated community learning processes are constrained by lack of time and lack of resources. Some are having to spend more time raising income to meet family needs because the sources of their income are being negatively impacted on by COVID-19. For example, community members involved in farming and dependent on income from agricultural produce, have been facing marketing challenges due to travel restrictions. Many employees, especially in the tourism and travel sectors, have been losing their jobs due to lack of demand for their services. Consequently, they are having to prioritise income-generation over participation in community learning.

Context-appropriate improvisations in response to COVID-19

Our interest in finding silver linings to the COVID-19 crisis made us ask questions about innovative educational responses. But it was too early to start talking about 'innovations' because there has not been enough time to prove their effectiveness. Rather, we find it more appropriate to talk about 'improvisations', which refer to exploration, experimentation and knowledge creation to maintain effectiveness to cope with turbulent and uncertain times (Hitt, 2000; Leybourne & Kennedy, 2015). Green (2009) said improvisation occurs when agents invent in the interplay between freedom and constraints. Similarly, Sridharan (2020) described improvisation as the ability to adapt or to deal with surprises so that we have the best chance of survival. When successful improvisation goes beyond survival it can lead to innovation that enhances effectiveness and value creation by the improviser and by other actors, while enabling continuous improvement of practice (Leybourne & Kennedy, 2015).

Improvisation also includes the ability to "ingenuously adapt to a set of circumstances" (Preston, 1991, p. 88) and devise "resourceful solutions to intractable problems" (Meyer, 1998, p. 572).

Transforming to blended learning beyond COVID-19

A South African university in the Eastern Cape Province has been escalating its efforts at blended learning and enhancing its effectiveness. A learning and research centre at the university has traditionally held a weekly face-to-face reading circle to enhance peer support and learning for PhD scholars. But COVID-19 has rendered the face-to-face learning moments almost impossible due to expenses associated with short-term transport and travelling to and from the university. Vehicles that are authorised to transport passengers in line with COVID-19 restrictions have had their carrying capacities halved resulting in a doubling of the transport fee to maintain the viability of the transport business. Prior to COVID-19, the university had established an online platform for off-campus students which proved useful for all students during COVID-19. One lecturer reported giving more appropriate support to her postgraduate students, by taking into account the contexts in which they are learning. The university itself has responded by providing other support for students such as laptops and data bundles, which was already needed by some students before COVID-19.

Expanding mandates to respond to the most urgent issues

Sridharan (2020) referred to an organisation's ability to adapt as 'fungibility', an example being whether organisations could move from being developmental (or educational) organisations dealing with developmental issues, to dealing with a crisis. We identified a particularly interesting example of how a community-based organisation (CBO) is being fungible in South Africa. The CBO only works in one community where its mandate is to alleviate poverty by running a year-long permaculture course where women are taught how to grow food and basic business skills and given psychological support. None of the women they work with have enough income to even reach the UN poverty datum line (US$1.90 per day). COVID-19 curtailed their livelihood options even further. Most of the women supplemented their social grants by selling vegetables from their gardens, but street vendor selling was not allowed under lockdown restrictions. Small amounts of money they may have received from relatives or estranged partners immediately stopped as many people found themselves unable to work for an income under lockdown. In this situation, the small CBO was 'fungible' enough to respond almost immediately. They partnered with a local orphanage and began raising funds for food parcels. The vegetables grown by the women were bought and included in the food parcels. A new obstacle emerged: Government required NGOs apply for a permit to distribute food parcels to ensure the food was safe for consumption. However, local municipality offices that needed to issue the licenses were closed. Under these circumstances, the CBO team decided to go ahead with distribution

anyway. They did their best to avoid military roadblocks but found local police roadblocks waved them through as the people they were feeding were known to the local police who understood how much in need they were. In this case, the CBO team found itself in a difficult position where they had to make sense of the rules and procedures, interpret them and use their sense of judgment (Lipsky, 1980) in dealing with ambiguous and non-routine situations (Maynard-Moody & Musheno, 2003).

Improvisations to support livelihoods

One of the greatest challenges for southern Africa during COVID-19 has been food security. Our findings showed that organisations have had to shift from providing training to ensuring people get enough to eat. We have discovered that there is a lot to learn from people about innovations in a crisis. The COVID-19 crisis connects us back to the source of what keeps us alive – the earth, water and what grows. We have observed several improvisations in and around our homes. We have also seen an escalation of efforts to improve food self-sufficiency and reduce the need to buy groceries frequently while at the same time making home a pleasant environment with recreation. For example, one family in urban Harare has begun keeping free-range chickens, ducks and rabbits in their orchard and is using their garage to keep broilers. We also observed some individuals sending money not only to their families but also to colleagues and friends to help sustain their home food gardens. We have noticed that gardening is not only helping with food and income but also enabling greater focus on the use of locally available resources and learning of survival skills. Virtual libraries have become an important ally in this process of improvisation. For example, a woman who was trying to cut the costs of feeding ducks and chickens has learnt how to produce duckweed, which is far cheaper to produce and yet more nutritious than most store-bought feed.

Addressing physical and emotional distance of learning during COVID-19

When the immediate risk of starvation had been addressed, the CBO team mentioned earlier began to consider other issues created by the crisis. It seemed urgent to start a new permaculture course and the team began thinking through how they would run the course within the context of COVID 19. In the previous course, the fences and shade cloth structures had only been constructed around the women's gardens six months into the year. This needed to change as the NGO team realised the women needed to start growing immediately. Once the workshops started, the participants and team found it difficult not seeing each other's full faces and the distance between them was felt on both physical and emotional levels. The permaculture trainer remarked, "COVID-19 has taken away our smiles". The NGO team took photographs of all the women with their masks both on and off. These pictures were shared with the women so that they could consider how we read faces when we can see whole faces. The CBO made brooches with the unmasked face of each woman which could be worn during class so everyone's whole face could be seen.

Introspection and activism to tackle educational quality and equity challenges

COVID-19 has made researchers in the Global North more aware of their reproduction of colonial practices that silence local research partners through a monopoly on proposal design, selection of design theories, and methodologies for monitoring. In Africa, we have observed that COVID-19 has stimulated stronger activism from learners, educators and human rights movements, especially around structural issues related to access to education, health and livelihoods. Student movements have joined hands to reject digital learning as an educational solution in Africa when digital access is limited to the elite. Teachers in southern Africa have also been resisting the opening of schools before adequate health and learning requirements are met. In Zimbabwe, the nine (often-competing) teacher unions combined efforts to successfully prevent schools from opening under circumstances where both educators and learners would be exposed to the virus. A parent in South Africa spoke about his resistance to his children returning to school, commenting that he did not see why children needed to be the experiments of COVID-19. Through his activist and political networks, he also reported on how the opening of schools was linked to crony tenders for hand sanitisers and protective equipment for schools in his area.

A South African activist described how the COVID-19 crisis has exposed elements of systemic violence towards ordinary people by the state. He shared how pensioners were queuing for their pensions when the military arrived and without any warning or explanation began beating people who were not socially distancing. He shared how a person does not receive a food parcel unless that person is a political party cardholder. When asked about resistance, he explained that people were scared: "We remember too well what happens when the military arrives". He linked this to his own experiences as an activist under apartheid having to flee from the military. "There is nowhere to run to and hide now as we can't leave our homes. This makes activism and resistance very hard but we are now seeing the full extent of the damage to our democracy through COVID-19 and we won't forget."

Silver linings for educators, education researchers and evaluators

Despite all the pedagogical and contextual hurdles being encountered, there seem to be silver linings for educators, education researchers, popular educators and evaluators. These are still forming and the direction they will take is not yet certain. They include: (i) more contextualised responses to education and learning, (ii) strengthening the link between education and sustainable development, and (iii) fostering of responsible educational activism.

More contextualised educational responses

Our study has revealed moments where people have been able to improvise quickly to the context of the communities they serve. The Ministries of Education in various SADC countries have developed responses that are suitable for those with access to digital resources as well as those without. This is illustrated by Botswana, Malawi, Namibia, South Africa and Zimbabwe having developed Education Sector COVID-19 Response plans or strategies. Schools and universities have developed learning materials and provided instruction via different online facilities, intended to provide for the majority of students. This has been illustrated in formal education in South African and Zimbabwe and the informal education sectors of Zambia and Zimbabwe. Parents have converted their homes for home schooling, workplace learning and for doing some of their professional work. Organisations involved in non-formal education have rescheduled their work, included COVID-19 training in their curriculum, and devised new strategies to enable education and learning to continue taking place. In the process, the different actors in the education system have exercised their creativity and tapped into their agency to find and implement context-specific solutions to education and health problems (often through improvisation).

Strengthened link between education and sustainable development

The emergence of the pandemic has been linked to the way humans have exploited the planet on which life depends. The pandemic has also compelled international and national organisations across different sectors to develop response strategies at an unprecedented scale and pace. For example, the World Health Organisation, the United Nations Food and Agriculture Organisation (FAO), UNESCO, UNDP, international climate organisations, SADC and its Member States have all been developing responses to the pandemic. At the same time, urban households have been adapting by producing more vegetables and keeping small livestock in smallholdings. In the process, they have increased household food production and acquired new life skills. This could lead to an accelerated promotion of Education for Sustainable Development (ESD) and usefully highlights the intersectionality between ESD and livelihoods.

Fostering of responsible education activism

Our study has shown that structural inequalities are also negatively impacting on the adequacy and effectiveness of COVID-19 responses in education by favouring those with digital access. This has resulted in student bodies in the SADC region rejecting digital education as the solution to the disruptions caused by COVID-19 in education. The student bodies comprise students from well-to-do families as well as poorly resourced families. This kind of solidarity between students who have and those who do not, can be seen as responsible education activism. Educators on their part have put their heads together and fought against continued schooling that exposes learners and educators to the virus. We view this as responsible education activism as it ensures that the learners and educators' health and livelihoods are considered alongside continued education. This kind of activism

is needed in the future to ensure that curricula and assessments are appropriate in current times and different contexts.

Conclusion

COVID-19 has most certainly highlighted the shortcomings of the current education systems in terms of inequality and the ability to be responsively relevant. The inequalities in education are closely tied to historical and current everyday structural inequalities. This challenges educators to rethink what to teach and how to teach. The silver linings of the COVID crises point to educational improvisations that may need to be explored and expanded further for future use.

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Percentage contribution

Areas of contribution	Author	Percentage contribution
Conception or design of the paper, theory or key argument	Mukute	60 %
	Burt	20 %
	Francis	10 %
	De Souza	10 %
Data collection	Mukute	25 %
	Burt	25 %
	Francis	25 %
	De Souza	25 %
Analysis and interpretation	Mukute	50 %
	Burt	25 %
	Francis	15 %
	De Souza	10 %
Drafting the paper	Mukute	50 %
	Burt	25 %
	Francis	15 %
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Critical review of the paper	Mukute	20 %
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Creating Environmental Awareness using an Eco-Feedback Application at a Higher Education Institution

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Abstract

Providing environmental education and creating environmental awareness assists future generations to conserve, preserve and sustain the environment. Organisations are supporting environmental awareness education efforts and universities are increasingly being required to exercise sound environmental behaviour and educate all stakeholders on their responsibility of being aware of their environmental impact. Gamification and eco-feedback applications in previous studies have been used to provide feedback on an individual's behaviour with the goal of creating environmental awareness. Students are generally not provided with environmental information regarding their use of electricity, water and waste management whilst on campus. In this exploratory study, an eco-feedback application was developed and used to create environmental awareness amongst postgraduate students at the Nelson Mandela University and the functionality of the eco-feedback application was evaluated. The results indicated that participants became more aware of their environmental impact after being exposed to an eco-feedback application. The functionality provided by the eco-feedback application, to assist in creating environmental awareness within an academic institution, proved to be useful.

Keywords: *environmental awareness, eco-feedback applications, behavioural change theory*

Introduction

Globally, organisations are promoting environmental awareness and responsibility (Kencanasari, Surahman & Permana, 2019). Increased environmental awareness allows organisations to implement better sustainable practices and improve their competitive advantage (Walton & Galea, 2005). Universities are increasingly being required to exercise sound environmental behaviour and educate all stakeholders on their responsibility of being aware of their environmental impact (Kaur, 2019).

The recording and reporting of environmental data, such as electricity and water usage and waste management information, in an organisation can assist with reducing the overall environmental impact (Jakobi & Schwartz, 2012). If organisations manage their environmental data, by adopting new technological applications that will allow information

sharing, such as the sharing of electricity usage information, they will be able to reduce energy consumption (Jain, Taylor & Peschiera, 2012). Information regarding electricity and water usage can be used by individuals and organisations for better decision making and to create environmental awareness (Hough, Thompson, Strickland & Gamble, 2011; Kencanasari, et al., 2019). Individuals who are aware of their environment-impacting activities can act to decrease their electricity and water consumption, leading towards sustainable development practices (Olsen, 2014).

Creating environmental awareness is critical and has resulted in an increase in the development of applications to support individuals monitoring their environmental impact (Gadenne, Kennedy & McKeiver, 2008; Jorgenson, Stephens & White, 2019). Modern technologies are gradually being adopted to communicate environmental alerts, awareness and concerns and promote eco-friendly behaviour (Piccolo et al., 2012; Hamid et al., 2018).

Modern technologies are used to help raise environmental awareness and motivate eco-friendly behaviour to nurture environmentally aware individuals and students (Castelli et al., 2017; Dubois & Pittarello, 2018). Several gaming applications, including serious games and eco-feedback applications have been used for environmental management education at Higher Education Institutions (HEIs) (Madani, Pierce & Mirchi, 2017). These applications provide feedback on individual and group behaviour with the goal of reducing environmental impact (Jakobi & Schwartz, 2012; Jain et al., 2012).

This paper investigates the use of an eco-feedback application implemented at the Nelson Mandela University (NMU) to determine the effect of the use of the eco-feedback application on the environmental awareness of postgraduate students. This paper includes a literature review (Section 2), which provides a discussion on environment education and awareness, gamification and eco-feedback technologies. A theoretical perspective is also provided. The development of the eco-awareness application is explained in Section 3 and the research methodology is presented in Section 4. Section 5 highlights the results from the comparison between the pre-test and post-test used for the evaluation of the use of the eco-feedback application. The paper concludes with a discussion on the contribution of the research and recommendations for future work (Section 6).

Literature review

Institutional environmental impact

HEIs produce large amounts of greenhouse gas emissions through electricity (Association for the Advancement of Sustainability in Higher Education, 2012). Limiting the use of electricity and water, together with recycling efforts, in promoting sustainable development, has a positive impact on the environment. HEIs should strive to reduce electricity and water consumption as well as promote recycling activities to reduce their environmental impact. The energy use of these institutions needs to be closely monitored and recorded (Klein-Banai & Theis, 2013). The visualisation of electricity and water usage within buildings can create awareness and help decrease the impact on the environment (Cetin & Nisanci, 2010).

The use of modern technologies can create environmental awareness and influence the behaviour of staff and students (Dubois & Pittarello, 2018). Social media platforms (such as Facebook and Twitter) have also been used effectively to create environmental awareness amongst staff and students in higher education (Hamid et al., 2018).

The promotion of pro-environmental behaviour and the understanding of individual actions in areas of water and electricity consumption, recycling and waste management, can reduce the impact individuals have on the environment (Kollmuss & Agyeman, 2002). The insights gained from pro-environmental behaviour studies have been applied in a study relating to university students by Thondhlana and Hlatshwayo (2018) who highlighted the need to encourage environmental behaviour in university residence settings and promote pro-environmental actions.

Environmental education and awareness

Environmental education aims to increase an individual's environmental awareness (Cruz & Tantengco, 2017; Jakobi & Schwartz, 2012; Jain et al., 2012). Environmental education allows individuals to explore environmental issues, engage in problem solving and participate in actions to restore and protect the environment. As a result, individuals develop a deeper understanding of environmental issues and have the skills to make informed and responsible decisions. If individuals are aware of the negative consequences of their daily activities and how these activities have an impact on the environment, they would be more concerned about their environmental impact (Olsen, 2014).

Environmental awareness research indicates that HEIs are increasingly becoming aware of promoting environmental awareness amongst students (Kaur, 2019). In a study on environmental awareness among college students in India, the researchers found that environmental awareness differs with socio economic status for students and that no difference was observed between males and females (Kaur, 2019). Sulaiman, Chan and Ong (2019) evaluated factors that influence recycling intentions among university students and found that past behaviour had a strong impact on recycling intention amongst students.

Instruments and technologies have been developed for measuring environmental awareness (Hartman et al., 2018). Environmental awareness includes factors such as knowledge, attitudes and behaviour or actions (Kencanasari et al., 2019). Biographical variables identified in environmental education studies included race, ethnicity, gender, socio-economic and religion (Derr, 2020).

Gamification and serious games

Human behaviour plays an important role in energy usage, water consumption and waste management; however, efforts to target behavioural change have produced varying levels of success (Johnson et al., 2017). Energy and water consumption and waste management are significant, critical, social and environmental issues. Gamification and serious games offer a means of influencing people (and specifically students) regarding these important issues (Hamari, Koivisto & Sarsa, 2014).

Gamification can be defined as the use of game elements in a non-game context to improve the user experience and user engagement. Serious games are defined as any form of interactive computer-based or mobile-based game software for one or multiple players to use with the intention of being more than entertainment. The distinction between gamification and serious games is that serious games are fully fledged games (e.g., a digital role-playing game in which the player completes challenges or quests designed to educate them about environmental factors, such as energy consumption), while gamification refers to the application of parts of games in a non-game setting (e.g., a mobile app designed to track and encourage actions, that uses different avatars, levels, rewards and badges) (Johnson et al., 2017).

Johnson et al. (2017) evaluated 25 gaming studies and grouped them into four categories, namely behavioural outcomes, cognitive outcomes, learning and knowledge acquisition outcomes and user experience. Behavioural outcomes are specifically applicable in environmental behaviour studies and included both actual and intended behaviour outside the game or application (referred to as real world behaviours). Real world behavioural outcomes included energy consumption, energy saving activities/actions and intention to engage in energy-saving behaviour.

Serious games have been used for environmental management education in higher education (Madani et al., 2017). Research has shown that playing a serious game affects people's attitudes towards the environment and the sustainability of their behaviour (Chappin, Bijvoet & Oei, 2017). Additionally, games have been used for the teaching and awareness of environmental issues and problems. Souza et al.(2019) developed and evaluated a serious game to raise environmental awareness and prevention of water pollution. They found that the game affected players' knowledge about environmental issues and that in a pre-test post-test scenario, the participants were slightly more aware of how different types of waste affected the environment.

Eco-feedback technologies

Eco-feedback technologies provide environmental usage information to individuals and/or organisations to promote awareness of their impact and encourage behavioural change to minimise this usage (Froehlich, Findlater & Landay, 2010). A key feature of an eco-feedback application is to have a clear goal based on historical data, providing feedback and associated required action(s) using tips and hints (Fitzpatrick & Smith, 2009; Spagnolli et al., 2011). Such applications should be unobtrusive, display simple, easily understandable information and use intuitive and logical metaphorical indicators to simplify feedback (Spagnolli et al., 2011).

Eco-feedback technologies therefore do not only have the ability to create awareness of environmental impact, but also influence the user on a physiological and behavioural level (Yendapally & Yazdansepas, 2020). Spagnolli et al. (2011) also proposed that eco-feedback technologies make use of intuitive and logical metaphorical indicators to simplify feedback. This not only requires less thinking from the users' side but may also give a more visual

and often more effective expression of feedback. As an example, Fitzpatrick and Smith (2009) suggest the use of traffic light colours, i.e. red, orange and green, to indicate the severity of environmental impact levels. Such use of metaphors provides an effective, visual comparison of usage to target usage and should change in response to improvements or declinations of these comparisons.

The integration of eco-feedback technologies with smart phone applications, using 3D interfaces on university campuses, promotes emotional engagement and cognitive involvement (Dubois & Pittarello, 2018). The feedback provided by serious games, such as badges and rewards, could further be integrated with eco-feedback technologies to positively impact on the personal environmental behaviour of students.

Theoretical perspective

Presently, researchers apply different theoretical perspectives to create environmental awareness (Akintunde, 2017). Akintunde (2017) suggested an integrative application of different behavioural and environmental theories to help solve contemporary environmental problems. The expected outcome of this study was to increase the environmental awareness of students through the use of an eco-feedback application. It is therefore important to refer to behavioural models and related theories. The behavioural change model proposes that if people are better informed, they would become more aware of environmental issues and behave in an environmentally responsible manner (Prochaska, Johnson & Lee, 1998). The theory of environmentally responsible behaviour (Hines, Hungerford & Tomera, 1987) argues that, amongst others, attitudes and knowledge through education, suggest whether a person would adopt a behaviour or not.

The behavioural change model indicates that when knowledge increases, environmentally favourable attitudes develop responsible environmental actions (Akintude, 2017). The behavioural model provides a base for the consideration of possible relationships existing between environmental knowledge, environmental awareness and attitude and how these factors can lead to action. Shove, Pantzar and Watson (2012) criticised the narrow use of behavioural change theories in the field of environmental change for focusing too much on the individual's behaviour and mentioned that the view should be broadened to include social interaction, lifestyles, norms and values as well as technologies and policies as enablers or hindrances for behavioural change. This exploratory study includes all these factors with the exception of policy. The results of this study can provide a foundation for future studies that could inform environmental policy development for a university.

The feedback intervention theory proposes that feedback is an important component of many educational programmes and interventions. Feedback refers to the process of giving people information about their behaviour that can be used to reinforce and/or modify future actions (Karlin, Zinger & Ford, 2015). Bandura (1969), in his work on feedback, found that providing a goal and information about progress toward that goal could serve as a form of behaviour modification, much like providing a reward or punishment. Feedback after consumption can be either "direct" or "indirect" (Darby, 2006). Direct or real-time

feedback, which is more effective, is immediate and from a meter, other display monitor or application. Direct feedback can lead to behavioural change (Van Houwelingen & Van Raaij, 1989; Vine et al., 2013).

The eco-feedback application

Monroe et al. (2019) summarised various literature studies and the methods and interventions used to identify and create effective environmental and climate change education strategies. These strategies aimed to improve environmental knowledge, change attitudes, empower action and change behaviour. Fraternali et al. (2019) presented insights drawn from recent research projects aimed at developing visualisation and gamification tools to stimulate individual behaviour to change and promote energy and water savings. Studies used tools such as pre/post-test and specifically validated surveys, such as the 2MEV scale to measure environmental attitudes (Monroe et al., 2019).

NMU students and staff had no direct means of viewing their environmental consumption and therefore were unaware of the institution's environmental impact. Students have daily access to personal computers on campus, which provided an appropriate and effective means to deliver campus related environmental information, using an eco-feedback application. The design of eco-feedback applications to improve environmental awareness and provide timely feedback have had a positive impact on creating increased environmental awareness (Dubois & Pittarello, 2018). This study created the first eco-feedback solution for the NMU and its usefulness for creating environmental awareness was evaluated.

A number of existing eco-feedback tools and mobile applications were evaluated before designing the user interfaces for the NMU Eco-Feedback application (Yendapally & Yazdansepas, 2020; Dubois & Pittarello, 2018). Existing literature focusing on the design of eco-feedback applications for improving environmental awareness on a university campus were reviewed (Dubois & Pittarello, 2018) and several prototypes were developed using an iterative approach. The aim of the study was to develop an application to assist students to become aware of their impact on the environment and to motivate them to change their environmental behaviour. The usability of the NMU Eco-Feedback application was evaluated by staff and postgraduate students from the Department of Computing Sciences at NMU.

The NMU Eco-Feedback application used data directly from NMU's environmental information database. The environmental information database stores weekly and monthly electricity usage, water consumption and waste data for each building on campus and was used for data acquisition for this study (Calitz & Zietsman, 2018). The NMU Eco-Feedback application was developed as a Windows' application (Figure 1), which was run when the students logged onto the NMU network. The information displayed included water and electricity usage, as well as waste management data of NMU, how well these levels compare to predetermined targeted levels, specific buildings' electricity, water and waste recycling data, a summary of all levels of usage at NMU and tips on how to reduce water and electricity

usage and increase recycling (Figure 3). The application further provided more in-depth drill-down information, including historical data.

Figure 1: *An example of the live tiles of the Eco-Feedback application on the Windows start screen*

Colour-coding was used to indicate how the current environmental resource usage related to the targeted usage levels, namely green indicating good, orange indicating moderate and red indicating poor as suggested by Fitzpatrick and Smith (2009). Different icons were also used to represent electricity, water and waste levels (Figure 2). Additionally, customisation of the user interface was supported to allow the user to filter the information displayed and activate or de-activate certain features. The user of the application could select buildings and obtain environmental data on electricity usage and water consumption (Figure 2), including waste management for a specific building, residence or campus.
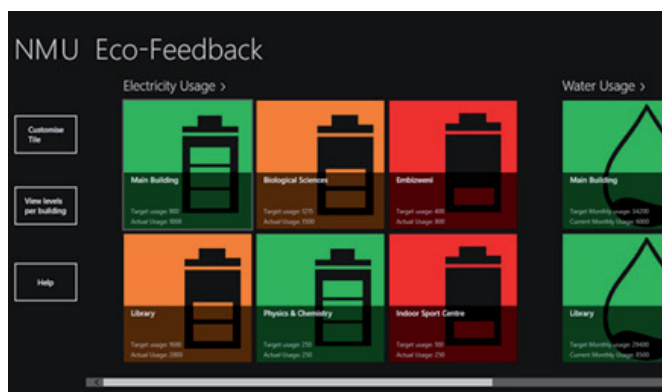
Figure 2: *The user interface of the main Eco-Feedback application*

The Eco-Feedback application further provided daily environmental tips to students (Figure 3).
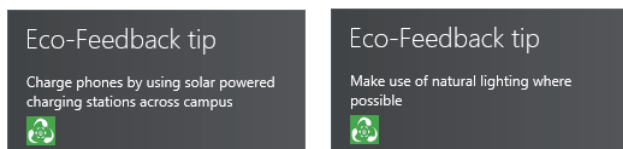
Figure 3: *Eco-Feedback application environmental tips*

Research methodology

The research problem addressed in this exploratory study was that postgraduate students were not aware of their environmental impact whilst on campus. The research objective of this exploratory study was to develop an eco-feedback application that could be used to create environmental awareness of electricity and water consumption levels in order to reduce its overall environmental impact. The research question of the study was: To what extent could the use of an eco-feedback application raise students' awareness of their environmental impacts on campus?

The research approach applied in this study was a literature synthesis followed by an experimental assessment of an artifact, namely the NMU Eco-Feedback application. A convenience sample of sixteen participants, the Computer Science Honours class, participated in the study. The students completed a pre-test questionnaire, prior to using the eco-feedback application and a post-test questionnaire, after four weeks using the application. The questionnaire evaluated student's awareness of environmentally friendly behaviour on campus. In accordance with similar research relating to creating environmental awareness and the evaluation thereof (Zyadin, 2015; Biswas & Roy, 2016; Cruz & Tantengco, 2017), quantitative feedback was captured using the pre- and post-questionnaires. The usefulness of the eco-feedback application was also evaluated. Ethics approval was obtained from the NMU Ethics Committee for the study.

Evaluation method and tasks

The students were provided with a pre- and post-test questionnaire (Figure 4) using a 5-point Likert scale (1 = Strongly disagree to 5 = Strongly agree). The statements focused on knowledge, attitudes and behaviour (Kencanasari et al., 2019). The 16 students completed the questionnaire before the four-week environmental awareness intervention and again after the intervention, in order to determine the effect of using the NMU eco-feedback application.

The environmental data for the university was displayed (Figure 1) during the four weeks of the experiment when the 16 students logged onto the NMU computer network.

The participants were required to find relevant information regarding buildings' electricity and water usage and waste management. They viewed a daily environmental tip (Figure 3) and had to complete various tasks including:

- Customising the eco-feedback application;
- Recording a specific building's electricity and water usage reading for a certain month and year;
- Determining which buildings on campus where performing the poorest;
- Viewing how well these levels compared to predetermined targeted levels;
- Viewing a summary of all data on a specific campus.

Results

The biographical data of the 16 postgraduate participants from the NMU Department of Computing Sciences indicated that the age of the students ranged between 21-24 years. Seven participants were females and nine were males. Six students lived in a university residence and ten lived in off-campus accommodation. All students had at least four years of experience in Microsoft Windows.

The results from the eight questions relating to environmental impact, answered by students before using the NMU Eco-Feedback application and four weeks later, after using the application, are presented in Figure 4. Figure 5 indicates the average percentage change per question.
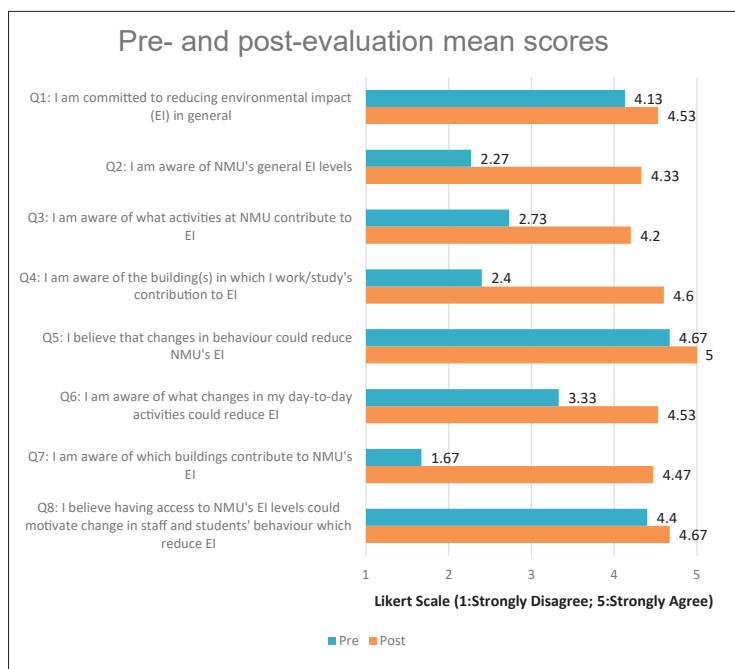
Figure 4: *Pre- and post-test evaluation mean scores for environmental impact statements*
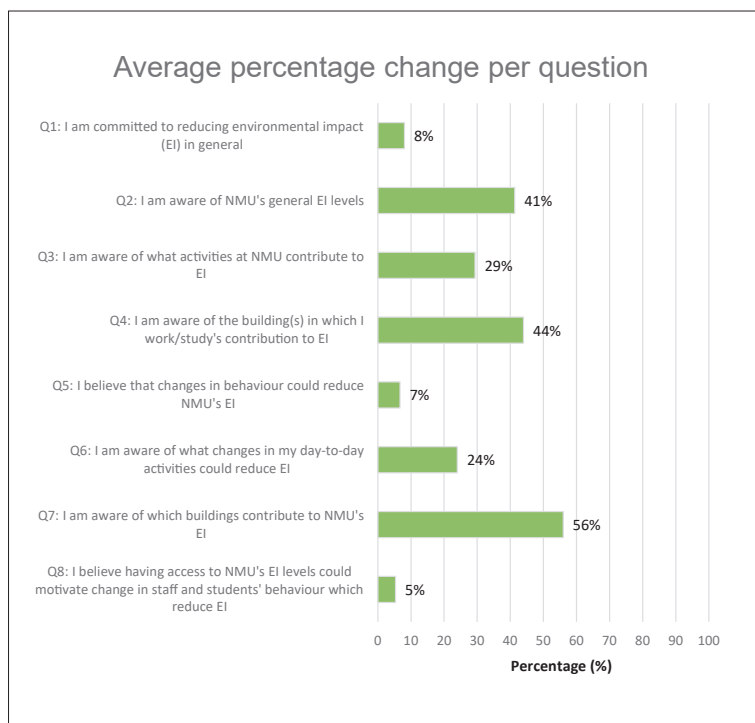
Figure 5: *Average percentage change per question*

Table 1 indicates the increase in environmental impact awareness created by the functionality provided by the NMU Eco-Feedback application.

Table 1: *Awareness questions linked to system functions*

Question	Create awareness of...	System function	% increase
2	impact levels	Display environmental impact levels and comparisons	41 %
3	activities which contribute to environmental awareness	Display and categorise electricity, water and recycling waste levels	29 %
4	environmental impact of building in which participant operate	Display impact levels of each building, customise live tiles to display data of specific building	44%
6	what changes in activities can reduce impact	Provide tips on how to reduce impact, customise Live Tile to display tips	24%
7	which specific buildings contribute to impact to what extent	Compare impact levels across buildings and other impact levels	56%

Table 2 presents the results from the one-sample t-tests relating to the eight questions, including the practical significance as indicated by Cohen's d. Cohen's d is an appropriate effect size for the comparison between two means and a Cohen's d value greater than 0.8 indicates a large effect size.

Table 2: *One-sample t-tests: Q1 to Q8 (n = 16; H1: μ ≠ 0.00; d.f. = 23)*

Items	Mean	S.D.	t	p	Cohen's d	Practical
Q1	0.71	0.81	4.30	<.0005	0.88	Large
Q2	2.13	1.23	8.48	<.0005	1.73	Large
Q3	1.71	1.16	7.21	<.0005	1.47	Large
Q4	2.29	1.37	8.21	<.0005	1.68	Large
Q5	0.96	1.08	4.34	<.0005	0.89	Large
Q6	1.63	0.97	8.21	<.0005	1.68	Large
Q7	2.83	0.96	14.41	<.0005	2.94	Large
Q8	0.63	0.82	3.71	.001	0.76	Large

Discussion

Eco-feedback technologies aim to make people aware of their impact on the environment in order to motivate action that reduces this level of impact (Dubois & Pittarello, 2018). The evaluation of the use of the NMU Eco-Feedback application by the students involved a comparison of the responses to the eight items, labelled Q1 to Q8 (Figure 4). The survey was conducted between the pre-test, completed by participants prior to using the NMU Eco-Feedback application and the same eight items in the post-test questionnaire, completed four weeks after using the application. The aim of this comparison was to determine whether the NMU Eco-Feedback application had a positive impact on the participants' environmental awareness.

Pre- and post-test research findings

All students recorded a higher post-test score compared to the pre-test ratings (Figure 4). Participants perceived themselves to be more committed to reducing their general environmental impact after using the NMU Eco-Feedback application (Q1: μ=4.53). Participants felt strongly that changes in behaviour can reduce the university's environmental impact (Q5: μ=5) and thus having access to the university's environmental data can motivate a change in their behaviour (Q8: μ=4.67).

The students emphasised the need for an eco-feedback application at NMU, after using the NMU Eco-Feedback application, as these statements received higher ratings in the post-test. All items related to the awareness of NMU's environmental impact were rated higher after the use of the NMU Eco-Feedback application (Q2: μ=4.33; Q3: μ=4.2; Q4: μ=4.6; Q7: μ=4.47). The use of the application assisted in allowing participants to be more aware of changes they could make in their daily activities to reduce their environmental impact (Q6: μ=4.53).

The average percentage change per statement (Figure 5) illustrates which items were rated higher in the pre- and post-tests. Participants became more aware of NMU's environmental impact using the NMU Eco-Feedback application, as can be seen by the positive changes in items Q2 (41%), Q3 (29%), Q4 (44%) and Q7 (56%). The application also assisted in helping participants become more aware of what changes can be made in their daily activities to reduce their environmental impact (Q6: 24%).

The remaining statements had smaller positive change between pre- and post-tests. Participants indicated that they were more committed to reducing their environmental impact after using the NMU Eco-Feedback application (Q1: 8%), they believed that changes in behaviour can reduce NMU's environmental impact (Q5: 7%) and that providing access to such information provided by the NMU Eco-Feedback application could assist in changing a student's environmental awareness (Q8: 5%). It appears then that the use of an eco-feedback application at an academic institution could encourage positive environmental behavioural change within the institution, as well as in the students' daily lives. The students further indicated that the NMU Eco-Feedback application provided useful feedback with regard to the environmental data at NMU.

One sample t-tests for the pre- and post-tests

In order to determine the significant effect from the sample, t-tests and Cohen's d calculation were performed. Cohen's d is used to represent the extent of differences between two (or more) groups of a given factor (Salkind, 2010). Cohen's d is used for practical significance in a one-sample t-test. The interpretation intervals for practical significance indicated by a Cohen's d value are Not significant (<0.20), Small (0.20-0.49), Medium (0.50-0.79) and Large (0.80+) (Gravetter & Wallnau, 2009). Caution must, however, be taken when interpreting Cohen's d values for small sample sizes.

A one-sample t-test of the factors with the sample size of 16, was performed to determine the existence of statistical and practical significance (Table 2). A p-value of less than 0.5 indicates statistical significance, while Cohen's d value indicates practical significance. Table 2 indicates that all the items had a positive mean score and a large practical significance, as indicated by Cohen's d. The comparison between the pre- and post-tests confirmed that the NMU Eco-Feedback application supports the purpose of an eco-feedback application, as indicated by Dubois and Pittarello (2018). The application provided useful environmental information to promote awareness of the institution's environmental impact. The students became more aware of water and electricity consumption on campus.

Conclusions and future research

The design and use of eco-feedback systems for improving environmental awareness of people on a university campus leads to an increase in environmentally aware lifestyles (Dubois & Pittarello, 2018). The use of eco-feedback technologies provides users with feedback on the impact of their actions towards the environment (Yendapally & Yazdansepas, 2020). Eco-feedback technologies have further been used to create environmental awareness (Spagnolli et al., 2011; Fraternali et al., 2019). Johnson et al. (2017) reported that applied games can have a positive effect on energy related domains and can potentially influence behaviour or behavioural antecedents.

The process followed in this study, establishing environmental awareness levels, introducing an eco-feedback application as an educational tool and the re-evaluation of awareness levels, supports the behavioural change theory. According to Kencanasari et al. (2019), the environmental awareness indicators include factors such as knowledge, attitudes and behaviour or actions. However, Shove et al. (2012) believe that this is too narrow and should be broadened to include social interaction, lifestyles, norms and values as well as technologies and policies in addition to individual behaviour. This study was approached from the broader view and included a high percentage of these factors.

In this exploratory study, the use of and exposure to an eco-feedback application, made participants more aware of the electricity, water and waste impacts at the university. The feedback intervention theory advocates that feedback is an integral component of many educational programmes (Karlin et al., 2015). The NMU Eco-Feedback application provided real-time feedback, which supports the feedback intervention theory. Dubois and Pittarello's (2018) findings also indicated that eco-feedback interfaces required cognitive involvement and emotional engagement by users on a university campus. Overall, the results of the comparison between the pre- and post-tests indicated that the NMU Eco-Feedback application provided support in creating environmental awareness. Participants were generally much more aware of the NMU's environmental impact after using the NMU Eco-Feedback application. Participants became more aware of their own environmental impact and what changes could be made to reduce this impact in their daily activities.

The functionality of the NMU Eco-Feedback application confirmed the design of eco-feedback systems as indicated by Dubois and Pittarello (2018). The colour-coding, symbols and visualisation techniques assisted in finding relevant information regarding the institution's environmental impact as proposed by Frittzpatrick and Smith (2009). The tips assisted participants in becoming more aware of their own environmental impact and of how they could reduce this environmental impact.

The limitations of this exploratory study were the small sample size, using a convenience sample, the scale (questionnaire) containing only eight items and the environmental data not being updated in real-time. Current research involves evaluating the NMU Eco-Feedback application using students from different faculties, extending the questionnaire to focus on the factors, environmental awareness knowledge, attitudes and behaviour (Kencanasari et al., 2019), as well as using real-time environmental data. Future research

includes the development of mobile applications, serious gamification and the use of social media campaigns for use by students to create environmental awareness and influence and promote changes in environmental behaviour.

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Percentage contribution

Areas of contribution	Author	Percentage contribution
Conception or design of the paper, theory or key argument	Calitz	60 %
	Cullen	30 %
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Data collection	Calitz	10 %
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Analysis and interpretation	Calitz	40 %
	Cullen	10 %
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Drafting the paper	Calitz	70 %
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Institutional Analysis of Adoption of Agroforestry Practices in the Eastern Cape Province of South Africa

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Abstract

Agroforestry practices are innovations developed in response to problems associated with inappropriate land use practices. The latter refers to the use of agricultural land for non-agricultural purposes because of an increase in urbanisation, rapidly developing industry, and investments, and, finally, gaps in laws and regulations (Cengiz, 2013). Agroforestry practices are land-based economic development strategies with a perceived positive role in supporting rural livelihoods. Using a logistic regression model with cross-sectional data, this study explores the impact of institutional factors and incentive mechanisms that affect the adoption of agroforestry innovations. The study finds that a larger number of extension services, access to credit, access to extension, information exchange among farmers, trust in local institutions, active participation in social groups and organisations, and prior exposure to agricultural technologies are the variables that positively affect the adoption of agroforestry innovations in the study area. These findings have policy implications in promoting integrated rural development in the Eastern Cape Province of South Africa.

Keywords: *adoption, agroforestry, innovation, institutions, logit model, odds ratios, South Africa*

Introduction

In this paper agroforestry is defined as "land use that involves deliberate retention, introduction, or mixture of trees or other woody perennials in crop or animal production fields to benefit from the resultant ecological and economic interactions" (MacDicken &Vergara, 1990, p. 382). The prevailing environmental distress in South Africa, particularly in rural areas, calls for the adoption of integrated sustainable rural development strategies like agroforestry practices. The experiences from other countries show that agroforestry can contribute to sustainable rural development as a natural resources' management technology with proven positive impacts on the economy of rural households (Van Noordwijka, 2019). Following a gradual evolutionary process, agroforestry has become an interdisciplinary science with wider application in the areas of socio-economic, ecological, and environmental development (Lassoie & Buck, 2000; Food & Agricultural Organisation [FAO], 2013). Although agroforestry practices were introduced to South Africa as early as 1887 (Nair, 1993), the sub-sector has not been well developed due to weak institutional support and poor incentive mechanisms. The Eastern

Cape Province, one of the rural provinces in South Africa, was selected for the study due to its vast potential for agricultural activities and agroforestry practices.

Smallholder agriculture dominates the landscape of the developing world. Small farmers are a key group requiring attention in agricultural and rural development. Smallholders will not be able to solve the challenge of sustainable agriculture by themselves. Efforts are required from both the public and the private sector and effective public-private partnerships along the agricultural and food value chain. Sustainable agriculture also calls for the integration of modern, science-based technologies with local knowledge, and the participatory involvement of farmers in the technology process. Contrary to what is known about most of the countries in the Southern African Development Community (SADC) region, the practice of agroforestry is not well developed in South Africa. This problem is directly related to the dualistic nature of the agriculture sector in the country and bias against smallholder farmers in favour of commercial monoculture farming. Agroforestry is a multiple land use system where agricultural crops and woody perennials are grown on the same land management unit (Owunubi & Otegbeye, 2012; Brown, Mille, Ordonez & Baylis, 2018). Traditional agroforestry systems have been practised for millennia by agrarian-based societies throughout the world (Garrity, 2006). These systems demonstrate an ability to conserve biodiversity, suppress insect pests and weeds better than monoculture agricultural systems (Sileshi, Akinnifesi, Ajayi & Place, 2009). Recently, agroforestry has progressed to become one of the science-based pathways for achieving important objectives in natural resource management and poverty alleviation (Owunubi & Otegbeye, 2012; Van Noordwijka, 2019). The objective of this study is to explore institutional factors and incentive mechanisms that affect the adoption of agroforestry practices in the Eastern Cape Province of South Africa. The study hypothesises that institutional factors and existing household incentive mechanisms have statistically significant impacts on the adoption of agroforestry practices in the study areas. These hypotheses are proved based on binary logistic regression analysis.

Growth and sustainability of the South African agricultural sector has been challenged by factors such as decreasing soil quality and changing weather patterns, among others (Department of Agriculture, Forestry and Fisheries [DAFF], 2012). A significant proportion (i.e. slightly less than 40%) of the South African population is residing in rural parts of the country. It is widely believed that land-based economic development strategies play a major role in livelihood improvement and economic development in South Africa (Shackleton, Shackleton & Cousins, 2001; Lahiff, 2002; Manona, 2005). Moreover, South Africa's new growth path document perceives the agricultural sector as a major contributor to job creation and rural development (Sibisi, 2011).

Limitations in this study are linked to the unavailability of data pertaining to different types of agroforestry practices in the study areas; specific factors affect a specific type of agroforestry practice. Collection of longitudinal data on various types of agroforestry technology adoption would be useful for understanding appropriate agroforestry technologies for specific provinces or agro-climatic regions in the country. This would further speed up improved agroforestry adoption and indicate areas for effective policy intervention by government agencies and NGOs. A further limitation is the lack of a qualitative, descriptive account of agroforestry

practices in the area. Future studies in the area could consider these missing aspects of this study.

The remaining sections of the paper are organised as follows. Section two briefly reviews the concept of agroforestry practices and the roles of institutions in promoting such practices. Section three presents the data and methodology used in the study while section four presents discussions on relevant issues in the study areas and empirical findings of the study. The last section concludes the study.

Literature review

Agroforestry practices and the role of institutions

The adoption of agroforestry technology can be associated with the concept of induced innovation, which was influenced by Boserup's (1965) analysis of agricultural growth. Boserup (1965) showed that as population densities rise, demand for agricultural products increases, and the resulting land pressures induce adoption of technological and institutional practices to intensify land use. Basically, the scarcity of land relative to labour and/or capital induces investment in additional labour or capital inputs to maintain or increase agricultural production. Agroforestry practices are considered 'induced innovations' as they have been developed in different parts of the word in response to land use pressures in an attempt to address deteriorating environmental conditions and are common to innovation decision processes in any sector (Reed, Dougill & Taylor, 2007; Sahoo,Wani & Satpathy, 2020).

In terms of climate change and the global carbon cycle, agroforestry is beneficial for at least two reasons. Firstly, trees fix and store carbon from the atmosphere. Because trees are perennial plants they can function as active carbon sinks for many years; trees continue to store carbon until they are cut or die. Secondly, agroforestry can reduce the need to clear forests for agriculture by providing an alternative to shifting cultivation (Sanchez & Jama, 1990). A key structural attribute of agroforestry is multiple vertical strata that occupy space efficiently and provide a range of growing conditions. The tree canopy provides shade and reduces evaporation from the soil. This shading effect also reduces temperature and provides a more moderate microclimate for crop growth. The tree canopy further provides shelter from wind, protects the soil from the impacts of heavy rain and helps to reduce soil erosion. Leaf litter acts as mulch and reduces both evaporation and surface runoff and erosion. Incorporation of leaves into soil adds organic matter and improves soil quality. Below the ground, tree roots penetrate to deeper soil layers than crop roots and bring nutrients to the surface via leaf fall. Nitrogen-fixing agroforestry tree species capture nitrogen, a key nutrient from the atmosphere and make it available to crop plants. The economic benefits of agroforestry derive from diversification of outputs, spreading risk, and, in many cases, increasing physical output (MacDicken &Vergara, 1990). These characteristics may also make agroforestry systems more resistant to climate change than mono cropping systems. There are multidimensional aspects to agroforestry which require in-depth scientific analysis for the extensive application of agroforestry practices in sustainable land management endeavours.

Table 1 *Major agroforestry practices in the tropics*

Type of agroforestry practice	Brief description
Taungya	Agricultural crops grown during the early stages of forest plantation establishment
Home gardens	Intimate, multi-storey combinations of a variety of trees and crops in homestead gardens; livestock may or may not be present
Improved fallow	Fast growing, preferably leguminous woody species planted during the fallow phase of shifting cultivation; woody species improve soil fertility and may yield economic products
Multipurpose trees	Fruit and other trees randomly or systematically planted in cropland or pasture for the purpose of providing fruit, fuel wood, fodder, and timber, among other services, on farms and rangelands
Plantation-crop combinations	Integrated multi-storey mixtures of tree crops (such as coconut, cacao, coffee, and rubber), shade trees, and/or herbaceous crops
Silvopasture	Combining trees with forage and livestock production, such as grazing in existing forests; using trees to create live fences around pasture; or to provide shade and erosion control
Shelterbelts and windbreaks	Rows of trees around farms and fields planted and managed as part of crop or livestock operations to protect crops, animals, and soil from natural hazards including wind, excessive rain, seawater, or floods
Alley cropping	Fast-growing, preferably leguminous woody species in single or grouped rows are applied as mulch into the agricultural production alleys to increase organic matter and nutrients and/or are removed from the field for other purposes such as animal fodder

Source: Adapted from Alavalapati & Nair (2001) and Alavalapati, Mercer & Motambault (2004)

Factors affecting adoption of agroforestry practices

Because of its ecological, economic, and social attributes, agroforestry is widely recognised as a sustainable land management practice particularly in the tropics (Lassoie & Buck, 2000; FAO, 2013). In this section we review existing literature on factors, incentives, mechanisms, and processes linked to the adoption of agroforestry. There are two types of studies associated with the analysis of agroforestry technologies: *ex-ante* and *ex-post* studies. Ex-ante studies of the profitability, feasibility and acceptability of experimental agroforestry systems are essential for researchers in helping design appropriate systems, for development agencies in determining how and where to allocate scarce programme funds, and for farmers as they experiment and test new systems as part of the adoption process. Ex-post studies are equally important for predicting which segments of society will adopt at various times in the adoption cycle, for estimating the livelihood and equity impacts of agroforestry projects, and for designing effective policies to encourage adoption by target populations. Pattanayak, Mercer, Sills and Yang (2003) reviewed

ex-post studies on adoption of agricultural and forestry technology by smallholder farmers and found that five categories of factors explain technology adoption: household preferences, resource endowments, market incentives, biophysical factors, and risk and uncertainty. Likewise, in a comparison of tree planting between Brazil and Panama, Simmons, Walker and Wood (2002) found that institutional variables were more important than household preference variables.

Methodology

Study area and the data

The Eastern Cape Province is situated in the south-eastern part of South Africa. The north-west part of the province borders on KwaZulu-Natal and touches the southern tip of the Drakensberg range. Mountains and hills are common in the southern parts of the province, although the Karoo is generally flat. The dominant land use in the majority of the Eastern Cape is livestock grazing, along with dry land agriculture in the eastern section of the province. Figure 1 shows the study area.
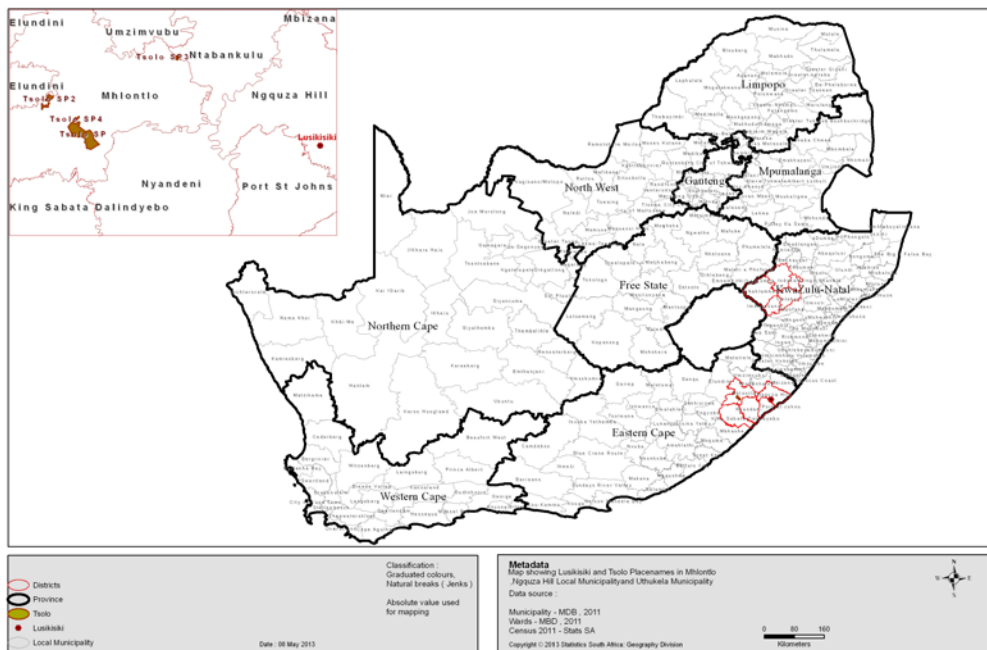
Figure 1 *Map showing study sites* (Source: StatSA – customised for study)

Agriculture in the Eastern Cape is dominated by intensive beef and fruit farming in the south-western parts, and subsistence farming (mainly cattle, maize and sorghum) in the north-eastern regions. The southern coastal area is conducive to forestry. The Eastern Cape faces several environmental threats, chiefly land degradation. It exhibits high levels of soil

degradation, particularly in commercial farmland areas. In other areas, the thicket biome is threatened by invasive alien species and overgrazing by domestic herbivores.

Quantitative data was collected from Tsolo and Lusikisiki Magisterial Districts of the Eastern Cape Province by use of a pre-tested, validated, and standardised questionnaire. The survey was conducted from December 2011 to June 2012. These two sites were selected for their noticeable agroforestry practices. See Figure 1 for the geographical location of the study sites. A total of 300 households were surveyed. Mixtures of purposive and systematic random sampling methods were used to draw the final sample. Table 2 presents the descriptive statistics of the dependent and explanatory variables in the regression analysis. The dependent variable for both groups of explanatory variables used in the logit regression was the dichotomous variable of agroforestry adoption. The value '1' indicates the respondent had adopted any one of those agroforestry practices mentioned in Table 1.

Table 2 *Descriptive statistics of variables included in the analysis*

Explanatory Variable Code	Variable Description	Mean	Std. Deviation
Institutional variables			
WAL	Women's access to land i.e. land ownership	0.86	0.345
PRAs	Participation in the religious institutions	1.53	1.186
IEWF	Information exchange among farmers	1.92	0.796
TEWF	Technical exchange with other farmers e.g. farm equipment	2.02	0.892
TP	Trend of participation in groups or organisations among household members	0.37	0.484
TA	Trust in local associations /organisations	0.44	0.497
Sample Size (N)	300		
Dependent variable	Adoption of agroforestry technologies: if "yes" 1, if "no" 0		
Household incentive mechanisms			
AE	Access to extension	.81	.393
FES	Frequency of extension services	1.35	1.039
AC	Access to credit	.64	.480
PEAT	Prior exposure to agricultural technologies	.40	.654
Agroforestry PS	Agroforestry products harvested/services generated	.52	.500
IO	Incentive obtained	.24	.430
RI	Risks involved	.43	.496
Valid N	300		
Dependent variable	Adoption of agroforestry technologies: if "yes" 1, if "no" 0		

Source: Computed from survey data

Empirical model: Logit model specification

Most agroforestry adoption studies have relied on logit or probit models to analyse dichotomous or binary adoption decisions in which the dependent variable is binary (1 if adopts, 0 otherwise). This study used a more realistic logit model that assumed logistic distribution unlike the probit model that assumes normal distribution to find the best fitting and most parsimonious yet technically reasonable model. Logit models employ logit regressions with correction for heteroskedasticity. Heteroskedasticity usually arises in cross-section data where the scale of the dependent variable and the explanatory power of the model tend to vary across observations (Green, 2002; Klieština, Kočišováa & Mišankováa, 2015). For more details on the benefits and limitations of logit model see Gujarati (2004, pp. 596-609).

The logit modelling approach considers adoption as a dichotomous independent variable, which takes '1' if adoption is present and '0' otherwise. The model produced in logistic regression is non-linear and the outcome variable, Y, is the probability of having one outcome or another based on a non-linear function of the best linear combination of predictors, with two outcomes. Following a logistic regression model (applied by Christensen, 1997; Peng & So, 2002; Agresti & Finlay, 2009; Kabwe, 2010; Zerihun, 2014) we have:

$$\ln\left(\frac{\pi}{1-\pi}\right) = \log(odds) \Rightarrow \log Y = \alpha + \beta X \tag{1}$$

When we take the antilog on both sides of equation (1), we derive the equation to predict the probability of the occurrence of the outcome of interest as shown in equation (2):

$$\pi = P(Y) = \frac{e^{\alpha+\beta\chi}}{1+e^{\alpha+\beta\chi}} \tag{2}$$

where

π is the probability of the outcome of interest (Y=1);

α is the Y- intercept (constant of the equation);

β_i are the regression coefficients of the explanatory variables;

X_i are a set of predictors; and

e is the base of the system of the natural logarithms.

The dependent variable Y_{1i} =
$\begin{cases} 0 \text{ if household has not adopted agroforestry technologies} \\ 1 \text{ if household has adopted agroforestry technologies} \end{cases}$

Finally, taking the log of equation (2) we have the following logit model for estimating coefficients to find the best linear combination of predictors to maximise the likelihood of obtaining the observed outcome frequencies,

$$\ln\left(\frac{P(Y=1)}{P(1-P(Y=1))}\right) = Y_{1i} = \alpha^* + \beta_1^*\chi_1 + \beta_2^*\chi_2 + \dots \beta_n^*\chi_n \tag{3}$$

Discussion

Land tenure types in the study areas

As shown in Figure 2, in Tsolo large land size dominates followed by a category with land size less than one hectare and then medium land size (i.e.2ha). However, in Lusikisiki households a small land size dominated.
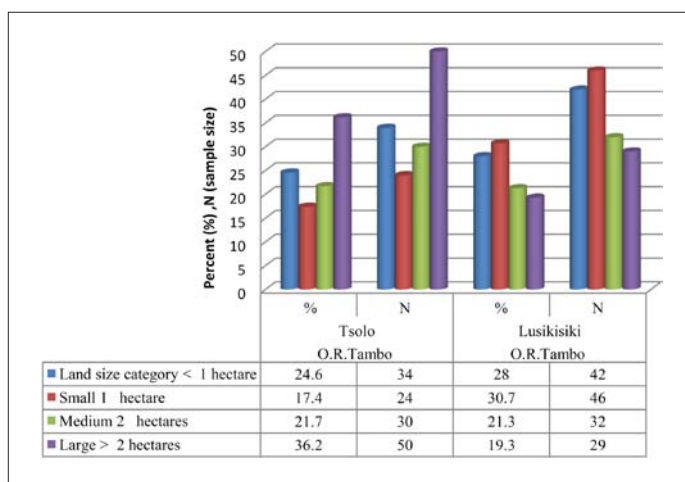
Figure 2 *Land size categories in Tsolo and Lusikisiki Magisterial Districts*
(Source: Computed from survey data)

As indicated in Table 3, when we consider the age group of the respondents, 66.7 % are in the age group 20-29 years and own agricultural land less than one hectare. This age group also owns the highest percentage (33.3%) of land that is one hectare. In the two hectares category, the age group 50-59 years possessed 27.7% of the land. Of the 60-69-year-old respondents, 32.8% owned the large land size category of two hectares and larger.

Table 3 *Agricultural land size by age group*

Land size category	20-29 years		30-39 years		40-49 years		50-59 years		60-69 years		70+ years		Total	
	%	N	%	N	%	N	%	N	%	N	%	N	%	N
<1ha	66.7	2	33.3	8	31.4	11	26.6	25	18.8	12	25.0	17	26.0	75
1 ha	33.3	1	25.0	6	28.6	10	14.9	14	26.6	17	32.4	22	24.3	70
2 ha	.0	0	20.8	5	14.3	5	27.7	26	21.9	14	17.6	12	21.5	62
>2 ha	.0	0	20.8	5	22.9	8	29.8	28	32.8	21	25.0	17	27.4	79
Total	100	3	100	24	100	35	100	94	100	64	100	68	100	288

Source: Computed from survey data   Note: Percent (%), N (sample size)

Respondents were asked how they acquired their land and to state the land tenure situation in their localities. These questions are relevant due to the fact that tree planting is a long term investment which requires tenure security. Farmers may be reluctant to invest on their land to conserve it if they are uncertain about future rights to use it. On the other hand, a secure tenure system could lead to better land management technologies, which would improve soil quality and boost agricultural productivity. Many empirical studies claim that secured land rights create an essential economic incentive that enhance long-term land investment, which affects soil fertility and hence significantly influences agricultural productivity. However, some studies claim that land tenure security and/or insecurity are not significant for determining long-term land investment and thereby agricultural productivity. For instance, empirical findings by Brasselle, Gaspart and Platteau (2002) using household data from Burkina Faso cast doubt on the systematic influence of land tenure security on long-term and investment. In this study, as shown in Figure 3, the most frequent land acquiring modality is inheritance through communal ownership, followed by permission to use (user-right) and purchase. Inheritance was dominant in Tsolo while permission from local chiefs to use land was dominant in Lusikisiki.

	Inherited	Permission to use	Rented	Purchased	other
■ Land acquiring modality Tsolo	55.6	4.5	0.8	34.6	4.5
■ Land acquiring modality Lusikisiki	34.9	64.4	0	0	0.7
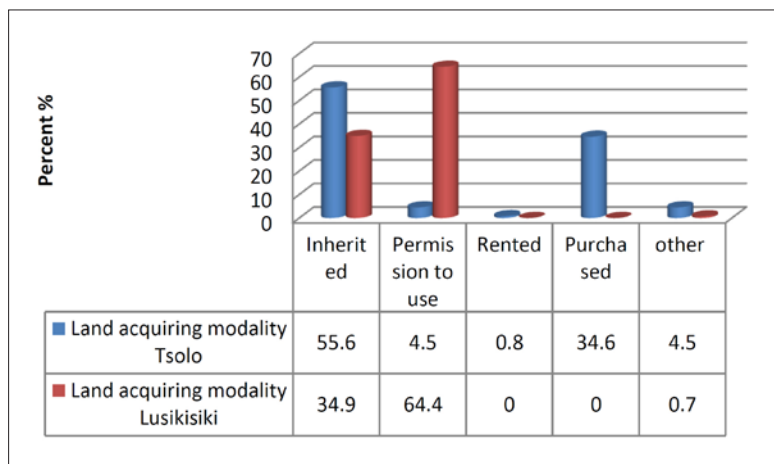
Figure 3 *Land acquiring modalities in the study areas*
(Source: Computed from survey data)

Of the respondents in Tsolo, 34.6% said they acquired their land through purchase. It can be useful to analyse the extent of the land market in the area. If there is an efficient land market, this can lead to optimal utilisation of land resources in the area. However, this is beyond the scope of this study. The respondents were also asked about the type of land ownership. As shown in Table 4, in Lusikisiki 67% of the respondents claimed that they had private ownership of land with title deeds. In contrast, only 34.4% in Tsolo have private ownership. Additional investigation is needed, however, to come to any conclusions given the communal ownership of land in the areas.

**Table 4** *Existing land tenure type in the study area*

Existing tenure type	Tsolo		Lusikisiki		Total	
	%	N	%	N	%	N
Own with title deed	34.4	44	66.9	95	51.5	139
Owned by parents or relative but with user right	20.3	26	8.5	12	14.1	38
Own without title deed	37.5	48	23.9	34	30.4	82
Community ownership	6.3	8	.7	1	3.3	9
Other	.8	1	.0	0	.4	1
Total	100.0	128	100.0	142	100.0	270

Source: Computed from survey data

The respondent farmers were also asked to list major problems in getting farmland in their localities. Some of the problems listed, among many, included gender bias in favour of males, being single (i.e. unmarried children are not entitled to inherit land), and corrupt land distribution practices by local chiefs. These problems need to be addressed for the efficient utilisation of land in the areas.

Social capital in the study areas

Social capital has become a critical issue in agricultural development as it plays an important role in collective action, such as management of common resources and collective marketing (Njuki, Mapila, Zingore & Delve, 2008). At the farmer level, although there are many factors that influence adoption and use of agroforestry technologies, studies have shown that rural communities characterised by strong social capital have faster rates of technology diffusion and improved environmental management (Woolcock & Sweetser, 2007). This is because social capital may be the most important resource available for poor communities that are often burdened with low incomes, poor education, and few material and financial assets (Woolcock & Sweetser, 2007). To observe the impact of social capital on the adoption of agroforestry technologies in the study areas, dummy variables for the household's membership in a group organisation and for the level of trust in local institutions were included in the survey. Most of the respondents are members of religious associations (29%) (see Figure 4). However, membership in religious associations does not contribute positively towards agroforestry technology adoption in the study areas. This requires further investigation. The other variable for social capital in this study was the respondent's trust in local organisations and institutions which positively contributes towards adoption of agroforestry technology.
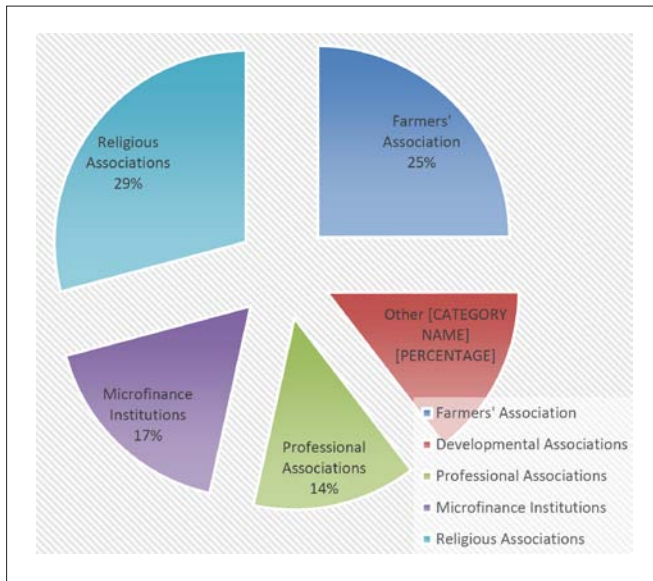
Figure 4 *Types of membership among agroforestry adopting farmers*
(Source: Author, estimated from survey data)

Institutional Aspects of Agroforestry in the Study Areas

As summarised in Table 5, there are seven assertions to assess the institutional aspect of agroforestry in the study areas. The respondents were asked to confirm those assertions using a scale of five: strongly disagree (5), disagree (4), no opinion (3), agree (2), and strongly agree (1).

Table 5 *Measures of institutional aspects of agroforestry in the study areas*

Assertions/hypothesis	Statistics	Strongly agree	Agree	No opinion	Disagree	Strongly Disagree
All the stakeholders are working jointly in promoting agroforestry or forestry	Frequency	29	86	26	27	53
	Percent	9.7	28.7	8.7	9.0	17.7
	Valid Percent	13.1	38.7	11.7	12.2	23.9
	Cumulative Percent	13.1	51.8	63.5	76.1	100.0
Agroforestry practices are promoted by the Department of Agriculture and Forestry	Frequency	39	93	8	24	42
	Percent	13.0	31.0	2.7	8.0	14.0
	Valid Percent	18.9	45.1	3.9	11.7	20.4
	Cumulative Percent	18.9	64.1	68.0	79.6	100.0

Assertions/hypothesis	Statistics	Strongly agree	Agree	No opinion	Disagree	Strongly Disagree
Agroforestry helps reduce poverty	Frequency	152	50.7	64.1	64.1	152
	Percent	66	22.0	27.8	92.0	66
	Valid Percent	5	1.7	2.1	94.1	5
	Cumulative Percent	6	2.0	2.5	96.6	6
Agroforestry can meet the household demand	Frequency	33	46	10	12	11
	Percent	11.0	15.3	3.3	4.0	3.7
	Valid Percent	29.5	41.1	8.9	10.7	9.8
	Cumulative Percent	29.5	70.5	79.5	90.2	100.0
Agroforestry practices decrease the land for other uses	Frequency	4	14	10	34	57
	Percent	1.3	4.7	3.3	11.3	19.0
	Valid Percent	3.4	11.8	8.4	28.6	47.9
	Cumulative Percent	3.4	15.1	23.5	52.1	100.0
The existing tenure system disfavours promotion of agroforestry in the study areas	Frequency	8	19	9	31	22
	Percent	2.7	6.3	3.0	10.3	7.3
	Valid Percent	9.0	21.3	10.1	34.8	24.7
	Cumulative Percent	9.0	30.3	40.4	75.3	100.0
Overall, the adoption of agroforestry practices has positively affected the household's livelihoods	Frequency	13	40	14	6	3
	Percent	4.3	13.3	4.7	2.0	1.0
	Valid Percent	17.1	52.6	18.4	7.9	3.9
	Cumulative Percent	17.1	69.7	88.2	96.1	100.0

Source: Author, computed from survey data

With reference to the results summarised in Table 5, when we consider the assertion that 'all the stakeholders are working jointly in promoting agroforestry or forestry' with regard to the extreme values using a valid percentage as a point of comparison, most of the respondents did not support this. This means that stakeholders working to promote agroforestry practices in the localities do not work jointly and do not have a common strategy towards promoting

agroforestry practices. The second assertion 'agroforestry practices are promoted by the Department of Agriculture and Forestry' was also not supported. This implies that the line departments in charge of prompting agroforestry are not working to meet the expectations of the respondents. The next assertion which stated that agroforestry helps to reduce poverty was inconclusive. There was also not enough evidence to accept the fourth and the fifth assertions. This means that agroforestry practices thus far do not meet household demands for various products and services. However, the argument that agroforestry will reduce the land available for other alternative agricultural uses was not supported by the data. The sixth assertion that the existing common tenure system (i.e. communal ownership of land) discourages the adoption of agroforestry practices was not accepted. The last assertion was also strongly rejected by the respondents which implies that, in general, the adoption of agroforestry practices has not positively affected the livelihoods of households in the study areas. This finding corroborates with the study by Sahoo and Wani (2019) for rural India. In addition, some of these assertions are also verified by the empirical results discussed in the next section.

Empirical results

Logistic regression result on institutional factors

The explanatory variables selected as institutional variables in this study included: women's access to land, participation in religious associations, information and technical knowledge exchange among farmers, participation trends in groups or organisations, and trust in local organisations or institutions. Incentive mechanisms can be part of institutional setup in a given society, however, in this study these two categories of factors affecting agroforestry adoption were treated separately.

As shown in Table 6 women's access to land significantly reduced the maximum likelihood of agroforestry technology adoption at 1% level of significance. However, the odds ratio was very low. This could be because of weak socioeconomic characteristics of female headed households. This finding is in line with the study by Oino and Mugure (2013) and studies from Malawi (Thangata & Alavalapati, 2003) and Kenya (Sanchez & Jama, 2002) show that female-headed households tended not to adopt agroforestry technology when compared to those headed by males. Old women, widows and female-headed households generally do not have access to secure land rights. This could be due to gender-equity issues linked to the introduction of technology to farmers, which includes land tenure issues (Oino & Mugure, 2013). An increase in the other three variables (namely, the level of information exchange among farmers, increasing trends of participation in developmental groups or organisations, and household head's trust in local institutions) increased the likelihood of agroforestry technology adoption by higher odds ratios i.e. by more than one time when compared with the rest of the variables in the model.

Table 6 *Logistic regression results on the effects of institutional factors on the adoption of agroforestry practices*

Variable Name	B	S.E.	Wald	df	Sig.	Exp(B) (odds ratio)
Women's access to land	-1.680***	.565	8.860	1	.003	.186
Participation in religious institutions	-.295**	.128	5.306	1	.021	.744
Information exchange with other farmers	.286	.181	2.509	1	.113	1.331
Technical exchange with other farmers	-.347**	.162	4.583	1	.032	.707
Trend of participation in social groups or organisations	.225	.370	.369	1	.543	1.252
Trust in local institutions/organisations	.285	.373	.584	1	.445	1.330
Constant	2.896	.734	15.590	1	.000	18.105
Omnibus Tests of Model Coefficients ■ Chi-square ■ Df ■ Sig.	20.501 6 0.002					
% correct predictions	72.2					

Source: Estimated from survey data

Logistic regression result on incentive mechanisms

In most cases existing incentive mechanisms can promote the adoption of agroforestry technologies. Here all the variables used to assess the impact of the incentive mechanism on agroforestry adoption are qualitative variables represented by proxy or dummy variables for the purpose of logistic regression. The overall model has 74.7% correct predictions with a significant Chi-square value. Four of the variables in the regression analysis positively affect the likelihood of agroforestry technology adoption with larger odds ratios while the other three variables negatively affect the process (see Table 7). However, only two of the variables have maximum odds ratios with the positive and significant effect on the agroforestry adoption both at 1% level of significance. These variables are frequency of extension services and access to credit. The respondents with more frequent agricultural extension services adopted agroforestry practices five times more than those with no/less frequent extension services. Similarly, the respondents with access to financial credit services adopted agroforestry practices twice as much as those with no access to credit services.

Table 7 *Logistic regression results on the effect of household incentive mechanism on the adoption of agroforestry innovations*

Variable Name	B	S.E.	Wald	df	Sig.	Exp(B) (odds ratio)
Access to extension	.410	.291	1.984	1	.159	1.506
Frequency of extension services	1.607***	.482	11.094	1	.001	4.988
Access to credit	.840***	.327	6.598	1	.010	2.317
Prior exposure to agricultural technology	.048	.284	.029	1	.865	1.050
Agroforestry products harvested/services generated	-.091	.502	.033	1	.856	.913
Incentive obtained	-.829	.591	1.965	1	.161	.437
Risks involved	-.185	.160	1.334	1	.248	.831
Constant	.614	.595	1.064	1	.302	1.848
Omnibus Tests of Model Coefficients ▪ Chi-square ▪ Df ▪ Sig.	47.347 7 .000					
% correct predictions	74.7					

Source: Author, computed from survey data

Conclusion and policy implications

Previous studies in the adoption of agroforestry practices propose the need for additional research for better understanding of the role of incentive mechanisms and institutional factors. This study focuses on these factors in the Eastern Cape Province of South Africa. In the two study areas, the younger generation of farmers tend to own less than one hectare of land. The respondents were also asked how the prevailing tenure system affects the adoption process. The argument was that farmers would be reluctant to invest in their land and make efforts to conserve it if they were uncertain about future rights to use it. On the other hand, a secure tenure system could lead to better land management technologies, which would ultimately improve soil quality and boost agricultural productivity. The main conclusion from empirical studies so far has claimed that secured land rights create an essential economic incentive that enhance long-term land investment, which improves soil fertility and hence significantly influences agricultural productivity. The findings in this study do not support the hypothesis that the existing tenure system disfavours promotion of agroforestry practices in the study areas.

Among institutional variables included in this study, women's access to land significantly reduces the likelihood of agroforestry technology adoption at 1% level of significance. However,

the odds ratio was very low. This could be due to the poor socio-economic situation of female-headed households. The other three variables in this model, namely, the level of information exchange among farmers, a trend towards increased participation in developmental groups or organisations, and trust of the household head in local institutions, increase the likelihood of agroforestry technology adoption by more than once if the opposite were the case.

In the second model, the variables of incentive mechanisms regressed on the dependent variable. Only two of the variables had maximum odds ratios with the positive significantly effect on agroforestry adoption at 1% level of significance. These variables were frequency of extension services and access to credit. The respondents with more frequent agricultural extension services adopted agroforestry practices five times more than those with no/less frequent extension services. Similarly, the respondents with access to financial credit services adopted agroforestry practices more than twice more than those with no access to credit services.

Relevant authorities should facilitate financial credit services and incentive schemes via various portfolios like the Comprehensive Agricultural Support Programme (CASP) for those framers with experience and willingness to promote agroforestry practices. The activities of agricultural/forestry/agroforestry extension services should continue a regular basis in consultation with local municipalities, landowners, farmers, traditional authorities, and individual households. To speed up the adoption of agroforestry practices in the study areas, the nexus between land tenure systems and other institutional variables needs to be explored further. Farmers with insecure land rights tend to be unwilling to plant trees. Improved access to land is vital to improve adoption of agroforestry practices, though not necessarily via individual title deeds. The ongoing land reform in South Africa thus should contribute towards adoption of agroforestry practices among smallholder farmers.

Acknowledgements

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Project-based Learning for Environmental Sustainability Action

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Abstract

The quest for social and economic development coupled with a growing population has led to complex and unsustainable interactions between humans and the natural resources of planet Earth. One approach to addressing complex, 'wicked' problems involves closing the gap between the sustainability knowledge of individuals and the competencies for positive environmental behaviours. Project-based learning is one teaching-learning strategy which provides opportunities for cultivating a wide range of sustainability competencies to close this gap. Two cases are presented in this paper in which project-based learning was used for fostering environmental competencies and advancing sustainability. One relates to teachers in a graduate course, and the other, to students using an online learning platform. Evaluation of various qualitative documents and artefacts produced by participants revealed that i) teachers and students were motivated and enabled to take action on environmental and sustainability issues through project-based learning ii) participants' environmental knowledge and sustainability competencies such as communication and collaboration skills were enhanced. School administrators should therefore encourage a culture where project-based learning is infused into the curriculum, and teachers' collaborative efforts regarding projects are supported.

Keywords: *project-based learning, education for sustainable development, teacher preparation, online learning platform*

Introduction

A number of today's sustainability challenges can be characterised as 'wicked' problems that are "highly resistant to resolution" (Australian Public Service Commission, 2007, p. 3). These problems include a range of issues such as obesity, land degradation, and, of course, climate change (Australian Public Service Commission, 2007). These and other wicked problems have the potential to "threaten at least the standard of living for most of the people around the globe, and possibly the survival of the species" (Jones & Akura, 2017, p. 75). These issues are wicked in nature due to their distinguishing characteristics, which include: they are difficult to define, multi-causal in nature with interdependencies, socially complex, involve multiple stakeholders with contrasting views and have no definitive solution (Australian Public Service Commission, 2007; Krasny, 2013; Wright & Monsour,

2020). Given the nature of these problems, environmental scientists have proposed several approaches to addressing them including cross-disciplinary and participatory research and systems thinking (Krasny, 2013).

Traditional education, rooted in what Buckles (2018) referred to as the Modern Social Imaginary (akin to a modern worldview), can be seen as a contributor to these wicked problems given that it has promulgated the idea that the natural world is measurable, controllable, predictable, and subject to humans' manipulation. A different type of education is therefore needed to tackle these issues (Jones & Akura, 2017). Leicht et al. (2018) proposed that "... in an increasingly complex and interconnected world with a very real existential threat such as climate change, there is a growing demand for education that goes beyond acquiring knowledge and skills to find jobs. It has become clear that education is not only an instrument for sustainable development but that the concept of teaching and learning must be transformed to enable individuals to lead sustainable development as agents of change" (p. 32). Education for Sustainable Development (ESD) offers considerable potential for addressing wicked problems given the pedagogies and competencies it embraces, such as systemic thinking, problem solving skills, authentic and real-world learning (Jones & Akura, 2017; Leicht et al., 2018). Among its learning outcomes are collaborative decision-making, intergenerational perspectives, and action competencies (UNESCO, 2014).

Education for Sustainable Development "empowers learners to take informed decisions and responsible actions for environmental integrity, economic viability and a just society, for present and future generations, while respecting cultural diversity. It is about lifelong learning, and is an integral part of quality education. ESD is holistic and transformational education which addresses learning content and outcomes, pedagogy and the learning environment. It achieves its purpose by transforming society" (UNESCO, 2014, p. 12). Education for Sustainable Development is thought to be broader than environmental education being set "... in the broader context of socio-cultural factors and the socio-political issues of equity, poverty, democracy and quality of life..." (Gough, 2006, p. 2).

According to Gough (2006), the 'language' of sustainability emerged during the 1980s and 1990s through major global documents, entities, and forums such as the World Conservation Strategy, the World Commission on Environment and Development, and the United Nations Conference on Environment and Development (UNCED). Education's role within and for sustainability was also discussed and voiced during this time. *Agenda 21*, one of the major outcomes of the UNCED, outlined four main emphases of ESD, in Chapter 36, one of which was the reorientation of education towards sustainability. This reorientation involves "developing strategies to teach awareness, skills, perspectives, and values that will guide and motivate people to pursue sustainable livelihoods, participate in a democratic society, and live in a sustainable manner" (McKeown & Hopkins, 2003, p. 120). Hume and Barry (2015, p. 733) proposed that ESD must be "interdisciplinary, action-orientated, and holistic and combine both cognitive and conative aspects, as well as integrating both ethical and political analyses". Further, it is important to note that, as voiced in *Agenda 21*, ESD must take place at all educational levels and in formal and non-formal education. Education for Sustainable Development has been promoted more recently through the Decade of Education for Sustainable Development

(DESD), the Global Action Programme (GAP) on ESD, and the Sustainable Development Goals (SDGs), in particular SDG 4 and Target 4.7.

With increasingly pervasive threats of wicked problems, ESD's potential for addressing these at all educational levels is clear. In light of this, we explore Project-Based Learning (PjBL) in this paper, highlighting how it can support ESD to foster competencies required for addressing wicked problems. We focus on two seemingly disparate examples drawn from Jamaica and Bulgaria, one of which focuses on teachers in a graduate course, and the other on students using an online learning platform.

There are many examples in the literature of studies on PjBL applied to sustainability. This paper, however, highlights PjBL in two country contexts – Jamaica and Bulgaria – that are not always in the forefront of ESD literature. The paper is guided by the following question: *In what ways do these two case studies illustrate the use of project-based learning to promote competencies in support of environmental sustainability?*

Theoretical framework

Education for sustainable development competencies

Considering the role of education in conveying the messages of sustainability to learners and empowering them to take an active part in creating sustainable societies, the United Nations Economic Commission for Europe (UNECE) proposed a strategy to "facilitate the introduction and promotion of education for sustainable development" (UNECE, 2005, p. 2) for member states. Among the actions targeted was to "develop the competence within the education sector to engage in ESD" (p. 10). This mandate might have contributed to considerable work being done in identifying and naming specific sustainability competencies.

There are varying interpretations of the term 'competencies' in different sectors and contexts. Lambrechts et al. (2013) indicated that competencies are sometimes equated with ESD knowledge, skills, and attitudes. Leicht et al. (2018), however, defined competencies as "the capacity or disposition to act to address complex challenges..." (p. 45). Wiek et al. (2016) offered a similar definition: "a functionally linked complex of knowledge, skills, and attitudes that enable successful task performance and problem solving" (p. 242). In all three definitions, specific elements must be present in order to address sustainability problems.

In trying to identify these specific elements, various frameworks have been proposed including: the Curriculum, Sustainable Development, Competences, Teacher Training (CSCT) framework (consisting of five competence domains) (Sleurs, 2008), the UNECE (2011) framework for teacher education (four clusters of competencies), and De Haan's (2006) Gestaltungskompetenz (shaping competence) framework of 12 competencies. Wiek et al. (2011, 2016), drawing on a variety of scholars, proposed a framework which has six competencies. Wiek et al.'s model also crafted learning outcomes in order to operationalise the competencies at different educational levels, a feature they argue has been missing from the literature.

The selected models, although different, have similar characteristics. Rieckmann (2018) presented these as a synthesis of competencies which includes all six from Wiek et al.'s

framework and others, namely: systems thinking, being anticipatory (futures thinking), normative (values thinking), strategic (action oriented), collaboration (interpersonal skills), critical thinking, self-awareness and integrated problem-solving. In addition to these competencies, Rieckmann (2018) claimed that communication skills are critical for dealing with sustainable development. Generally, ESD competencies require futures thinking, an interdisciplinary approach, personal involvement (reflection, empathy, motivating self and others), and attention to values and ethics (Lambrechts et al., 2013).

Project-based learning

Education for Sustainable Development focuses on content related to 'wicked problems' which are complex in nature. A related consideration of the focus on ESD competencies is the question of how they can be acquired to enable successful solving of real-world issues. Lambrechts et al. (2013) identified three categories of teaching and learning methods suitable for ESD: they should be interactive and participative (e.g., group discussion and peer assessment), research oriented (e.g., problem analysis, values clarification) and action oriented (e.g., solving real community problems). Project-based learning has been named as an action oriented strategy suitable for ESD (Kilinc, 2010; Cloud, 2014; Lozano et al., 2015; Scott, 2015).

The Buck Institute of Education (as cited in English & Kitsantas, 2013, p. 130) defined PjBL as a "…method that engages students in learning knowledge and skills through an extended inquiry process structured around complex, authentic (real-life) questions and carefully designed products and tasks". Bell (2010, p. 39) highlighted that PjBL is a critical strategy "for creating independent thinkers and learners. Children solve real-world problems by designing their own inquiries … organizing their research, and implementing a multitude of strategies." These definitions suggest students are central in PjBL, actively self-regulating their learning, and connecting with their community (English & Kitsantas, 2013; Stefanou et al., 2013).

One model of PjBL has identified the following necessary elements: a central question (open-ended, complex), student voice and choice (they select their own topic and resources for inquiry), opportunities to build 21st century skills (communication, collaboration, critical thinking, creativity and technology use) and findings publicly presented (e.g., to the community, parents, peers) (Larmer & Mergendoller, 2010).

The benefits of PjBL include increased understanding of particular issues, motivation, independent thinking, responsibility, collaboration, communication and problem-solving skills (Bell, 2010; Duerden & Witt, 2010; Tamin & Grant, 2013 ; Genc, 2014). Some challenges to PjBL are also identified in the literature. These include lack of resources and administrative support, the time needed to transition to a facilitative teaching style and contending with completing curricula in exam-driven contexts (David, 2008; Saavedra & Opfer, 2012; Tamin & Grant, 2013; Malek, Hall, & Hodges, 2014; Aitken, 2019).

The characteristics of PjBL are aligned with ESD competencies. For instance, strategic competencies (developing and implementing actions), collaboration (facilitating participatory problem solving, learning from others, dealing with group conflicts), critical thinking (questioning norms, practices and opinions) and integrated problem-solving competencies

(applying problem-solving frameworks to complex problems and developing solutions) can be facilitated through PjBL.

Project-based learning and the concept of acquiring sustainability competencies are aligned with social constructivism in which learners construct knowledge through experiencing things, reflecting on those experiences and interacting with their peers for discussing, generating, and sharing information (Roessingh & Chambers, 2011). Both are also aligned with the experiential learning theory where individuals' learning is linked to applying various skills to real-world problems. The experiential learning theory which draws on the work of John Dewey, Jean Piaget and others (Efstratia, 2014) simply proposes that individuals 'learn by doing'. This suggests that being immersed in relevant issues and reflecting on them will encourage development of new skills and actions.

There is a need for more research concerning pedagogical approaches related to ESD competencies (Laurie et al., 2016). This paper seeks to address this need by identifying the competencies linked to sustainability that were evident when PjBL was applied in different cultural contexts: a Higher Education Institution and an online platform for younger learners.

Methodology

To showcase the opportunities presented using PjBL to advance ESD activities, two case studies are presented in this paper. Case studies are important for providing a contextual analysis of a phenomenon or situation and for establishing patterns and extending relationships (Gomm, Hammersley & Foster, 2000). As such this approach was deemed useful for highlighting the use of PjBL at two different levels of the education system.

The first case study highlights PjBL in an Environmental Education (EE) graduate-level teacher training course at a School of Education at a university in Jamaica, while the second case study showcases students at the K-12 level pursuing modules as investigations of the global impact of waste issues through an online learning platform called 'TrashedWorld' hosted in Bulgaria. Though these contexts are dissimilar, they are unified through a common purpose of creating a more sustainable world. Another difference between the cases is the host country context which provides opportunities for intercultural as well as cross-cultural analysis and insights.

Data was collected for Case Study One through the analysis of the course syllabus, projects produced by graduate students, reports on projects and students' course reflections. For Case Study Two, content on the online platform (TrashedWorld), module syllabi, lessons, products and reports from students' investigations, and feedback reports from their teachers were analysed. In both cases, participants' identities have not been revealed and the necessary protocols for access to materials were observed to ensure adherence to ethical considerations.

Results

Case One: Project-based learning in an environmental education course within a teacher preparation programme

Context

The School of Education at the University of the West Indies (UWI) prepares educators for national and regional education systems and contributes to educational policy within the Caribbean (The UWI – School of Education, https://www. mona.uwi.edu/soe/aboutschool). The School of Education is well placed to prepare teachers in utilising appropriate pedagogical strategies to foster sustainability competencies. This paper provides an account of the 2016 offering of the semester-long environmental education course for science and non-science specialist in-service teachers. The major assessment task in the course involves formulating and implementing a project for addressing a local environmental problem. This is discussed in the first week of the course. It is a requirement to implement the project collaboratively within schools, homes or communities. At the end of the course the participants submit a report on the project implementation and outcomes. Teachers' experience of PjBL was analysed from pre-and post-course reflection documents as well as the project reports which also had a reflective component.

Outcomes

The teachers selected their focus issue by the third week of the course. Project formulation was assisted through discussion of articles in the course material, lectures on selected environmental and sustainable issues, and mentoring from the course lecturer who is one of the authors of this paper. The teachers designed and implemented projects in various settings such as homes, communities, workplaces and schools (see Table 1).

Table 1 *Projects implemented by in-service teachers*

Teacher	Project theme
1	Investigating water conservation by households in an urban community
2 & 3	Developing a whole-school approach towards becoming an eco-school in an inner city community
4 & 5	Plastic bottle recycling at the workplace and in a community housing complex
6	Improving paper use and disposal efficiency in a work-place
7	Implementing an environmental stewardship programme in a primary (elementary) school
8	Investigating household electricity consumption and energy conservation practices

Importantly, the project by Teacher 8 was conducted by students in their homes. Further, the data from that project provided content for classroom discussions (see Table 2), thus interlinking the school context with real-world experiences. These students had opportunities to gain knowledge and skills (e.g., collaboration, communication), and at the same time practise responsible, environmental and sustainable behaviours.

Table 2 *Outline of an energy conservation project implemented by students in their homes*

Week	Activities
1	**Teacher:** ■ Taught lesson on energy conservation methods and how to read electricity meters. ■ Discussed project with students; distributed permission letters to take home for participation in the project. **Students:** ■ Formed a social media communication group to remind each other to read their meters on Sundays. ■ Designed tables to record their meter readings.
2	**Students:** ■ Read meters and record results. **Teacher:** ■ Checked students' readings on Monday. ■ Discussed data. ■ Re-taught meter-reading for two students who had forgotten how to but instead had taken photographs of the meter readings.
3 -5	**Students:** ■ Read meters and recorded results. ■ Calculated the amount of electricity consumed over the period. **Teacher:** ■ Discussed five energy saving tips with students. ■ Encouraged students to implement the tips at home.
6-9	**Students:** ■ Practised energy conservation tips along with family members. ■ Continued to record meter readings. **Teacher:** ■ Discussed practices and challenges faced.
10	**Students:** ■ Performed final calculations. ■ Completed and returned questionnaire about their energy conservation practices since initial electricity bill was received. **Teacher:** ■ Held final discussions about the class results.

Teachers and students were motivated to take action through the PjBL approach. One teacher, reflecting on her paper recycling project, wrote "I have developed a greater appreciation of trees and their place in our environment. It has inspired me to address the issues of the environment in particular deforestation" (Teacher 6, Post-course reflection document, May 2016). It was reported that students who worked alongside their teachers on waste management projects voluntarily monitored the activities of their peers. One teacher explained "… students will exhibit positive actions if they are taught values and benefits, and are involved in decision-making" (Teacher 3, Action project report, May 2016). The teachers' and students' actions represent positive outcomes of the EE course, and highlight how ESD competences such as collaboration and action orientations were being developed.

Teacher 8, however, indicated difficulty in getting full class participation as only 20 of 36 students (55%) willingly participated (Action project report, May 2016). Other teachers stressed the need for 'buy-in' from stakeholders. For instance, Teacher 3, with reference to her school administrators wrote "If you could NOT get others to see your ideas as sound and valid then it would be an uphill battle to implement the plan" (Action project report, May 2016). Overall, Teacher 6 supported the value of PjBL by stating her intention to use it as an assessment method "… with the aim of addressing my students attitudes/values …" (Post-course reflection document, May 2016).

Both positive and challenging experiences were reported by the teachers regarding implementation of their projects. However, feedback obtained from the project participants indicated evidence of some sustainability competencies such as motivation and commitment. ESD competencies were also evident through teachers' pedagogical approaches that encouraged integration of environmental sustainability issues into classroom discussions and promoted action-oriented activities that sometimes extended to contexts beyond the classroom.

Case Two: Project-based learning with younger learners – TrashedWorld

Context
TrashedWorld, a web-based platform hosted in Bulgaria, was constructed based on a documentary film *Trash* (https://blenheimfilms.com/trashed-no-place-for-waste/) that investigates the global impact of modern consumerism on pollution. The platform was conceptualised recognising the role of education in engaging young students on environmental and sustainability issues. Two major aims of the platform are to develop awareness of waste issues and improve communication among users. Content and language integrated learning is the disciplinary specialisation of one of designers (also an author of this paper) thus a core focus skill is improving communication while dealing with environmental issues. An intercultural communication framework (Schoen, Weisheit & Kelly, 2011) guided the development of the materials for the website.

There are four modules in the programme, each focusing on one waste issue presented in the *Trash* documentary. Each lesson in the module includes a glossary, vocabulary, comprehension activities and concludes with an 'investigation', a project-based activity where students explore a waste issue in their schools or community.

Outcomes

The platform was piloted, then launched in June 2016. Teachers registered their school then accessed the resources on the platform. After interacting with the content and activities in the modules, the students devised their investigation and implemented it in their schools or communities. The students recorded their results and experiences in various forms (e.g., videos, PowerPoint presentations, investigation report sheets). These artefacts were uploaded to the website by their teachers for access by peers globally. The teachers gave feedback about the platform through the website and other social media applications (e.g. Google Groups©). The investigation reports and artefacts indicated that students collected data through forms such as questionnaires and interviews administered to community members (e.g., shopkeepers, waste facility managers). The reports and artefacts of the students from Slovenia, Bulgaria and Italy were analysed to provide insight into students' activities.

In Slovenia, some students investigated waste management in their communities and produced a PowerPoint presentation entitled the 'Circle of Trash'. Here they identified various types of community waste and considered how they were discarded. From their investigation they concluded waste management efforts in their community were effective.

Bulgarian students reported on a 'waste clean-up campaign' in their community by creating news posters which were displayed at their school. The students reported a sense of ownership of the project due to their close involvement in it. For example, one student wrote about waste observed in her community: "The trash is there because of US! It is our responsibility to clean it. We must try to keep our town for the future generations."

In Italy, after watching the documentary clips, students implemented various projects in their school, home and community. One project involved waste separation in their homes and tracked how much waste was generated. They reported: "We produced about 10 kilos of glass during a week, about 2 kilos of paper and 15 kilos of plastic". In another project, the students compared grocery store packaging in their city with examples in the film, and reported that the dimensions were similar to those recommended in the film.

The students applied critical thinking competencies to knowledge gained about the state of waste in their specific country, city and community. For example, in referring to their community, one group wrote "... half of the inhabitants use bins so the town is very dirty ... in the city centre on the floor there is scrap paper, chewing gum or cigarette butts". Students started to form opinions about the habits of residents. According to one report, "... sometimes we find some plastic wraps or some cans on the ground because some people don't care very much about the environment ...". Another report stated: "We think many people don't use bins because they don't care a lot about the environment. Others, instead, know how much this can help the planet, so they use them ... Also, a lot of people don't recycle, because they simply don't know the consequences". Through the platform these learners communicated with their peers locally and in other countries about the environmental issues. Comparisons made with environmental issues globally support competency in self-awareness.

Discussion

Descriptions of two cases were provided in this paper of how PjBL can foster ESD competencies and promote environmental sustainability actions. In Case One, PjBL was used as a summative assessment tool, but supported formatively throughout the course in the form of class discussions. With respect to Case Two, project formulation and implementation supported classroom teaching. The data suggests that some ESD competencies were evident in the participants' actions namely: strategic competencies (the participants devised and implemented projects in their local contexts dealing with local environmental issues and in Case Two, these were shared globally), collaborative competencies (participants worked with internal and external partners such as students, school personnel and community members to complete projects), critical thinking (authentic environmental problems were identified which challenged personal practices and behaviours; participants reflected on practices and observations) and integrated problem-solving (solutions were proposed for environmental and sustainability issues).

The ESD competencies observed can be explained by the action-oriented approach and authentic contexts provided by PjBL – TrashedWorld provided opportunities to do this within an intercultural context. By 'learning to do' (UNECE, 2011; Efstratia, 2014), participants gained new knowledge (e.g., about solid waste pollution, electricity and water consumption patterns), confidence (e.g., gathering and interpreting empirical data, convening meetings, conducting interviews), problem-solving skills, and increased motivation (e.g., being inspired to address issues such as deforestation) (Bell, 2010; Genc, 2014; Rieckmann, 2018).

The online platform allowed students to be active global citizens, positioned them as change agents and provided an avenue for sharing the results with local and global communities, thus supporting the development of communication competencies. The online platform was relevant for supporting PjBL as a tool for giving students from different cultures and contexts a global voice about environmental issues (Larmer & Mergendoller, 2010).

One challenge identified in PjBL in this study was obtaining support from collaborators, also reported by Aitken (2019). Teachers in Case Two felt that more time was needed for supervising projects. The latter would pose an even greater challenge for teachers operating in exam-driven contexts such as in the Caribbean, who have long contended with the pressure of completing curricula (David, 2008).

In comparing the two cases, we learnt that environmental issues such as solid waste management are similar in both cultures which necessitated real-world problem solving, and PjBL facilitated this. We noted that young people were at the heart of the engagement – directly (Bulgaria) and indirectly (Jamaica – through capacity building of teachers who then translated this into their classroom practices). In Bulgaria there was one large project and issue around which youth action coalesced, whilst in Jamaica there were various projects around various issues amongst teachers. The specific differences in our approaches to PjBL implementation could have been influenced by cultural factors. This suggests that in applying PjBL, one should consider the specific cultural context as this may influence how the strategy is implemented.

Conclusions and recommendations

Project-based learning is relevant in facilitating ESD competencies. It centralises teachers' and students' learning experiences to enhance various skills and competencies related to environmental and sustainability actions in different cultural contexts. These include collaboration, critical thinking, strategic competencies, self-awareness and communication, all of which are necessary to address the local and global challenges facing the 21st century world. Project-based learning takes varied formats and can be implemented in formal and non-formal settings. In both cases shared in this paper, authentic issues were addressed through a collaborative, problem-solving approach in a project-related context that connected adult and young learners with various stakeholders within their educational institutions and their communities.

We support the recommendation for PjBL to be a part of teacher-preparation and professional development programmes to provide real-world experiences, and develop teachers' ESD competencies (and to encourage others) to become change agents. School administrators should encourage a culture to support curriculum activities that infuse PjBL, and enable teachers' collaborative efforts on projects so it does not feel like 'added work'. Mentors and experts outside of the formal education system could collaborate to provide project design and implementation support for teachers and students.

We are not aware of any study which focused on PjBL and ESD competencies in our country contexts, thus this paper adds to the body of literature and contributes to this gap. We recommend in future more research to provide cases showing how PjBL can be infused in teaching to support ESD for effecting sustainability action, and also to target specific competencies. Future research can also focus on which competency framework/s may be suited for specific cultural contexts.

In conclusion, PjBL transcends disciplines and cultures. It is a valuable teaching-learning strategy that supports environmental learning, fosters ESD competencies and can close the gap between environmental and sustainability knowledge and action.

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Percentage contribution

Areas of contribution	Author	Percentage contribution
Conception or design of the paper, theory or key argument	Bramwell-Lalor	20 %
	Kelly	20 %
	Ferguson	20 %
	Hordatt Gentles	20 %
	Roofe	20 %
Data collection	Bramwell-Lalor	20 %
	Kelly	20 %
	Ferguson	20 %
	Hordatt Gentles	20 %
	Roofe	20 %

Areas of contribution	Author	Percentage contribution
Analysis and interpretation	Bramwell-Lalor	20 %
	Kelly	20 %
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	Hordatt Gentles	20 %
	Roofe	20 %
Drafting the paper	Bramwell-Lalor	20 %
	Kelly	20 %
	Ferguson	20 %
	Hordatt Gentles	20 %
	Roofe	20 %

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Epistemic Cartography: Evaluating Net-Map as a Frontline Tool for Navigating Informal Knowledge Networks

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Abstract

Sustainability transitions are dependent on the development and diffusion of transformative skills and competencies. However, the prevailing notion that learning for sustainability transitions will be led by universities, technical colleges and other similar institutions is practically not feasible in much of the global south. Net-Map is a social network analysis tool that uses interviews and mapping to help people understand, visualise, discuss, and improve situations in which many different actors influence outcomes (Schiffer & Hauck, 2010). In response to the pressing need for new approaches to the development and diffusion of sustainability skills, this paper evaluates Net-Map's suitability as a methodological tool for educators, knowledge brokers and students seeking to enhance the navigability of the often complex and uncharted occupational pathways they encounter. To do this, the research applied Net-Map to an emerging sustainability niche within the food system in order to map the learning pathways of successful sustainability pioneers. We found that Net-Map was helpful in identifying diffuse informal knowledge networks and teaching resources. Being free, quick to learn and easy to use, Net-Map is a potentially low-cost method for circumventing traditionally costly approaches to curriculum development and accreditation – assisting community-based actors to make sense of the informal knowledge and competency networks that support emerging career fields. In emerging career fields such as organic farming, where pioneer knowledge is fragmented, poorly documented and often disregarded by mainstream-science, Net-Map could be useful in the preparatory phase of curriculum planning and design, providing training designers, course conveners and facilitators with contextually informed insights.

Keywords: *Net-Map, knowledge networks, agricultural curriculum, sustainability skills, skills ecosystem, transitions*

Introduction

Sustainability transitions are dependent on the development and diffusion of new competencies. A transition to a global food system based on principles of social and environmental justice, for example, will rely on vast numbers of young people learning how to farm, trade and self-organise in new ways (Klerkx, Hall & Leeuwis, 2009; Kabasa, Kirsten & Minde, 2015;

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Yeboah, 2018). The prevailing notion that learning for these kinds of transitions will be led by universities, technical colleges and other similar institutions is unlikely to hold true for much of the global south. Of the 800 million youth projected to enter the job market in Africa over the next 30 years (Losch, 2016), only 10% will have a tertiary qualification (Minde et al., 2015; Darvas et al., 2017). While we need to question the type and quality of skills this 10% will acquire in tertiary training, the far bigger question is: 'What about the other 90%?' If this 90% is not formally trained, how do we consider engaging this overwhelming majority in the imagining and construction of a better future?

This simple question highlights the need for increased research into ambitious alternatives to the existing capacity building platforms. From a sustainability perspective, recognising the limitations in formal training highlights the need to begin thinking about how to increase the dissemination and diffusion of new knowledge and competencies from within emerging sustainability niches – particularly in the global south, but also in the north. Theorists from across the fields of sustainability transitions, pedagogy and complexity, respond by arguing for the need to take a networked view on the development and diffusion of competency at an individual and societal level (Carlsson & Stankiewicz, 1991; Reed et al., 2010; Kilelu et al., 2011; Goodyear & Carvalho, 2013; Lotz-Sisitka et al., 2015; Kelly, Bennet & Starasts, 2017; Wals et al., 2017). Concurrently, there is an increase in voices calling for more place-based approaches to learning which embrace the notion of learning through context-sensitive practice (Smith, 2002; Sobel, 2004; Gruenewald & Smith, 2014; Vallabh et al., 2016; Shannon & Galle, 2017). These place-based approaches, which use students' local community and environment as a starting point for learning, encourage academic achievement while developing a heightened commitment to serving as active, contributing citizens (Sobel, 2004). It can also be argued that foregrounding local knowledges and centring the forms of learning that take place through localised lived experience are opportunities for deconstructing hierarchical epistemic traditions (O'Donoghue, et. al. 2019, Mendoza-Zuany & Shava, 2019).

In response to the need for new approaches to education which are both inclusive and transformative, we see a role for increased attention to new methodological tools for curriculum development – methods capable of translating place-based pedagogies into practice at a grass-roots level where institutional capacity is weak and educators themselves lack the very skills they strive to pass on to their students.

Considering where transformative knowledge resides

In thinking about systemic transitions, such as in the agricultural sector, Carlsson and Stankiewicz (1991) highlighted the need to consider the centrality of competency flows and the institutions that enable these:

> Technological systems are defined in terms of knowledge or competence flows rather than flows of ordinary goods and services. They consist of dynamic knowledge and competence networks… [N]etworks of agents interacting in a specific technology area under a particular institutional infrastructure to generate, diffuse and utilize technology. (p.111)

Similarly, in their research relating specifically to food system transformation, Goodman, DePuis and Goodman (2012) highlighted that network processes of knowledge transmission are the catalyst for expansion by horizontal replication. In other words, horizontal (or peer-to-peer) knowledge networks are a means through which pioneer projects can multiply their effect.

Viewing systemic transitions from this perspective "highlights more explicitly the importance not only of understanding the creation of transformative technology, but also its *diffusion and utilization*" (Geels, 2004, p. 898. Own emphasis). This emphasis on the networked nature of competence is shared by a range of pedagogical theorists (Hakkarainen et al., 2004; Lorentzen, 2008; Moore & Westley, 2011; Hakkarainen et al. 2013; Torre et al., 2016).

Taking this further, theory from the field of Transitions Management suggests that transitions within complex systems require a mix of three distinct types of knowledge: systems, target and transformative knowledge (Pohl & Hadorn, 2007; Rauschmayer, Bauler & Schäpke, 2015). Formal research institutions tend to do better at developing systems and target knowledge than transformative knowledge. Sustainability scholars and educators tend to have a better idea of current issues and where we would like to be than of how to get there – uncertainty is inherent in complex challenges and transformations. In almost all cases, the path is not clear yet, and needs to be created as the system's actors experiment with new behaviours. The generation of new competencies for transformation (transformative knowledge) is often a bottom-up process, which occurs on the fringes of the established system. This suggests that in our attempts to identify and access transformative knowledge for teaching purposes, we need to be looking beyond the formal channels of institutionalised innovation – particularly in economies where public research institutions are under-resourced.

Research objective

In light of the need for more inclusive approaches to the development and diffusion of sustainability skills, this paper evaluates the potential of Net-Map, a social network analysis tool that uses interviews and mapping to help people understand and improve situations in which many different actors influence outcomes (Wikipedia, 2020), as a supportive tool for transgressing the boundaries of formal, hierarchical education.

In addition, this paper sought to support a growing body of work around networked approaches to learning and competency. It offers a methodological starting point for educators, knowledge brokers and students seeking to enhance the navigability of the often complex and uncharted occupational pathways they encounter.

Design and methodology

Case study

Southern Africa faces a range of social, economic, and environmental challenges. Of particular relevance is the food system, which is associated with a wide range of environmental problems as well as social inequalities and injustices (Patel, 2012; IPCC, 2014; FAO, 2016). In some parts

of the region, the food economy accounts for as much as 80% of livelihoods. The majority of these livelihoods are in the informal economy (Tschirley et al., 2015).

For these reasons, testing the applicability of Net-Map on an occupational cluster centring around more sustainable food production seemed useful. The organic agricultural sector in South Africa is in its infancy. It is also very loosely organised and lacks any official regulation or formal qualifications (Kelly & Metelerkamp, 2015). Thus it was an ideal case study for testing Net-Map.

Overview of Net-Map process

Net-Map was originally developed to better understand multi-stakeholder systems by gathering in-depth information about resource networks, goals of actors, and their power to influence system outcomes (Schiffer & Hauck, 2010). Net-Map merges two existing methods, namely social network analysis and power-mapping. As a research method, it is well-suited to the collection of qualitative and quantitative information in a structured and comparable way (Schiffer & Waale, 2008).

Net-Map enables participants within a particular system to surface and explain the diverse and often obscure spectrum of actors who exert influence over the outcome of a particular objective or process within that system. For this study, Net-Map was applied to an emerging sustainability niche within the food system. The resultant network maps indicated who the relevant actors were, the kinds of information they contributed to their community, the ways in which they were connected to one another and, finally, the power they were considered to wield within the system (Schiffer & Waale, 2008).

Generally, the Net-Map process consists of five steps – these are described below in the light of their application to the current research process.

Step 1. Prompting question

A clear prompting question is required to demarcate the boundaries of the Net-Mapping process for participants.

The prompting question posed to interviewees in this case study was:

Who are the actors that influence the success of an organic farmer in South Africa and how [/to whom] are they accountable?

This prompting question enabled the research to focus on the full spectrum of actors influencing the success of farmers rather than a direct question about who their knowledge resources were. This was done for two reasons: firstly, we wanted to construct a holistic picture of the full range of actors at play in their lives because, from a capacity-building perspective, these actors benefit from training targeted towards this occupational pathway. Secondly, approaching the topic of learning too directly could bias responses and result in the exclusion of valuable insights due to differences in respondents' understandings about what constituted a useful knowledge resource.

Step 2. Listing actors

Working together on a large sheet of paper, the interviewer assisted with listing all the actors whom the interviewee felt influenced success within the particular occupational pathway for the given region, in this case an organic farmer in South Africa. At the discretion of the respondent, each actor was classified into one of five categories: Farmer, Community, Civil Society, State and Private Sector.

Importantly, respondents were not unified in their classifications of actors. For example, Farmer 5 listed "internet & YouTube" as a farmer-based actor because they were using it to access others farmers' knowledge. Farmer 3 listed this as a community-based actor because of the general spirit in which it was created and shared. In most cases these differences were not problematic and could be reconciled during data analysis.

Step 3. Network mapping

The interviewer then guided the interviewee to establish the nature of the linkages between each of the identified actors based on a set of five pre-determined types: information, finances, resources, advocacy and authority. Each of the five types was listed using a different colour (see Figure 1). Respondents denoted the direction of the relationship as to/from/bidirectional.
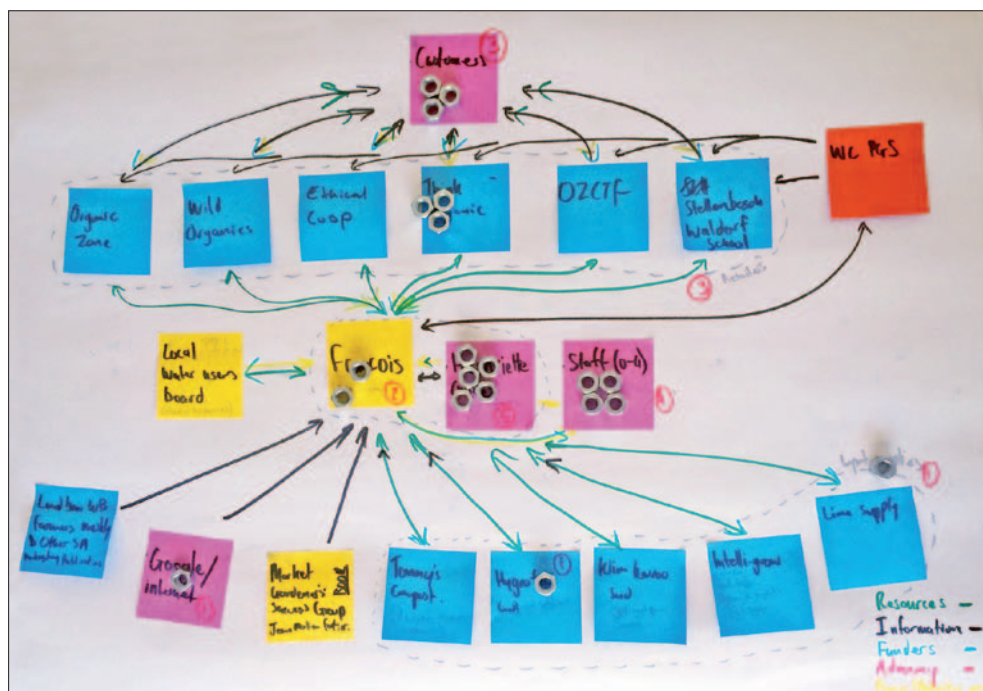

Figure 1 *Example of a completed farmer Net-Map*

Step 4. Allocating influence

Once the actors and their links with other actors were established, the influence of these actors was determined using checkers pieces to construct *influence towers*. This allowed the abstract concept of power and influence to be tangibly represented in a three-dimensional form. A limited number of checkers pieces were provided so interviewees had to consider carefully who the most influential actors were.

Step 5. Reflection and discussion

Net-Maps serve as useful boundary objects for anchoring complex discussions (Hauck et al., 2015; Stein & Barron, 2017) and the process naturally tended to evoke substantial reflection and explanatory discussion from the participants. Allowing participants to embark on tangents and enter into storytelling mode as they were developing their networks, appeared to increase the amount of actors and connections they listed. At the end of the process, as time allowed, participants would be invited to step back from their network maps, reflect on what they had laid out and make any amendments they felt were necessary.

Sample

The Net-Map method was applied by individually interviewing a sample of organic farmers and related sector organisations.

A snowballing sampling process was used to develop a shortlist of 50 organic farmers and supporting organisations in the Western Cape Province of South Africa. Each of these 50 actors were then rated against a common set of criteria to produce a shortlist of five farmers, each representing a different scale of operation (see Tables 1 and 2).

Table 1 *List of farmer respondents*

Farm type	Years in operation	Farm size
Urban community school garden	1	0.1 ha
Peri-urban micro vegetable farm	2	0.5 ha
Rural vegetable farm	10	1.5 ha
Peri-urban vegetable farm	14	10 ha
Urban vegetable farm	11	24 ha

Table 2 *List of sector organisation respondents*

Organisation type	Respondent years' experience
Retail cooperative	7
Sector activist	7
Sector representational body and trainer	44
Local fresh produce market	25
Rural development and organic participatory guarantee systems	10
Provincial Department of Agriculture	9
Farmer advocacy and training	40

Twelve Net-Maps were subsequently presented to an expert panel of 25 regional and international sector representatives and farmers. Through facilitated small-group engagement with the Net-Maps, this panel reflected on the Net-Maps and their inputs informed an over-arching analysis.

Results

The maps varied greatly in nature. In total, the respondents listed 380 actors and 880 relationships. On average, farmers listed 17 actors in their Net-Maps, while sector organisations listed 43. The level of connectivity and complexity depicted in individual Net-Maps also varied greatly. On the whole, farmers tended to list individuals and identify the factors influencing their success in simpler, more direct terms than sector organisations. Differences such as this highlighted that the process is not so much about mapping reality, but rather mapping network perceptions which provide the basis for behaviours and decision-making.

Prevalence and influence were also considered in the analysis. Prevalence refers to the frequency with which an actor or category of actors appeared. Influence refers to the weighting interviewees allocated a particular actor or grouping of actors.

General actors and influencers

The most influential actors in the eyes of farmers were members of their community (36%) and the private sector (24%). The least influential were civil society (16%), state actors (11%) and other farmers (11%). The most commonly listed were private sector (42%), community (19%) and other farmers (19%). The state and civil society were listed least frequently (12% and 9% respectively).

The most influential actors in the eyes of sector organisations were civil society (27%) and the private sector (23%). These were also the most commonly listed (28% and 24% respectively). The least influential were other farmers (12%) and community actors (11%). Community and other farmers were also listed least frequently (13% and 10% respectively).

Focus on learning networks

The Net-Maps indicate to whom farmers turn for knowledge, as well as those to whom they do not. They provide an initial indication as to whether there are particular concentrations of knowledge and experience in the system and which specific individuals or institutions appear to be making substantial contributions to the learning taking place within the niche. Of the 380 listed actors, approximately 30% (124) were identified by interviewees as having knowledge or information flowing to organic farmers. Figures 2 and 3 provide a distillation of the farmer and sector organisation Net-Map data filtered for information exchange and coloured by classification. Table 3 provides the related numeric breakdown.
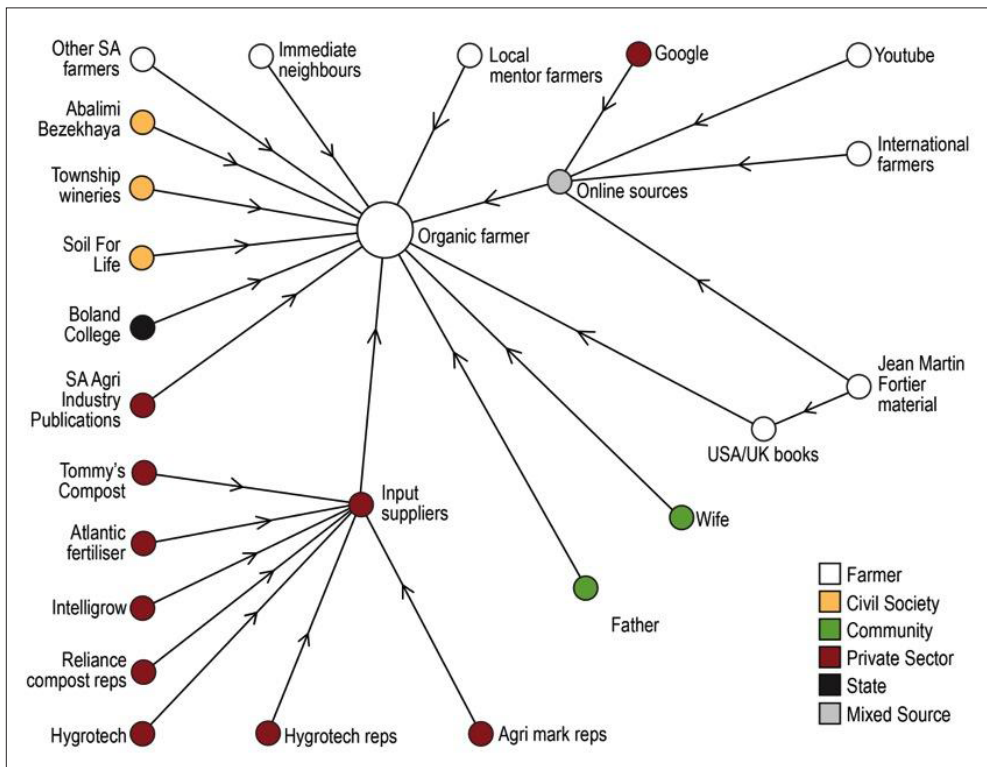

Figure 2 *Combined network map of all actors identified by farmers as sources of information that influenced their success*
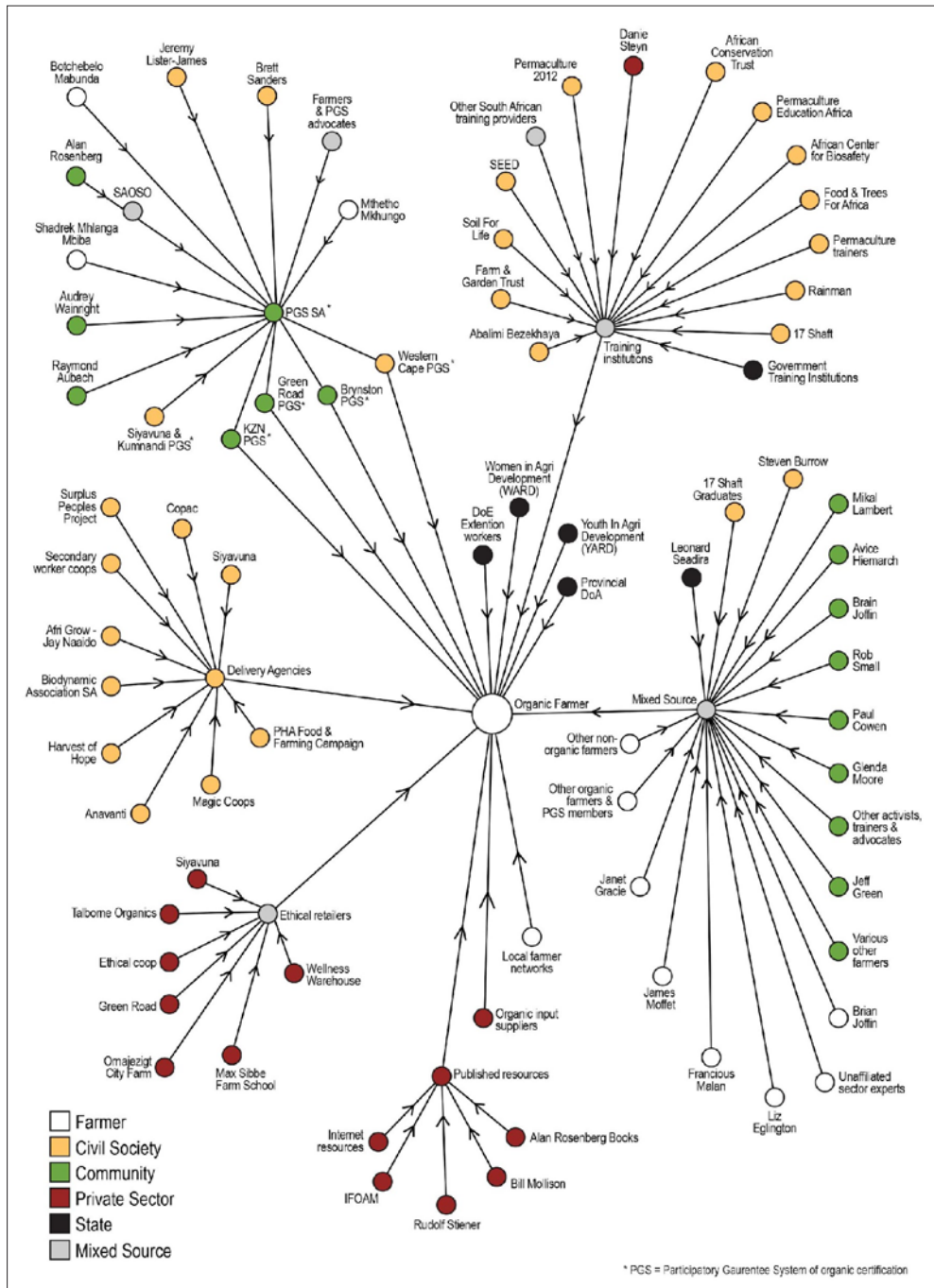
Figure 3 *Combined network map of actors identified by sector organisations as influential information partners to organic farmers*

Table 3 *Information sources as listed by farmers and sector organisations*

Farmer knowledge resources	Percentage of total actors	Number	Example
Private Sector	42%	10	Hygrotech[1] sales representatives, Reliance Compost sales representatives
Farmer	29%	7	Immediate neighbours, other SA farmers, Market Gardeners Success Group, Google, YouTube[2]
Civil Society	13%	3	Abalimi, Soil for Life
Community	13%	3	Google, YouTube, wife
State	4%	1	Boland College
Sector Organisation knowledge resources	Percentage of total actors	Number	Example
Civil Society	44%	43	Western Cape Participatory Guarantee System, Abalimi Bezikhaya
Private Sector	18%	18	Ethical Co-op, Internet, Input Suppliers
Community	17%	17	Sector activists
Farmer	13%	13	Local farmer networks
State	7%	7	Department of Agriculture, individual departmental advocates

Discussion

This research suggests Net-Map could be a supportive tool within sustainability transitions and the method could serve as a useful tool to support curriculum designers, facilitators and students. The discussion that follows is presented in two sections: strengths of the method, followed by its weaknesses. Based on this, a revised version of the standard Net-Map method is provided aimed specifically at use in the educational context.

Strengths of the method

Net-Map proved well suited to supporting learning within niche environments, although it was not originally intended for use in an educational context. The strengths of the methods are discussed briefly below, after which certain limitations are listed.

Surfacing system structure and relationships

Firstly, Net-Map proved to be a simple and relatively rapid means to engage with the knowledge embedded within a particular context. Using Net-Map can assist a training organisation to surface critical relationships relating to the particular competency or career trajectory they are seeking to support.

Net-Map not only provided a overview of how a wider community of actors influence success within a given discipline, it also helps to protect against the potential blind-spots within existing curricula. In our case study, for example, sector organisations appeared to be overlooking the important role of supportive partnerships at home, online learning and the specific role which private sector actors played in the success of pioneering farmers.

Identifying keystone knowledge brokers

Having established a basic model of the relationships that were important to the success of organic farmers, the Net-Map process further provided a simple means by which to identify regional actors who were particularly central to what Carlsson and Stankiewicz (1991) referred to as the 'diffusion and flow' of knowledge across the network. These keystone knowledge brokers appear to play a 'pollinator role', joining the dots between common problems and emerging solutions. By their nature they tend to be connected to far more nodes in the system than the average actor, and they tend to feature consistently in Net-Maps showing different kinds of actors. Ethical Co-op, for example, appeared as a richly connected actor in seven of the 12 Net-Maps suggesting that it held a central role within the network economy. From an educational perspective, understanding who these actors are is important as they may serve as enabling allies providing advice and access to network resources. Furthermore, O'Donoghue et al (2019), suggest that actors such as these may also serve as vital links in the intergenerational transmission of local knowledge, cultures and values.

Identifying subject specialists

Following this, curriculum designers, facilitators and students can use Net-Map to assist in identifying content specialists in contexts where knowledge is both fragmented and poorly archived. Using the different colour lines to indicate different forms of connection between actors, helps educators and students understand which kinds of actors hold knowledge on specific aspects of the system. Additionally, the influence weighting attributed to each actor in the individual Net-Maps is an indication of the potential importance of the knowledge particular actors have to offer.

The Net-Maps generated in the process provide a quick and easy reference point for facilitators and course coordinators seeking to bring in specialist guest presenters, plan field trips or organise internships. Table 4 provides an example of how data from the Net-Maps can be distilled into a local competency catalogue. Central to the power of these kinds of competency catalogues is that they are peer reviewed by practitioners through the Net-Map process (we elaborate on this in the following section).

Table 4 *Abbreviated example of local competency catalogue*

Key competencies	Competency specialists
Organic vegetable production	Francios Malan, Jacques Olivier, Skye Felman, Market Gardeners Success Group
Seed and seedling production	Hygrotec and Klein Karoo Seed
Compost production	Tommy's Compost, Reliance Compost
Record keeping and accounting	Henriette Malan
Alternative retail systems	Ethical Coop/Anique van de Vlugt, Wild Organics, Audrey Wainright, Market Gardeners Success Group
Philosophy of agroecology	Alan Rosenberg, Raymond Auerbach
Communal farming and urban food gardens	Soil For Life, Rob Small

Verifying practitioner knowledge in the absence of formal qualifications

The case study suggested that often those most qualified to teach within transitional spaces are practitioners and activists who possess a proven ability to function within the system but have no formal qualification relating to their expertise. This raises the need for ways of validating expertise and establishing who subject specialists are.

When attempting to support competency development within niche spaces, which by their nature attract radical thinkers, the challenges faced by students and facilitators in discerning fact from fiction should not be underestimated.

To overcome these challenges, the Net-Map process provides a form of grass-roots peer review for knowledge sources within a given network. As they seek to overcome their day-to-day challenges, niche actors are continually trialling solutions. Based on this, we assert that the level of influence attributed to a particular knowledge source and the number of niche actors who make reference to a given information source, can be used as a means of verifying the degree to which a particular knowledge source (or type of knowledge source) can be depended on in a given context.

A supportive tool in the absence of formal articulation frameworks

While the validation of knowledge is important, this also needs to be pitched at the relevant level. The kind of information sources that yield value for an actor with 10 years of experience, may differ significantly from the needs of a young entrant taking their first tentative steps into a new career. While it was not a direct aim of our study to test the application of Net-Map for this purpose, a reflection on our process suggests potential in this regard.

Our study covered a broad spectrum of farmers ranging from those working in a fledgling 0.1ha community garden to a well-established 24ha commercial operation (see Table 1). We noted that as the nature of each operation changed, so too did the kind of knowledge and

supporting knowledge resources. While more data points for each scale of farming would be necessary before conclusions could be drawn, an initial review of the Net-Maps of the five distinct farm types displayed substantial differences. For example, farmers in the earlier stages of their careers tended to turn more towards civil society organisations and more established farmers. In turn, these more established farmers appeared to have outgrown the available local resources and resorted increasingly to a smaller handful of international knowledge resources.

Assisting in understanding the learning resources required by students
Once a list of key knowledge resources has been defined, an assessment can be made to determine the kinds of learning resources required in order to access these knowledge resources.

Understanding the nature of knowledge resources operating within a given niche or career field allows facilitators to begin asking the relevant questions: if key online resources are available for free, then do students have access to smartphones or computers to access these? Do they need mobile phone data to be able to work from home? And so forth. For students for whom English is not their home language, translation of material may be an additional consideration.

Building on this, Table 5 provides examples of case study specific insights for localised agroecological food systems. The research identified six particular groups of influential knowledge partnerships that could be of value to educators seeking to support aspirant farmers.

Table 5 *Examples of case study specific learning insights from Net-Map process*

Knowledge actor	Notes for educators
Online knowledge communities and resources	A wide range of free and high value learning material exists online. However, for those without extensive practical knowledge in the field, sifting through the plethora of international sources to determine the true utility of information and its local applicability can be challenging. Probing successful farmers for the online resources they trust and use most frequently provides a reliable screening and validation approach. Once these online resources have been curated, sharing this information with other, less experienced or less online-savvy farmers could highly increase their effectiveness and efficiency of accessing useful information online.
Alternative retail outlets and consumer cooperatives	These are keystone actors in the system that tend to be very well networked potentially making them critical knowledge brokers. Because they engage with a large number of farmers, they tend to have the most accurate picture regarding the most successful farmers and where they are based. They are also well positioned to provide information on other markers of agricultural success.

Knowledge actor	Notes for educators
Private sector input suppliers	Expecting farmers to be achieving the idealistic goal of total farm sufficiency in terms of generating farm inputs such as seedlings and compost is setting them up for failure. Relationships with good compost and seedling suppliers emerged as particularly important to success not only because of the critical materials they supplied, but also because they unlock access to important specialist information. Private sector input suppliers like these play an important role in the niche which should not be underestimated. As with retailers, input suppliers share a vested interest in farmer success. Unlike agricultural extension agents, farmers beyond the subsistence level tend to see input providers and retailers on a regular basis, so both can be effective connectors to a large base of farmers.
Home relationships	Successful farmers did not make it alone; most appeared to have succeeded as a close-knit husband/wife team. This suggests that farmers should not be trained in isolation. Thought should be given to jointly capacitating husbands/wives/families in other aspects of farm business. This appeared to be a major blind spot among supporting organisations.
Other successful farmers in local context	In the organic context, given how few farmers exist, care needs to be taken not to overwhelm them with requests for guidance. Working to document and digitise this pioneer knowledge may be one way of greatly expanding access to valuable knowledge resources without over burdening practitioners with teaching requests. Involving farmers' spouses in training processes may also assist in expanding teaching capacity.
Civil society organisations	Play an important role in the learning landscape of some niche actors – particularly emerging farmers. This is probably especially true in contexts of great inequality.

Limitations of Net-Map

Net-Map was not originally intended for use in an educational context. Despite this, it proved well suited to supporting learning within niche environments. In order to refine its efficacy in these spaces we reflect on a number of potential limitations that were observed.

Blind spots and social bias

Net-Map was good at identifying where exchanges of information were taking place. However, in the case where no connection was present, it was not always clear if this was because the actors were not of value or if they were not connected to the prevailing social network being sampled. This has the potential to create blind spots in the knowledge landscape where actors who are not richly connected, are assumed not to have valuable knowledge.

Overlaps between competence and incompetence

If network connectivity, frequency and influence are to be used as a frontline proxy for knowledge validation in the absence of scientific or curriculum review processes, care needs to be taken in determining which specific competencies the network is ascribing to a specific actor and which they are not. Without careful documentation of this qualitative, actor-specific information, there is a risk that competence in a specific area results in false assumptions of competence in other fields. The fact that an actor has become a knowledge resource through their mastery of one aspect of a system does not mean their knowledge around other aspects is deemed credible by the network.

We found that adding simple notes to the connection arrows enabled us to ensure this information was reflected in the final maps.

Reliant on social capital

As the strength of the process rests on being able to get direct information from the most successful actors within a given system, the absence of sufficient social capital required to access these actors could make the Net-Map process difficult and time-consuming to execute effectively.

Customised Net-Map approach

In weighing up the strengths and limitations of Net-Map as a support tool in educational contexts, a noteworthy attribute of the method is the ease with which it can be adapted on the ground, to fit the needs of a specific context. Thus, while Net-Map in its current form yielded some useful insights, customisation of the method that can further improve its utility to educators is relatively simple. As alluded to earlier, gathering education-specific baseline information during the mapping process could make a big difference in the use of the Net-Maps to support learning processes.

An indication of some important educational characteristics of the listed actors could include:

- Availability and/or interest of an actor to be involved in teaching;
- Level of teaching experience;
- Nature of the potential teaching resource (digital/institution/individual); and
- Specific area of competency.

The main challenge in customisation is balancing the desire to add new layers of data collection with the need to retain the simplicity that makes the method so effective. Therefore, in thinking about process customisation, thought needs to be given to layers of data collection that can be discarded, as much as to those which can be added.

Using the insights listed above, Metelerkamp and Biggs (2020) have developed a simple practitioners' tool kit for using Net-Map in educational settings.

Joining the dots in practice

The effectiveness of niche networks depends on the collective capacity to facilitate exchanges of information and resources. In the terminology of network analysis, this capacity is known as the network's 'navigability' (Buchanan, 2002; Spielman et al., 2008). For those working in emerging knowledge environments, Net-Map, quite literally, provides a means to map out uncharted actor networks so that they can be effectively navigated.

In the context of emerging career fields, where pioneer knowledge is fragmented and poorly documented, Net-Map could prove useful as an entry point during the preparatory phase in curriculum planning and design – particularly in assisting training designers, course conveners and facilitators to move beyond flawed assumptions and uncertainty in order to provide contextually informed insights into:

1. What should be taught?
2. Who/what are the most suitable actors and resources are for teaching this?
3. What kinds of networks of relationship matter most for the local working context students are entering?
4. Pathways for supporting students to cultivate these relational networks.

In doing so, Net-Map enhances the navigability of locally grounded networks of practice by providing answers to some of these 'who', 'how' and 'where' questions.

Furthermore, we believe there to be a secondary opportunity for the use of Net-Map by students, empowering them to focus on existing local knowledge within their own communities.

For students Net-Map is a practical tool for answering questions like:

1. Are there existing informal networks within my context that can support my journey?
2. What kinds of things do I need to be learning about in order to succeed in my context?
3. Who/what are the best available resources I can draw on for this learning that have worked for others like me?
4. When faced with a particular kind of challenge, who can I turn to?

Conclusion

In light of the need for more inclusive approaches to the development and diffusion of sustainability skills, this paper has evaluated Net-Map's utility as a supportive tool for transgressing the boundaries of formal, hierarchical education.

In the case study, Net-Map was shown to be capable of surfacing informal learning networks and the knowledge resources that influenced the successful establishment of new kinds of livelihoods. It also demonstrated that it could assist in validating these informal knowledge resources through a simple form of practitioner peer-review.

These attributes make Net-Map a potentially low-cost method for circumventing traditionally costly approaches to curriculum development and accreditation. In doing so, it could assist community-based actors to make sense of the confusion surrounding emerging

career fields. The method's ability to connect learners to communities of practice also implies alignment with the kinds of place-based pedagogies advocated by educational theorists engaging with questions of socio-ecological sustainability (Sobel, 2004; Parr & Van Horn, 2006; Spielman et al., 2008; Wals et al., 2017).

Importantly, the research did not go on to test the application of the method empirically with students. Nor did it undertake a direct comparison with other approaches. As such, we suggest cautious experimentation with this tool in educational contexts in parallel with existing approaches. Empirical testing of the revised method is needed to begin developing a more comprehensive understanding of the potential efficacy of Net-Map in an educational setting.

Endnotes

1. Hygrotech is a local supplier of seedlings, irrigation systems and agricultural inputs. The company approach is sensitive to ecologically friendly agriculture.
2. While Google and YouTube were not knowledge actors in their own right, they featured repeatedly as the primary portals for the online problem solving.

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Luke Metelerkamp is a post-doctoral researcher at the Environmental Learning Research Centre at Rhodes University. His work focusses on the intersections between informality, skills development and food system transitions.

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Percentage contribution

Areas of contribution	Author	Percentage contribution
Conception or design of the paper, theory or key argument	Metelerkamp	100 %
	Schiffer	0 %

Areas of contribution	Author	Percentage contribution
Data collection	Metelerkamp	100 %
	Schiffer	0 %
Analysis and interpretation	Metelerkamp	80 %
	Schiffer	20 %
Drafting the paper	Metelerkamp	100 %
	Schiffer	0 %
Critical review of the paper	Metelerkamp	60 %
	Schiffer	40 %

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VIEWPOINT

Coronavirus Pandemic: The Roles of Environmental Education and Conservation Message Framing in Curbing Zoonotic Diseases

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Abstract

This viewpoint paper posits that it is helpful to frame environmental problems as human health problems. The most fundamental way to protect ourselves from zoonotic diseases (such as COVID-19) seems to be support healthy ecosystems that have resilience. Humans around the world are sometimes motivated by selfish motives and sometimes by altrustic motives. This viewpoint paper proposes an integrative view of environmental behaviour with dimensions of both self-transcendence (altruism) and self-enhancement (egoism), in the hope that both kinds of values could lead to an increase in pro-environmental behaviour.

Keywords: *pro-environmental behaviour, self-enhancement (egoism), self-transcendence (altruism), message frames, zoonotic diseases*

Introduction

Along with destruction of habitats and climate change, an increasing incidence of zoonotic diseases is evident in human populations across the world. Can environmental education help to change our unsustainable practices and lead to more responsible behavioural patterns? This viewpoint paper posits that it is helpful to frame environmental problems as human health problems. The ravaging coronavirus infection may have 'jumped' from animals to humans due to the destruction of natural buffers between them. The next zoonotic disease is on the horizon if ecological habitat destruction and human induced climate change are not kept under control.

A global increase in zoonotic diseases

According to a 2016 United Nations Environment Programme (UNEP) report, on average, three new infectious diseases emerge in humans every year; 75% of these emerging infectious diseases in humans are now zoonotic (UNEP, 2020a & 2020b). The emergence of the COVID-19 pandemic (a zoonotic disease) is at present disrupting health systems, negatively impacting the physical and mental health and well-being of societies, and causing deaths. Framing environmental actions (such as conserving natural habitats and slowing climate change) as

promoting health behaviours should therefore be relevant, meaningful and acceptable to individuals and nations around the world, especially at this time.

Recent zoonotic disease outbreaks include Severe Acute Respiratory Syndrome or SARS (2002); Avian Influenza or Bird Flu (2004); H1N1 or Swine Flu (2009); Middle East Respiratory Syndrome or MERS (2012); Ebola (2014–2015); Zika virus (2015–2016); and the West Nile virus (2019). In addition to the current SARS-CoV-2 virus, scientists warn that there are other coronaviruses circulating in animals that have not yet infected humans (UNEP, 2020a & 2020b).

Growing evidence suggests that outbreaks or epidemic diseases may become more frequent if we continue to destroy nature, exploit wild species and engage in actions that increase climate change (UNEP, 2020a & 2020b). The nations of the world can either choose between marshalling medical science and technology to produce vaccines for more than 1.7 million pathogens and viruses that are capable of jumping from wildlife to infect humans, or address the underlying drivers of zoonotic diseases – destruction of nature, exploitation of wildlife species and climate change.

This viewpoint paper proposes that policy makers and environmental education practitioners should integrate message frames presenting environmental problems as personal health problems into environmental education curricula and programmes to engage a larger audience in environmental actions. Message frames can be keys for engaging a broader audience in environmental action.

Environmental health message frames

Despite the links between the environment and health, campaigns designed to promote sustainable behaviour are rarely framed in terms of human health, and strategies to change health related behaviour patterns are not often applied to environmental behaviour (Nisbet & Gick, 2008).

Conservation message framing in terms of personal health matters should, in the author's view, ensure that:

- people personally feel greater susceptibility and severity of an environmental health risk with a less intense (weaker) cue;
- people see that the benefit of taking environmental action that is likely to prevent or reduce the personal health risk far outweighs the barriers or any obstacles that may prevent engagement in responsible or pro-environmental behaviour.

Nisbet and Gick (2008) submitted that future work by environmental educators and researchers should focus on three specific areas: increasing awareness of environmental issues, including their possible health consequences (and potential solutions); fostering positive attitudes and supporting environmental activities; and creating effective behaviour change interventions.

Altruism or egoism as motivators?

According to Batson (2011) and Knez (2013), there are two kinds of goals that motivate people towards environmental actions: the self-transcending (altruists) have empathy-related goals (sacrifice for the environment and others) while the self-enhancing (egoists) are motivated by self-benefit goals (such as personal comfort and safety and economic benefits).

People's moral obligations regarding the environment may be selfishness or unselfishness, differentiating them into egoistic and altruistic individuals respectively (Bucciarelli, Khemlani & Johnson-Laurd, 2008; Knez, 2016). Both egoism and altruism can play a role in pro-environmental behaviours. While the role of altruism is key for environmental education, it is proposed that policy makers and environmental education practitioners should also design and integrate message frames presenting environmental problems in terms of personal health problems in environmental education programmes and curricula, in order to engage a larger audience in environmental actions.

Many environmental education curricula are based on the approach that a self-transcending pathway will lead to positive environmental behaviour. However, in reality it is likely that more than altruism is responsible for strongly shaping and influencing environmental attitudes and values of individuals. Levy, Orion and Leshem (2016) argued that pro-environmental behaviour is driven by egoistic concerns, stressing that most environmental campaigns have failed (at least in Israel where their research was conducted) because they were based on altruistic slogans.

The dominant approach for promoting pro-environmental behaviour, to date, has focused on empathy for others or nature (De Dominicis et al., 2017). It appears that durable long-term pro-environmental behaviour requires activation of intrinsic motives (self-transcendence values) in individuals (Bolderdijk et al., 2013; Schwartz et al., 2015). Extrinsic motives such as economic interests or other financial incentives may even make people less likely to carry out environmental actions in general (Schwartz, 1992; Grouzet et al., 2005; Thøgersen & Crompton, 2009; Evans et al., 2013).

It is proposed that an integrative approach that frames environmental problems in terms of personal health problems can be used to modify attitudes that can be self-enhancing in the service of conserving and protecting the environment.

Conclusion

COVID-19 is a reminder of the close linkage between human health and environmental health, and of the fact that humans around the world are sometimes motivated by selfish motives and sometimes by altrustic motives. The most fundamental way to protect ourselves from zoonotic diseases seems to be to prevent destruction of nature. Only ecosystems that are healthy and support a diversity of species (or are rich in biodiversity) have the reslience and integrity to regulate and reduce incidence of diseases (UNEP, 2020a).

This viewpoint paper proposes an integrative view of environmental behaviour with dimensions of both self-transcendence (altruism) and self-enhancement (egoism), in the hope

that both kinds of values could lead to an increase in pro-environmental behaviour. In addition, appropriate message framing that presents environment problems as health problems could make individuals feel increased susceptibility and severity of health risks related to negative environment behaviour, even if such threats will occur in the long term.

The author concludes by advocating for further research on the persuasive effects of message framing in engaging a larger audience in environmental actions.

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VIEWPOINT

Repurposing ESD to Help Adapt to a Post-COVID World – Reflections from India and Africa

Jim Taylor, University of KwaZulu-Natal, South Africa, **Supriya Singh**, Tata Communications, India, and **Olivia Copsey**, Conservation Efforts for Community and Development, Uganda

Abstract

The world, as we are experiencing it, is in transition because of the COVID-19 pandemic. The crisis has engulfed every aspect of life forcing a re-evaluation of policies, priorities and practices. This viewpoint proposes that community embedded values inherent in some Education for Sustainable Development (ESD) practices could be used in the rebuilding of a post-COVID world. It contends that mere digitalisation of content will not suffice. We need to adopt an approach that considers situated and intergenerational thought and practice. We need to create a world that draws on indigenous knowledge practices and fuses these with the wonders of modern technology and multi-stakeholder interactions. Examples of community projects in Africa and India are used to point to how ESD practitioners could innovate and radically reorient learning environments.

Keywords: *pandemic, Education for Sustainable Development (ESD), environmental education, social change*

COVID-19 has dramatically changed the way we live. The effects of the pandemic are here to stay. Adaptation has required billions of us to completely refashion our existing way of living, in a time that is uncertain and ever-changing. While the focus was on sound and efficient implementation, the pandemic has exposed the limitations in the overall management of ESD programmes. For example, in India, where community based ESD programmes are common, the nationwide lockdown and high number of COVID-positive cases brought activities to a complete standstill. Most education institutions have found themselves completely unprepared to deal with a crisis of this nature. In response, ESD practitioners need to rethink the mechanisms and design of programmes. While the mainstream education sector has largely focussed on online, or broadcast learning, as a short to medium-term solution, this has increased inequality in many of the poorest communities. This brief paper, as a contribution towards ESD praxis, might provide alternative ideas and solutions. We identify some examples of situated and intergenerational thought and practice from the field of ESD which may support the immediate needs of children and communities during the pandemic, while advancing the kinds of educational transformations that in the field have long believed to be necessary.

A deep response to the new learning crisis

Approximately 1.6 billion learners (98% of the world's student population) have had their schooling interrupted during the pandemic (UNESCO, 2020, p. 7). Many are still out of school. Apart from losing learning opportunities, basic care needs, normally met by schools, have also had to be sacrificed. Out-of-school children are more vulnerable to health risks, including child labour, early marriage, teenage pregnancy, unsafe sexual relationships and violence as well as HIV/AIDS. For those who do return to school, critical overcrowding remains a challenge in many schools with an inadequate number of latrines and wash facilities, and overcrowded play areas. This not only impacts on children's ability to learn, but also their health, and ability to prevent future COVID-19 or similar viral outbreaks. These factors both outside and inside schools risk causing permanent drop-out for many more children, especially girls. While education is recognised as a crucial input for sustainable development (UNESCO, 2017, p.7), in many countries, already struggling to progress towards the Education 2030 and other sustainable development targets, COVID-19 has provided an inevitable, and potentially fatal, setback.

Understandably, a major focus is now on how it will be possible to overcome these challenges and return children to safe education and learning. Education for Sustainable Development (ESD) practices such as Eco-Schools in Africa have been shown to remove barriers causing low enrolment and early drop-out (Copsey, 2019) (see Box 1). However, a growing body of ESD literature asks us to consider the role of education in the trajectory of unsustainable development, especially in relation to social and environmental justice (Tickly, 2020). As ESD practitioners we need to be honest about the value of returning children to schooling which perpetuates regimes of inequality and un-sustainable development. This means paying attention to structural power relationships and colonial legacies embedded in modern education systems including elitism, emphasis on content and transmissive pedagogies, Eurocentricity, and neglect of native languages and indigenous knowledge (Tickly, 2020). The re-purposing of ESD should be conceived not only on a programming level but in systemic terms which consider hegemony and paradigm, and question the purpose of education itself.

Box 1 *Eco-schools in Uganda*

> Conservation Efforts for Community and Development (CECOD)'s Eco-Schools programme in Uganda focuses on schools as a hub for community engagement and development. The programme uses rights-based ESD approaches and action-based learning methodologies such as IVAC (Investigate, Vision, Action, Change) through sustainable natural resource management projects both inside schools and in the local communities. The schools are showing significant improvement in enrolment and attainment as well as retention of children in education. These projects create safer more child-friendly and conducive learning environments which remove barriers to school attendance. Democratic processes introduced at school via 'Pupils Parliaments', as well as improvement in the quality of the teaching and learning through

action-based learning methodologies have transformed the attitudes of learners to attending school and made them more interested in secondary education. Local interest in the practical skills being taught in the school is also encouraging out-of-school learners to attend. Closer relationships between school and parents mean more support for children with problems, reducing the likelihood of dropout. It has also brought significant resources to the schools in terms of labour and materials contributing to the success of micro-projects. Many learners and community members now practise water-harvesting, agricultural and agroforestry skills in their homes improving general health. The projects have instilled entrepreneurship, and replication of income-generating projects and livelihood skills has made a significant difference to the incomes of parents and their neighbours, increasing local prosperity and making it easier for families to pay schooling costs for children.

Reflections in between

In her doctoral thesis Terra Sprague proposed the need for a 'New Story' of human interaction with the Earth. This new story arises from a 'middle space' as the old paradigm is left behind and before a new one emerges (Sprague, 2019). Quoting Eisenstein (2017), Sprague (2019, p. 7) warned: "To alleviate discomfort, the temptation is to jump quickly to a solution, to quickly leave the space of unknowing, into a false knowledge which is actually a resurging of old patterns of thought". This middle space, which has been unexpectedly and vividly brought to life during the extended lockdown period, provides us with a period for reflection and enquiry. Rather than moving to rapid digitalisation of our existing education mechanisms and materials to reinstate education as we previously knew it, now is the perfect time to address the inherent assumptions in our programmes and explore alternative pathways for a radical re-orientation of the way we learn (Wals, 2007). During this time of reflection and deliberation, we are reminded to weigh up alternatives thoughtfully, and importantly, to unlearn former conventional wisdoms that are not doing much good for ourselves or our communities. We need to aim for better understanding of processes that are in the interests of the common-good (Taylor et al., 2020). To achieve this, we need to use the best approaches that modern times offer alongside the best practices from the past (Jewitt et al., 2019).

Relevance of intergenerational and situated knowledge

Before missionary and colonial education, in many societies, education was structured as an integral part of everyday lifelong learning. Modernising processes have little time or respect for knowledge practices or 'ways of knowing' that have enabled indigenous people to cope with health challenges, such as cholera, as well as weather events and locally-based decision making options relating to village-based risk avoidance. A very relevant example comes from elderly Nguni people who describe how, in the past, when a stranger arrived at a village a complex hand-washing ritual was followed before greetings were exchanged. Such a ritual has relevance

to the current COVID-19 crisis where the spread of a virus can be inhibited by careful hand-washing. Interestingly, the tradition held that it was unwise to dry one's hands on fabric (fabric could harbour germs). Hands were simply allowed to drip dry. Indigenous knowledge practices (and indeed natural and cultural heritage) have often been denigrated and their value has been unappreciated and undermined to the extent that this journal (SAJEE) produced a special edition, Volume 35, on this topic, in an attempt to restore some of this value.

In 2019 an article published in the SAJEE called for a restoration of situated, intergenerational processes of teaching and learning which refer to socio-cultural case histories, situated perspectives, lived experience, local metaphor and intergenerational knowledge practices (O'Donoghue et al., 2019). This requires education and learning to be considered, not in the modernistic (sometimes referred to as Western) context of individualistic agency but in the more complex context of uBuntu where the individual is a person through other people: 'I am because I belong' (Khupe & Keane, 2017).

Box 2 *Social capital in the uMngeni Catchment*

A closer look at the social fabric of communities living in economic poverty in the uMngeni catchment, in KwaZulu-Natal, South Africa, provides an illustrative example. Communities and societies may be economically poor and suffering great hardships but the ability of people to work together and support each other in challenging times is unprecedented. The Nguni tradition where people of a similar age are considered to be brothers and sisters, the elderly are considered to be the parents of all people younger than they are, and young people are regarded as the children of older people, is an example of this. Where such traditions are respected, the social capital remains strong since no one would wish to harm others who are considered members of one's family. The tradition that it takes a village to raise a child is one outcome of this indigenous knowledge. Child-headed households near Howick, where children who have lost their parents take care of each other, benefit from this powerful knowledge. In many instances such families survive and obtain food and nutrition by exploiting and applying indigenous knowledge while harvesting nourishing *imbhiba* (three-striped field mice) and *imifino* (wild spinach) (Kaschula, 2008).

With so many children learning at home, families and extended families are having to fill the void left by teachers. Lotz-Sisitka's notion of 'learning as connection' has never been more relevant. Alongside the global rush to expand technological access for children without computers, and internet, should be a widespread appraisal of the community-oriented learning processes practised in many parts of the world. This in turn requires exposure to a full and balanced curriculum that can lead to the development of a full range of cognitive, effective and creative capabilities required to support sustainable livelihoods and well-being (Lotz-Sisitka et al., 2015).

New priorities for ESD

It is important to note that over the years, ESD practitioners have learnt a considerable amount about science and medical matters. They have also learnt how to educate people and share knowledge in a practical and applied way. In the current crisis, exacerbated by the pandemic, they are therefore well-equipped to share this knowledge more widely in the community. The pandemic has exposed urgent social and economic fissures prevalent in our societies which are of particular importance for discussion among ESD practitioners – for example, job insecurity, poor nutrition, domestic violence, social isolation, children as carers, increased school drop-out numbers, and homelessness, as well as gaps within access to health care, childcare, disability services, technology, internet and outdoor spaces. Of course, the impact has been more severe for disadvantaged children and their families. The question to ask ourselves is how can ESD approaches be used to build community resilience to similar disruptions in the future, particularly in the areas where weaknesses were so quickly exposed when the crisis occurred? A good example of an ESD practice relevant to COVID-19 is the uBuntu Payments for Sustainability Practices project in Mpophomeni, South Africa (see Box 3).

Box 3 *Ubuntu payments for sustainability practices*

Mpophomeni is an apartheid-created township not far from Howick in South Africa. Most people who live there are unemployed. Inadequately designed services are resulting in serious water and sanitation failures. Huge amounts of litter and solid waste dumping contribute to the challenges of the township. In a recent innovation, that may have wider global implications, Ayanda Lepheana, from the Mpophomeni Enviro-Champs movement, is pilot-testing a process where unemployed participants, who are choosing to work for the common good (or Ubuntu) are reimbursed for their efforts through a 'live' e-wallet system where money is paid to them, via their cell phones, for the work they have completed. This approach seems to have much potential and could be the future that Harari (2018) is alluding to in his work on the merits of 'algorithms and artificial intelligence' and a 'world without jobs'! To avoid any abuse of the system, Ubuntu Payments for Sustainability Practices (UPSP) are managed through a geo-positioning computerised system, Geographic-Open Data Kit (Geo-ODK). Geo-ODK is a free open-source suite of tools that helps organisations create, field, and manage mobile data collection solutions. In this way a customised version is used, as an app on a cell-phone, by each participant in Mpophomeni. The Geo-ODK system records photographic evidence of environmental issues, and work done to rectify them, with a geo-positioning mechanism and an encrypted time and place record that can further be confirmed by a fingerprinting verification system. The UPSP concept in Mpophomeni is also supported by a number of Enviro-Champs who are happy to commit to UPSP as verifiers so as to achieve greater reliability and the best possible course of action for any particular challenge that is identified. Ayanda is also using Microsoft Power BI software to create accessible graphs and heat-maps of key issues in townships such as illegal solid-waste dumping, sanitation spillages and freshwater leaks.

Such questions have often been the focus of ESD programmes for Climate Change Education and Disaster Risk Reduction, especially in developing countries and tropical regions of the world. The field has developed a broad range of tools, experience and competencies which can be highlighted and shared with each other, as we prepare to adapt to new priorities post-coronavirus. For example, programmes for community and urban farming, use of WASH principles to reduce spread of infection, rights-based learning approaches as a protection from exploitation and violence, sustainable livelihoods and income generating handicrafts. Other potential gaps ESD might fill include health care and first aid, cooking, and budgeting. The MPowered programme in India is a recent example of the potential for ESD programmes to adapt in the face of rapidly changing priorities (see Box 4).

Box 4 *Mobile based training for livelihoods enhancement*

An example of community-based ESD programme from India is MPowered which was started in 2016 as a multi-stakeholder partnership between Tata Communications, Trickle Up India, local government bodies and the community to empower the poorest and most vulnerable women (the ultra-poor) who live on less than USD 1.25 per day in the east Indian states of Odisha and Jharkhand. MPowered focuses on improving livelihoods of women using mobile-based training and education. A special application has been developed in local languages which is preloaded on smartphones given to the women as part of the project. The application provides information on sustainable farming practices along with training the participants in financial and digital literacy in order to access local government schemes. The programme, now in its, fourth year, complements the efforts of local chapters of National Rural Livelihoods Mission (NRLM). Local women from the community have been trained as Smart Sakhis (sakhi is Hindi for friend) to act as champions and motivators. The idea is to harness inspiration from the community itself in order to encourage more women to participate. During the lockdown phase due to COVID-19, the Smart Sakhis quickly swung into action to sensitise the community on health and safety measures to deal with the virus. The programme is now aiming to train the women to start nutri-gardens that can ensure food security of their families, with surplus produce being used to feed the vulnerable in the community. The current crisis has highlighted the value of a self-sufficient village economy – a concept not new to the Indian ethos, with Mahatma Gandhi being one of its most venerated advocates.

Challenges for the field

Going forward, we will also have to ensure the resilience of our initiatives. There is a need to invest in scenario building and risk assessment to 'future-proof' programmes. This will also require us to invest more thought and energy in stitching together more effective multi-stakeholder partnerships as sustainability challenges are becoming more complex and often persistent, requiring a systems approach and multitude of actors to collaborate with (Loorbach et al., 2010).

We are finding that the five T's of Action Learning (Taylor, O'Donoghue & Venter, 2018) (see Box 5) are helpful for framing learning pathways. Such co-engaged, deliberative approaches are useful across various geographies. Of course the 5Ts intersect and flow into each other and are commonly mediated in a socio-cultural context. They apply open-ended methods to support co-engaged and experiential meaning-making. Working together, with principles and the ways of working outlined above, we can overcome the challenges that COVID-19 has revealed and placed in front of us. Such thoughtful approaches to learning can enable a more sustainable future for all – people, plants and animals.

Box 5 *The five T's of Action Learning (Taylor, O'Donoghue & Venter, 2018)*

- **Tune-in**: This involves engaging in a 'Tune-in' and 'planning together' process that connects the learners with the topic of instruction
- **Talk**: Discussion and dialogue by, with and amongst participants
- **Touch**: Real-life encounters, including practical outdoor experiences
- **Think**: 'Thinking' or reflection amongst participants
- **Take Action**: For sustainability and the common good

To conclude, Arundathi Roy (2020) has described the situation beautifully and succinctly:

> Historically, pandemics have forced humans to break with the past and imagine their world anew. This one is no different. It is a portal, a gateway between one world and the next. We can choose to walk through it, dragging the carcasses of our prejudice and hatred, our avarice, our data banks and dead ideas, our dead rivers and smoky skies behind us. Or we can walk through lightly, with little luggage, ready to imagine another world. And ready to fight for it.

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Percentage contribution

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Conception or design of the paper, theory or key argument	Taylor	33.33 %
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Drafting the paper	Taylor	33.33 %
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Critical review of the paper	Taylor	33.33 %
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THINK PIECE

Learning, Living and Leading into Transgression – A reflection on decolonial praxis in a neoliberal world

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Abstract

Three scholar activists from South Africa reflect on what it means to *transgress* the limits of a neoliberal world and its crisis times, particularly considering transgressions in the service of a decolonial future. The authors explore three questions: i) What kind of *learning* can help us transgress the status quo? ii) How do we extend this learning into a commitment to actively *living* in transgressive ways? iii) What does it mean to *lead* in ways that re-generate a transgressive ethic in a neoliberal world? In a dialogical conversation format, the authors outline nine different but interconnected perspectives on learning, living and leading into transgression, with the aim of concurrently revealing the multiple layers of work that a decolonial future depends on, while demonstrating the ambitions of a pluriversal decolonial future through their writing. The intertwined narrative is not conclusive, as the processes marked out in brief are experiences that still need to be fully practised in new relations in times to come within academia-in-society-and-the-world with human and more-than-human actors. However, they do offer a generative set of questions, concepts and metaphors to give courage to boundary-dwelling scholar activists attempting transgressive research. These reflections seek to regenerate the transgressive 'decolonial gestures' (decolonialfutures.net) that we can undertake in a neo-liberal world, as an important part of environment and sustainability education practices. It draws out what an embodied practice of transgressive learning can entail when we become discerning of hegemonic discourses that reproduce the status quo. We pay homage to those decolonial scholars in the field of environment and sustainability education as we traverse this terrain, recognising their imagination and the transgressive movement that has come before us, but importantly we seek to also open pathways for those yet to come.

Keywords: *transgressive learning, decoloniality, pluriversal, emancipatory visions, transformation, education, sustainability, Africa*

Introduction

Within environment and sustainability education, there is much boundary crossing, and navigating of plural ecosystems of knowledges, world-views, cosmo-visions and identities. There is therefore a need to generate creative and participatory instruments for surfacing these multiple worlds and multifaceted stories in meaningful and care-filled ways. The ecological crisis is a symptom of a systemic crisis in society, with its impacts most often felt first by those less resourced in modernist terms. Contemplating transgressive learning and the decolonial visions that it accompanies allows us to surface and traverse the fault lines of neo-liberalism as we embrace and chart potential and emerging regenerative futures. We recognise those who have started to chart this path before and alongside us. Sibongile Masuku, Edgar Neluvhalani, Rob O'Donoghue, Eureta Rosenberg, Mabongi Mtshali, Mba Manqele, Lesley le Grange, Soul Shava, Justin Lupele, Overson Shumba, Tsepo Mokuku, Million Belay, Charles Chikunda, Leigh Price, Mutizwa Mukute, Cryton Zazu, Jane Burt, Tichaona Pesanayi (late), Caleb Mandikonza, Charles Namafe, Dick Kachilonda, Anna James, and Priya Vallabh are a few that we can mention in the field of environment and sustainability education in southern Africa.[1] These pioneers, comrades and community of practice partners, together with our liberation leaders and African feminist scholars (cf. Burt, James & Price, 2019; Kulundu-Bolus, 2020 – too many to mention here) opened and are opening the road for decolonial praxis in environment and sustainability education in southern Africa and beyond its borders. It is on their shoulders and in their company that we move transgressively forward in our writings here.

This paper shares our three perspectives, as we, as scholar activists, reflect on what it may mean to *transgress* the limits of a neoliberal world and its crisis times in our research and praxis, in the service of a decolonial future. These reflections, crystallised during our participation in the International Science Council's Transformations to Sustainability T-learning project in which we were all engaged (www.transgressivelearning.org), are the fruits of decades of work in the context of South Africa, the southern Africa region, the continent and the world.

Our inquiries stem from an intergenerational and intersectional appreciation of South Africa's apartheid past and the colonial impacts on formal and informal learning processes in Africa more widely. The breadth of the work that pulled us into this conversation includes the nexus of working as researchers, educators and artist practitioners in and at the intersections of the fields of educational sociology, primary and early childhood education, higher education, ecological economics, politics, social justice, anthropology, social learning, sustainable rural development, agroecology, water security, and environmental justice. Here we have fought policy battles, crafted research reports and learning support materials, created learning opportunities for thousands of professional environmental educators and young people across many countries, supported small and large youth social movements, contributed to the shaping of eco-schools, programmes and learning networks such as Fundisa for Change (www.fundisaforchange.co.za) and T-learning (www.transgressivelearning.org), and engaged with the cutting edges of environmental justice coalitions, all the while developing critical pedagogies and learning pathways for cultural transformations towards sustainability, ecological citizenship, practice-based arts research and expansive social learning praxis.

Our work has been grounded in empathy and practices of care, transgressive social environmental learning, and fugitive ways of re-imagining and re-sourcing the lived practice of decolonial love; always holding women, young people, children and the most marginalised in our societies in mind, which at times includes not only people but those creatures that are dying out and the soil, waters and air being polluted due to human arrogance, extractivism and exploitation. This paper extends its emancipatory visions in ways that show concern for the dignity of human beings, all sentient beings and the Earth that sustains us.

The paper explores the answers to three questions:

i)   What kind of *learning* can help us transgress the status quo?
ii) How do we extend this learning into a commitment to actively *living* in transgressive ways?
iii) What does it mean to *lead* in ways that re-generate a transgressive ethic in a neoliberal world?

The paper is structured as a dialogical conversation that is receptive to different perspectives all at once. Within it, lie nine different but interconnected perspectives on learning, living and leading into transgression. The intention here is to reveal concurrently the multiple layers of work that a decolonial future depends on, while demonstrating the ambitions of a pluriversal decolonial future through our writing. An essential aspect of this future is an openness to many ways of being and knowing in the pursuit of emancipation. In doing so, the paper decolonises the prevalence of single authorship or a single narrative by signifying many starting points to an ongoing conversation. It guards against a superficial ordering of the world through one perspective by inviting the space for us to collectively unravel what is missing and what we feel is needed. The hope is that by thinking collectively we can begin to evolve past the inevitable 'blindsided-ness' of 'one single story' by harvesting the knowledge that sits within and between each offering (Adichie, 2009; Santos, 2014). This paper is inspired by the call and response tradition of singing in Africa, where one person sings a phrase, and inspired by their contribution, the crowd sings back; this becomes an intuitive ongoing iterative process of improvisation and meaning making together. It is this kind of call and response education that is needed for environment and sustainability education, an approach to learning and education that is contextually responsive, adaptive and moves towards solidarity in this time of crisis.

As such, this paper insists on pointing to different places at once. Its methodological refrain urges us to understand that we need to begin here, and here, and also here – all at once! It takes us beyond the binary bound ideas of a thesis and an anti-thesis, by juxtaposing different perspectives. In doing so, it tries to be honest about the complexity of the world by loosening the tyranny of human arrogance that tries to portray the world according to human thought (Dickinson & Goulet, 2010, p. 14). Instead, we seek to show human thought trying to awkwardly fit the complexity of the world (ibid.).

This methodology is an essential part of writing and thinking into a decolonial future. By showcasing the intersections between different perceptions we can begin to tune our ears to

what it means to listen to an 'ecology of knowledges' and more so, what it means to attend to a pluriversal way of understanding any subject matter (Ndlovu-Gatsheni, 2013; Santos, 2014). At the heart of this is a re-generative project that seeks to provide loosely hanging threads as multiple entry points into a future that is distinct from the past. By doing so we endeavour to transgress…

> the very heart of [a] social and symbolic system that has welded together Being, Subjectivity, Masculinity, compulsory Heterosexuality, and (Western) ethnocentrism [and Anthropocentrism]. (Braidotti, 2011, p. 31, our addition)

We seek to re-seed a decolonial future through a germ of multiple beginnings. This paper serves as a metaphor for the need for generous interactions across a myriad of voices waiting to arrive. Readers of this dialogue are equally asked to collaborate with the ideas presented here by actively holding the different threads of thought in tandem. Yours is the work of hearing the intonations held in these perspectives (as well as those that you hold) and actively weaving the possibility of their synthesis.

On learning into transgression

Injairu: **Morphing towards an undivided future**
Learning into transgression means learning to see and feel into what parts of oneself and the collective are left outside the ontological demarcations of our current reality. It requires that we lean into the parts of ourselves and the collective that have been forced into exile by the status quo. This kind of learning requires a stripping away of conditioned norms that no longer serve us or that were never of us. This is an act of "making credible non-western knowledges and practices that were placed on the other side of the line by abyssal thinking" (Santos, 2014, p. 226). Going beyond abyssal thinking means constantly meeting oneself and one's community at the borders of what dignity for the Earth and all sentient beings should be in this world. It compels us to actively redraw and even dismantle these borders. We can only do this by believing that we are worthy of the dignity of an undivided life, in which all parts of ourselves are permissible, not only some (Palmer, 2004, p. 17).

An important part of this process is the need for constant reflection in motion. This evokes questions such as: What are we learning right now? What are we currently creating from what we are learning? What does this serve? What still remains in exile? What does this mean for our individual change and what does this mean for collective solidarity? This is a re-generative ethic that consistently asks us to consider and submit into the fire that which does not serve the evolution of the highest good – conceived as an affirmation of a 'good life or buen vivir' for the Earth, humankind and all sentient beings (Santos, 2014, p. 3).

Transgressive learning is thus conceived as a "generative force of becoming" (Braidotti, 2011, p. 288), in which we resign ourselves to an understanding that: "the sustainability of the future rests on our ability to mobilize, actualize, and deploy cognitive, affective and ethical forces that had [have] not been activated thus far" (Braidotti, 2010, pp. 413, my addition). This

way of learning often means letting go of and giving death to even that which we have reclaimed at some point in our journey, that which may have given us the strength to exist and resist – but whose strength at another point in the journey may stagnate our further progression. James Baldwin put it well and simply when he stated that "any real change implies the breakup of the world as one has always known it, the loss of all that gave one an identity, the end of safety" (Baldwin, 1993, p. 117). This means that we have to continually commit everything to a renegotiation that is always aligned to what can create more solidarity, more cohesion, more expressions of our true selves in the world (Ndlovu-Gatsheni, 2013; Santos, 2014; May, 2015).

This kind of learning asks us to consider how we are implicated in the state that we are in. It requires that we look for what is both oppressive and liberating within ourselves and in the world. It asks us to dare to "transcend ourselves" at each turn whilst we continue to hold the flame of what it means to be a human seeking justice for the Earth (Okri, 1997, pp. 61, 66). Transgressive learning is about a commitment to movement that inevitably asks us to shed our old skins. It is about writing oneself right up to this present moment, by making sure that you (in community with others) are your own latest update of what is missing and what is needed in the world as you understand it. It is about the audacity of affirming that this is the only world we have. We therefore ought to try and live into it fully – together. Transgressive learning is about returning again and again to the fact that we are bound in fate with each other and the Earth (Okri, 1997, p. 70 and that we are the only vessels through which the future that we are longing for can be seeded within the present.

Dylan: **Decolonising the charade**

David Orr (2004, p. 11) quoted Thomas Merton (1985) who once identified modern education as the "mass production of people literally unfit for anything except to take part in an elaborate and completely artificial charade". Decolonising this charade and the educational systems that uphold it, is the task at hand, and involves a refusal to participate in the parts of the charade that reinforce privilege and exclusion. Learning into transgressive decolonisation is most likely a process of 'unlearning' – identifying how we might 'unlearn' the enculturated ways of being that encourage and reinforce coloniality. A good place to start is where Donna Haraway (2016) found inspiration. She quoted Marilyn Strathern (1988) who inspired the phrase: 'It matters what ideas we use to think other ideas (with)'. Learning into transgressive decolonisation must fundamentally be a practice of challenging the very ideas we use to think ideas with. Are these ideas a product of coloniality? Are these ideas even mine? Did I inherit them? Do I really believe them? How do these ideas conflict with other ideas? Focusing on the ideas we use to think, is also a process of investigating our very intentions, and the tensions inherent in our intentions. Might we call them *(in)tensions*? It is an introspective, uncomfortable and sometimes painful act that each of us must participate in. Questioning our (in)tensions within our ideas might challenge our identity, sense of self or more. 'Learning into transgressive decolonisation' is being comfortably uncomfortable with tensions, and seeing tensions as a vital mechanism of transgressive and generative social learning (Lotz-Sisitka et al., 2015). In the same way that conflict transformation research (Rodriguez, 2002) sees conflict as an opportunity for transformation, we need to be unafraid of the troubling tensions that lie dormant in our inner

ideas. Donna Haraway (2016) provided another mantra that helps us in this process, as she urged us to be brave and learn to 'stay with the trouble'.

Heila: **Building low theory out of the dust of the old**

Transformative, transgressive learning embodies often radical desires and ambition for change. Its ambition in crisis times is transgressing taken for granted, stale and out-of-date boundaries and norms. The question arises whether something can emerge from the dust of the old, or whether we are aiming at disconnected, radical emergence of the new, like in Žižek's (2014) event, or a complete about-turn of a different kind?

There is no doubt that decolonisation and transforming education requires expanding our imaginations. Our environments need to be rebuilt with the deployment of new passions. But this is not a neoliberal chase after change. Ambivalence arises when at times we need the same passions to hold at least some of that which is historically valued in place, and to establish the valued in the first instance. Surrounding oneself in such ambivalence is not easy, we may well find ourselves forced into permanent reflexivity, doubt and paralysis. But, we can do work to shake off paralysis, by really thinking carefully and critically about the work of enabling change in our society. More importantly, it is the work of transgressively embracing the unknown, challenging the dust of old, the stale out-of-date norms, and planting that which we desire most in their place. It is the work of transgressive learning in times of crisis (cf. Lotz-Sisitka et al., 2017).

But where do we find this kind of ambition around us today? Art has become retrospective, and theory's utopia got stuck in the academy (Wark, 2011). Commenting on the mechanisms that produce theory's utopia as end-point in the academy, McKenzie Wark (2011) eloquently warned that we should not ignore the way that "colonnades of founding fathers and new masters" (e.g. Lacan, Foucault, Derrida, Deluze) continue to surround us. He suggested that frenzied academic work caught in the new neo-capitalist regime of intellectual property produces a rising consumer demand that even prompts some to "chisel statues of new demigods while they still live" (Wark, 2011, p. 2). Wark remarked that some in the USA (e.g. Butler, Spivak, Haraway) at least appreciate the "double bind of speaking for difference within the heart of the empire of difference" (2011, p. 2). He remained silent on scholarly work in Africa. Are we in danger of falling into the same runaway split, learning into what could be misplaced ambition?

> At best theory, like art, turns on itself, living on through commentary, investing in its own death on credit. At worst, it rattles the chains of old ghosts … **What has escaped the institutionalization of high theory** is the possibility of low theory, of a critical thought indifferent to the institutional forms of the academy or the art world. **A low theory dedicated to the practice that is critique and the critique that is practice.** (Wark, 2011, pp. 2-3, my emphasis)

Think low theory for transformative, transgressive learning, as those to whom we pay homage in the introduction have also been doing. The method for thinking and working with low theory

involves dwelling in or creating a situation, at the same time remembering older situations for the ways in which they can ignite future possibilities.

Re-vise. Re-new. Re-vitalise. Re-invent. Re-imagine. **Low theory.** Re-generate. Re-exist.

Shall we now take what can be worked with from Dewey, Vygotsky, Bhaskar and the developers of other 'high theory' (as and from when it existed) to create 'low theory' for our times in the form of critique and practices in the everyday that matter, in ways that can overcome the separated nature of specialised knowledge(s), transforming our learning as we go? This is perhaps evident in the work of those we pay homage to above, and of bell hooks (1994) who taught to transgress with inspiration from Paulo Freire, Audrey Lorde and others, and Donna Haraway (2016) who re-invented science studies with cyborgs and feminism to stay with the trouble. Developing low theory is a method for expanding the imagination, in times that are tough, yet pregnant with possibility. Such possibilities emerge for us in the work of decolonial environment and sustainability education scholars such as Shava (2009), Le Grange (2012), O'Donoghue (2016), Masuku (2019), Mudokwani and Mukute (2019) and researchers such as Chilisa and Ntseane (2010), Ndlovu-Gatsheni (2013), Gqola (2017) and Kumalo and Praeg (2019), amongst others, on our continent.

Mbembe, writing in 2017, stated:

> In our world of hierarchical division, the idea of a common humanity is the object of many pious declarations. But it is far from being put into practice. Old colonial divisions have been replaced with various forms of apartheid, marginalisation, and structural destitution. Global processes of accumulation and expropriation in an increasingly brutal world economic system have created new forms of violence and inequality. Their spread has resulted in new forms of insecurity, undermining the capability of many to remain masters of their own lives. (p. 161)

Not giving in to this, Mbembe (2017) in response reminded us of Fanon's method:

> … a *'situated thinking'* born of a lived experience that was always in progress, unstable and changing. An experience at the limits, full of risk, where the thinking subject reflected in full awareness on his [her] history, his [her] very existence, and his [her] own name, and in the name of the people to come, those yet to be born. (p. 161, emphasis original)

On living into transgression

Dylan: Reinhabiting place

When I think of living into transgression in the context of decolonisation, I am transported to the 'places' we live in, and challenging the colonial, neoliberal histories that occupy these places and govern how we are able to live in them. There are many invisible meanings and memories to the places we live in that need to be lifted out and expressed in order for us to live well together, and avoid colonial amnesia. Gruenewald's (2003, p. 9) concept of reinhabitation as a process of decolonisation is useful here:

> If reinhabitation involves learning to live well socially and ecologically in places that have been disrupted and injured, decolonisation involves learning to recognise disruption and injury and to address their causes.

Working with place can be a profound catalyst and means for embodying, locating and holding decolonial action (Tuck & McKenzie, 2014). Along with this thinking I find it useful to look at Elizabeth Henry's (2014) and Somerville's (2007, p.149) process of developing 'new place literacy', a process in which "place learning involves a contact zone of contested place stories", where "changing our relationship to place, means changing the stories we tell about those places". Living into transgression is not shying away from, but embracing contestation, disruption and indignation, and using these as formative forces.

Living into reinhabitation is fundamentally interconnected with ecological thinking. Here social justice in space/place, is inherently tied up with ecological justice (Gruenewald, 2003). Henry (2014) drew on Scully's (2012) aboriginal place-based education:

> ... as a practice of both social and ecological justice – and opportunity for Canadian learners to be in right relations to the peoples and the lands of Canada through territorially and culturally specific teachings – it is a combining of place-based education with aboriginal education ... that creates an important 'unsettling of learners, but a familiar place where they feel they have agency'. (Henry, 2014, p. 20)

Living into and learning from indigenous movements can be particularly useful in considering 'living into transgression', as shown by Pesanayi (2019) in his eloquent recovery of the cultures of agriculture in Africa as a foundation for expansive, transgressive learning with small-scale farmers and college lecturers. Grande's (2004) *Red Pedagogy* informed an indigenous perspective on decolonising pedagogies, which highlights the importance of indigenous sovereignty, self-determined and self-directed communities in place as the ultimate goal of decolonisation. In the Standing Rock movement we witnessed a profound union between 'living-in' into transgressive decolonisation, that was deeply embodied by place. As Martha Chavès from the T-learning Network (pers.comm., 2018; www.transgressivelearning.org) reminded us: resistance is a process of re-existing, or living in ways that allow us to re-exist despite the violent pressures of coloniality.

Heila: **Escaping multi-form fractured selves**

Social exclusions have made us closed groups. Colonial intrusion and discord that fractured division of self, subject and collective must be exorcised (Mbembe, 2017). Layering the trouble with hyper-modernity and its cultural hypermedia influences, "it has become an impertinence to say '*we*' ... The collective pronoun is to be distrusted. Only the self seems to be authentic" (Wark, 2011, p. 33). In a hyper-capitalist neo-coloniality, the world of 'Me!, Me!, Me!' shouts at us from selfie-sticks, blogs and self-framed social media sites. Eloquently stated by Wark, such a world is "... a world of free agents vainly attempting to establish themselves on the slender resumé of their own qualities" (Wark, 2011, p. 33). Historically fractured subjectivities, with

contemporary types of hyper-individualism, rob our imaginations while making us different, separating us from each other and world. The result is an inability to embrace the plurality and empathy necessary to think and act anew. While a deeply problematic legacy, we should not underestimate the power and potential of the space that this absence offers transgressive learning researchers-as-T-learners to regenerate and re-invent praxis as is being shown in contemporary transgressive learning research-as-learning projects in environment and sustainability education (McGarry, 2014; Burt, 2019; James, 2019; Mudokwani & Mukute, 2019; Pesanayi, 2019; Kulundu-Bolus, 2020).

The need is to transgress temptation to sync hypermodern selves with fractured selves. Achille Mbembe's reminder of how the colonial subject was produced via 'primordial displacement between the self and subject' calls for living transgression, recovery of *selves-in-community, situated in unfractured or at least less fractured worlds*. Colonial subjects were produced not only as the 'other', but also as nature-culture separatists in the mirror image of modernists. In such a setting, education must refract the processes of internal fracturing of selves (colonial and contemporary), of which the colonial West and now its extended globalised hypermodernity are guilty (Mbembe, 2017).

Cesaire's thought "put racism and colonialism on trial" (Mbembe, 2017, p. 156). His hope was for "an unconditional relationship with humanity". This remains an unfinished project, and must by contemporary necessity be extended to an unconditional relationship between people and planet, situated on a rapidly degrading planet, now in COVID crisis. Fanon's method was "to walk with others toward a world created together unendingly, irreversibly, within and through struggle" (Mbembe, 2017, p. 161). Such a method is what we have at our disposal today, as we seek to 'live transgression' in times where erstwhile and contemporary colonial transgressions and their aftermath in modernities of crisis conditions continue to require transgressing. In the spirit of the work that *low theory* can do, and as noted by Mbembe,

> For a common world to emerge, critical thought had to be deployed like an artillery shell aimed at smashing, puncturing, and transforming the mineral and rocky wall and interosseous membrane of colonialism. It is this energy that made Fanon's thinking **metamorphic thought**. (2017, p. 162, emphasis original)

But the project of low theory is not only about launching critique, not only about smashing and puncturing. It must also be about restoring, reparation and regeneration. Creating new practices, activity, concepts and projects from the ashes that we sit in. The project of low theory is not simply an economic project, but a "process of reassembling amputated parts, repairing broken links, relaunching the forms of reciprocity without which there can be no progress for humanity" (Mbembe, 2017, p 182). It must also be about healing relations with the more-than-human, and reconstituting people-planet relations that are less destructive of the fabric of life. Seeing ourselves enmeshed in virus risk may help to steer creative forces.

Injairu: **Dancing between contradictory masks²**

Living into transgression is emerging into the world as your mirror. It means listening to the parts of yourself that are 'triggered' in your living world; the parts that are caught in fear in all its forms and the parts that can bring new life. Living into transgression means accounting for all the parts of yourself that are unresolved in the tensions that you see around you. It is about allowing the world to show you where its only healing and your only healing lies. An essential part of this reflective practice is understanding that our perception and relationship with the 'other' gives "the measure of our humanity, our courage, and our imagination" (Okri, 1997, p. 60). This is about bringing these messages that you hold about others home for you to scrutinise and learn with. We need to consider the sanctity of our choices in each moment by asking ourselves who we choose to be in the face of the world as it is. It is about listening to the reverberations of our actions by paying attention to the intentions that lie behind them.

Living into transgression asks us to witness the contradictions that play themselves out in the way that we live. This is a way of living that "reminds us of the painful gap between who we most truly are and the role we play in the so-called real world" (Palmer, 2004, p. 15). It asks us to position ourselves in the gulf between these contradictions as political praxis. This way of living must always be ready to unpack

> … how it is that many equality strategies paradoxically legitimize and even expand the forms of violence and harm that they seek to dismantle, in large part because they do not depart from the binary logics and hierarchical processes that undergird inequality. (May, 2015, p. 82)

This commitment to non-binary ways of being and seeing are an important way for us to bring the complexity of the world home in its entirety. It opens up the space for us to act in alternative ways within everyday life and asks that we expand the possibilities and language around what these actions can be in the world. As the poet Rilke said: "take your practiced powers and stretch them out until they span the chasm between two contradictions" (1989, p. 261). Living in this way seeks to give life to an undergrowth of subversive possibilities capable of reshaping our world by de-centring the status quo. Pumla Gqola reminded us that the "activity between these two masked positions… is not simply struggle. You can dance there. And yes, there are 'troubles and joys'" (2017, p. 11). This is an injunction to remember to joyously perform the creative release that can be found by placing oneself between troubling contradictions. Alice Walker (2010) similarly reminded us that "hard times require furious dancing". For me this signifies the need for creative catharsis as part of living into transgression. This is how we stay alive to ourselves in the face of the resilience and complexity of a neoliberal world order.

It is this very life force that we need intact and whole in order to create a future worthy of our longing.

On leading into transgression

Injairu: Relentless freedom experiments

Leading into transgression means constantly asking ourselves how we can "resist the present, more specifically the injustice, violence, and vulgarity of the times, while being worthy of our times, so as to engage with them in a productive, albeit oppositional and affirmative manner" (Braidotti, 2011, p. 268).

The emphasis on working in 'productive' and 'affirmative' ways intimates that leading into transgression requires a sense of optimism geared at asserting the possibility of what could be, within the constraints of what is. Baldwin ruminated on how strange and essential our optimism is to our survival:

> I can't be a pessimist, because I'm alive, to be a pessimist is to agree that human life is an academic matter. So I'm forced into being an optimist. I'm forced to believe that we can survive whatever it is that we must survive. (Baldwin, 1963, n.p.)

In order to 'survive what we must' (ibid.), we need to have reverence for the learning and unlearning happening for everyone – because this is the only adequate place to start. Leading into transgression is an open invitation for each person to become more of themselves in response to what they reclaim as well as what they strip away. It implies the cultivation of a fierce and generous spirit capable of creating spaces that invite a multiplicity of being. It requires that we are vigilant to the hierarchical and binary bound colonial ethics of domination that play themselves out even in emancipatory spaces. We need to do this even whilst relentlessly experimenting with creating a kind of freedom for ourselves and each other across intersecting realities. Part of this ferocity entails owning the different responsibilities that are at play in order to create unity. Adichie squarely addressed the power asymmetries that need to be addressed as a part of this process: "The premise for empathy has to be equal humanity; it is an injustice to demand that the maligned identify with those who question their humanity" (2016, p. 1).

Leading into transgression acknowledges that we need to create an example of what freedom looks like – even when we are unsure of what it is or the language we need to use to call it into being (Smith, 2013, p. 274). It is about being lost together on the way to the future whilst insisting that this place we create right now is worthy of this unknown future. In order to do this, we need to dare to create a vision together while listening intently to what the space we are currently creating enables or inadvertently shuts down. The question to come back to as a collective is: What does this serve and what kind of future will it create in its wake? We cannot gamble the future by creating additional 'isms' and 'schisms' in the present from which we will have to recover later. It means embracing the fullness of that vision now in fierce and generous ways. Embedded in this practice is the necessity of making sure that the 'safe spaces' that we create are not an "escape from the real, but a place to *practice the real* we want to bring into being" (Smith, 2013, p. 277, my emphasis). This is a movement to uncover the full potential of being human, in a world that has purposefully set dangerous limits to

this. We can only do this by being fully aware of the two sides of our power and two sides of our love and to practise moving fluidly between the regenerative and emancipatory potential that sits within both of these impulses (Kahane, 2010, pp. 129, 134). Attending to solidarity in edgy ways is an important aspect of this. Here we need to try and lead each other into "a conception solidarity that hinges on radical differences and that insists on relationships of incommensurable interdependency" (Gaztambide-Fernandez, 2012, p. 46). Again, we might not always know how to do this, but we must lead in ways that try to bring this intersectional complexity into play.

Dylan: Solidarity within intersectional movements

A key consideration for leading into transgression is encouraging solidarity within intersectional movements. This being said, solidarity can easily be conflated with unconditional unity, assimilation and wholesale 'like-mindedness'. It is important to be aware that only some common interests are brought together in solidarity movements, while other interests, world-views and values might not directly relate to those commonalities. What effectively enables solidarity must be sensitively and delicately considered in transgressive leadership. Pellow's (2016) work on solidarity and intersectionality in critical environmental justice is vital in this context, as often coloniality plays out in the form of enforcing a 'we are all one' ethos which drowns out difference, individuality and indigenous, brown, queer and more-than-human voices, in what he calls the 'assimilationist' perspective. Pellow (2016, p. 11) highlighted the importance of "racial indispensability [when referring to people of colour] and socioecological indispensability [when referring to broader communities within and across the human/more-than-human divide and their relationships to one another and the wider ecosystem]". His concern is that an assimilationist perspective can often involuntarily and violently incorporate 'others' into one's own vision of a society (Smith, 2005; see also Gaztambide-Fernandez, 2012). Rather, Pellow's (2016) indispensability saw all communities (more-than-human and human) as interconnected, interdependent, but also *sovereign*.

It is in this space between sovereignty and solidarity that transgressive leadership lies, or as Bhaskar (2008) articulated it, the 'pulse of freedom' lies in the tension between freedom and solidarity. Each individual requires the space to express this sovereignty and flexibility within the collective. Queer theory throws us a lifeline; fairn herising (2005) proposes the possibility of ex-centric research and queer flexibility as a means to sensitively navigate assimilationist perspectives. In the context of transgressive learning in universities, Temper, McGarry and Weber (2018) in their *Tarot of Transgressive Research* highlighted the power of ex-centric research and leadership which uses the research process itself to disrupt the academy's exclusion of marginalised voices, by centring subjugated knowledges and advocating for their epistemic value. Queer flexibility is a useful ally in leading into transgression, as it implies an ongoing opposition to the status quo by challenging the idea that identity is static, and provides for transgressive methodologies that can be used as tools to disrupt hegemonic, normalised, and naturalised structures within academia.

Heila: **Leading from the situation**

Creating new practices and projects from the ashes that we sit in requires *leading from the situation*, putting our living realities in focus, and 'staying with the trouble' as Haraway (2016) would put it. Here the living realities are those of everyday life where relationality between human/human and human/more-than-human intersect in daily struggles. The charge is to mend the metonymic fragments of the myriad social rifts between people founded via the colonial and apartheid atrocities,[3] and the myriad 'metabolic rifts' (Wark, 2015) to be found between people and degraded soil, between people and feral carbon, people and polluted water, people and coronavirus particles lingering in the air, and more. We need stronger subjectivities grounded in new relationalities, and for a stronger objectivity to prevail; not the fractured subjectivities noted above (in living into transgression), or the objectivity consecrated via the lens of the scientific method alone, but an objectivity that is more relational, and "grounded in a more extensive series of mediating links in the production of knowledge available for scrutiny" (Wark, 2015, p.146).

This is life beyond the peer-reviewed journal article. There can be no simple retreat into academic journals as an indicator of impact when there is racism, and no food, shelter, safety or love for the world. It is "the production and reproduction of our species-being, whatever it may be, that has to be a central concern of any critical knowledge" (Wark, 2015, p. 146) in the academy-as-linked-to-its-society.

Cohen and Colebrook (2016, p. 8) commented on the contemporary condition:

> Insofar as there is a 'we' or an 'us', we cannot say, in good conscience, that we only found out that we were destructive once it was too late. The formation of a 'we' is generated from destruction and from the recognition of destruction: humanity as global anthropos comes into being **with** the Anthropocene,[4] with the declaration that there is a unity to the species, and that this unity lies in its power to mark the planet.

In this we recognise that *leading from the situation* is not a locally inscribed transgressive endeavour only, but is intertwined with our relationality to the wider planet, where we, *Sapiens*, with our immense diversities, are but one species, part of the multiplicity, and all have to reverse and transgress the already-made *problématique* of coloniality and planetary boundaries for a viable collective future to emerge.

Leading from the situation will require transgressions in the academy between academe, people and worlds. Inside of the academy, this requires disciplinary transgressions in which the humanities can ask difficult questions in a scientific border zone, while also speaking knowledgeably about sciences in a humanities border zone, and vice versa. Our teaching, research and community praxis is and must be border zone agile, and be "intensely local and global at the same time".[5]

Non-conclusion, cross current reflections and parting thoughts

Heila: Non-conclusion

Most academic papers present an introduction, methodology, discussion and conclusion. Our think piece troubled this construction, instead sharing intertwining thoughts on an as-yet inadequately explored phenomenon. This conclusion is therefore a non-conclusion in the sense that the wider discussion of which this forms part, lies wide open before us. Across this paper we have sought to mark out some of the dynamics of what learning, living and leading into transgression might look like in a world where all have a place to be.

With this as background, our think piece traverses a range of what we see as nine important processes needed for habitable futures. These are morphing towards an undivided future (learning), dancing between contradictory masks (living), and engaging in relentless experiments with freedom (leading) [discussed by Injairu], decolonising the charade (learning), re-inhabiting place (living), and practising solidarity within intersectional movements (leading) [discussed by Dylan]. My own contributions join this intertwined story, with thoughts of how we might build low theory out of the dust of the old (learning), escape multi-form fractured selves (living), and lead from the situation (leading). Our intertwined narrative is not conclusive – nor can it be – as the processes marked out in brief are experiences that still need to be fully practised in new relations in times to come, and in academia-in-society-and-the-world.

Dylan: Cross-current reflections – Transgressing nostalgia

This think piece is an embodied expression of learning, living and leading into transgression. The autonomy and freedom the three of us have had to explore and express the key ideas that captivate or haunt us in transgressive decolonisation is a *living* into transgression. This work, as detailed in this paper, is an embodiment of moving beyond abyssal thinking, gifting each other our attentive, empathetic and critical hearts and minds, with less nostalgia and more re-imagining. Within this multi-voiced, thickly described and multi-layered rendering (Ellingson, 2009) is perhaps a version of Wark's 'low theory'. The perils of the great nostalgia and its trappings might hinder our next steps. In times of peril and transformation, a danger may lie in tendencies to hold onto that which is dying. Here we see daily how political, economic and cultural leaders draw on nostalgia for answers.

Nostalgia is a dangerous habit and hard to break; the oppressive slogan 'let's make america great again' and the racism and prejudice it has created, reveals much about this tendency. What we need instead is a new dreaming of the future; tangible expressions of futures that tend to Heila's concerns regarding the fracturing of subjectivities; and enlivening of Injairu's plea for relentless experiments with freedom. If we are to be nostalgic about anything, it will need to be about something deeper, and further away than our recent capitalist past. If knowledges today are ecological, then like biophysical ecosystems today, these knowledges may be eroded, dammed, marred, poisoned and exploited, and further fractured by obsessions with misguided, dystopian nostalgia. Nostalgia is a reflex of fear, and in times of transgression may be our Achilles heel. Change from what we know is hard, and re-imagining with brave utopian imagination is what may be needed next.

Injairu: **Parting thoughts**

At the end of this dialogical discussion, I am struck by how much we are collectively holding in the balance as we edge towards decolonial futures. The work involves a self-reflective practice that acts out in the world. Dylan emphasised that it is a practice bound in interdependence that also requires sovereignty. It responds to many levels of institutional and state orchestrated harm that are resilient and pernicious in the way they commodify emancipation. The contradictions that such a practice emerges from can be confounding. The rational mind alone struggles to hold onto what must be held in the balance to create a future that is different from the past. Perhaps then it is fitting to also retire from dissecting these issues from a purely logical rational perspective. This is perhaps a source of the paralysis of which Heila wrote; a potential second guessing of every move; a place where the vitality of one's presence is diminished and incapacitated by the weight of history and the asylum it holds in the present.

These parting thoughts feed an urgency to remind us to stay courageously fluid and in motion in and through the spaces we find ourselves; to shake loose the discourse in a way that allows us to move out of a tight frame of reference. And to be light and buoyant enough to find the re-generative spaces in between. We purposefully sought to explore *learning*, *living* and *leading* (all doing words!) in order to contribute to a conversation that can collectively embolden our actions. Inspired by those to whom we paid homage at the start of this paper, we aim for expansive, transgressive learning that may allow our words and works to serve as proponents of low theory thinking – something that we can dance with and test the limits of in our waking worlds. May we recognise each other as transformative and transgressive agents in the world by the embodied love that we have, for the world, for the future, and for the dignity of our own souls.

Acknowledgement

Endnotes

1. These scholars have produced a large body of research work, much of which can be found in back editions of the SAJEE (available as open access material on https://www.ajol.info/index.php/sajee). Other examples of their work can be found in the edited monograph by Janse van Rensburg et al. (2002); more recent edited books by Lotz-Sisitka, Shumba, Lupele & Wilmot (2017), Price and Lotz-Sisitka (2016), Corcoran et al., (2017), amongst other journals and books. A fuller set of references to how much of this work has been

oriented towards a decolonial 'politics of potentia', can be found in Lotz-Sisitka et al. (2020). Instead of referencing all of the works, we provide access to the works via the above links and volumes.

2. Gqola, 2017, p.11
3. A good example of such a metonymic rift is the use of racial categories in official documentation to refer to people (e.g. Black African, or White, or Indian, instead of reference to a person).
4. In using the term 'Anthropocene' we recognise the often apolitical nature of the term, and note that it is only a few humans who, at the expense of others, have produced the metabolic rifts named under the banner of the 'Anthropocene' (Wark, 2015; Haraway, 2016).
5. A phrase used at a recent Rhodes University transformation summit.

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VIEWPOINT

Prospect of Military Educational Roles during Public Health Crises: Lessons from the COVID-19 Pandemic in South Africa

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Abstract

This viewpoint paper examines the prospect of an effective educational role for the military during public health crises. Reflecting a broad understanding of environmental education as education to protect the public space, the authors argue that the military could provide this during times of crises. The response to the COVID-19 pandemic in South Africa included the South African National Defence Force (SANDF), thus offering a unique opportunity to inquire into this contentious possibility. At the outset of the outbreak, some scholars deemed the SANDF unfit to make any meaningful contribution to the fight against the novel coronavirus. Leadership and coordination hurdles, a longstanding legitimacy crisis and inadequate training, may justify this pessimistic view. Based on available literature and document analysis, the authors propose the viewpoint that the military *can* play a progressive environmental educational role during crises if (1) its educational programmes such as green soldiering are intensified, widened and adequately informed by training; (2) if more is made of the experience, cultural insights and personnel gain during peacekeeping missions; (3) if healthy civil-military relations are prioritised, along with (4) military professionalism, supported by a deeper understanding in society of the diversity of roles and skills the military could offer. The military itself needs to recognise this and not train all personnel as if they are about to enter combat with an enemy. Should these elements be present, the security forces could indeed be a force for good during times of public health crises.

Keywords: COVID-19, civil-military relations, environmental education, pandemics, SANDF

Introduction and background

This paper teases out aspects of the involvement of the military during crises (wars, pandemics, disasters) which are connected to environmental education, and highlights factors, processes and dynamics generating or influencing such initiatives.

The outbreak of the 2019 novel coronavirus disease, also known as the COVID-19 pandemic, has triggered a proliferation of war-related metaphors from world leaders. The French president, for example, noted that "we are at war", while his German counterpart stated, "this pandemic is not a war" (Breitenbauch, 2020). In South Africa, the president opined that the post-COVID-19 recovery will require a "post-war style of state-led economic reconstruction" (Merten, 2020). These metaphorical statements reflect the intensity with which governments have experienced the pandemic, as well as mixed views about how to address it. Should the military play a critical role or not?

Breitenbauch (2020) noted indications that military strategies can play a monumental role in tackling the pandemic. Elsewhere we have argued that military strategies, like proactive social strategies by any other professionals, can contribute to the mainstreaming of Education for Sustainable Development (ESD) through their position-practice systems enhanced by capacity building and training (Agbedahin, 2016; Agbedahin & Lotz-Sisitka, 2019). Historically, there is evidence that the military have been involved in the fight against epidemics and pandemics, providing skilled manpower and varying forms of security, medical and logistical support (Kohn et al., 2010; Arie, 2014; Gibson-Fall, 2020; Marcus, 2020). Accordingly, across the globe, soldiers have been mobilised to tackle COVID-19.

In South Africa, and at the outset of the pandemic, more than 76 000 SANDF members were deployed in two batches in response to the viral threat (Madisa, 2020). Besides their traditional defence, intelligence and security functions, the deployed troops have been tasked with functions linked to environmental control, sanitation and education.

This involvement of the army is diversely appraised. But generally, in the scholarly literature, pessimistic views outnumber optimistic views. The general fear of excessive use of force, leadership and coordination problems, a legitimacy crisis, inadequate training and questionable 'military professionalism', account for this public despondency (Messelken & Winkler, 2018; Heinecken, 2019, 2020; Bailie, 2020; Powell, 2020). It is therefore worth inquiring into the ambivalent role of the military, the relevance of the military in a disaster situation, and how environmental education and enforcement are complementary.

For the purposes of the inquiry, the authors conducted a scholarly critical analysis of the involvement of the military in the fight against COVID-19 in some countries (stated below) and particularly in South Africa. Key aspects included are green soldiering (and other environmental education activities); the benefit of peacekeeping experiences; civil-military relations and unequal dialogue; and military professionalism. Methodologically, this paper chiefly relies on document analysis as a qualitative inquiry method (Hodder, 2000; Atkinson & Coffey, 2004; Rapley, 2007; Bowen, 2009).

An analysis of military involvement in the fight against COVID-19

Professionalism aims to "improve practice and enhance accountability by creating means for ensuring that practitioners will be competent and committed" (Darling-Hammond, 2009, p. 49; Agbedahin, 2016, p. 24). Globally, the military have always but varyingly been involved in responses to health crises or other forms of disasters (Kohn et al., 2010;

Watterson & Kamradt-Scott, 2016; Agbedahin, 2019). The insecurity that arises during such crises, the burden of diseases and large-scale deaths, predatory and rapacious behaviours from within society, and other forms of threat, can be seen to justify such a response (Hays, 2009; Agbedahin, 2012; Devermont & Allison, 2020; Transparency International, 2020). Around the globe, several governments have mobilised the military in the response to the 2019 coronavirus crisis. One distinctive feature of this participation is its diverse nature. In Sri Lanka, for example, the response to the coronavirus crisis, at least at its initial stage, was highly militarised and also politicised (Nandakumar, 2020). In contrast to other countries where civilian agencies and health professionals oversee operations and strategies, in Sri Lanka the military has been in full control of processes including screening operations and the construction and running of quarantine centres (Nandakumar, 2020). In Germany, the military intervened to solve transport problems, while the Italian military was involved in the manufacturing of face masks and the collection of dead bodies. The military removal of corpses in Bergamo, 'Italy's Wuhan', is a case in point (Marsi, 2020; Mee, 2020). In Spain, soldiers were tasked to remove coronavirus corpses from retirement homes and care homes (BBC, 2020). These roles and contributions, potentially guiding public behaviour, demonstrating and enabling right actions, and helping to make the public space safe, can be considered as implicit and informal environmental education[1] endeavours.

In South Africa, the SANDF medical teams joined in screening and testing for COVID-19 (Brandt, 2020) working with the police to ensure security, and providing rapid logistical assistance. Despite these positive efforts, military scholars and analysts have argued that the SANDF members were ill-prepared to make any meaningful contribution to combat the invisible enemy. Some warned that the involvement of the military could become a 'double-edged sword' (Gibson-Fall, 2020). Some commentators have argued that a problematic shift from the apartheid military to the post-apartheid military has led to a lack of well-trained soldiers to deal with public health crises (Bailie, 2020; Heinecken, 2019). Instances of military brutality at the start of the lockdown (Bailie, 2020; Powell, 2020), as well as the existence of a civil-military gap or lack of mutual trust and respect (Heinecken, 2019), further prompted pessimistic prognoses for the South African military's participation in fighting the pandemic. Even the involvement of military healthcare personnel was not without ethical challenges (Messelken & Winkler, 2018). Clearly, there are a number of risks characterising the involvement of SANDF members in the fight against COVID-19. However, this paper also found a number of reasons to reduce this risk, and optimise the benefit of deploying the troops. This includes the military's experience of responding to public health crises elsewhere in Africa gained during peacekeeping missions, and the existence of environmental education initiatives in the military, as discussed below.

Environmental literacy, green soldiering and the fight against COVID-19

In this section, the authors propose that green soldiering, environmental awareness and literacy, education and training can combine to prepare soldiers for educational roles during a pandemic. Viruses and other pathogens are part of the public space or environment, and

are spread and made more harmful to humans, if special environmental management and care is not taken to mitigate against these risks. When soldiers are trained to care for the environment, they could also be equipped to share this knowledge with members of their community. When they are deployed in the fight against COVID-19, they would be better prepared and capacitated to contribute to environmental wellness, protection and the breaking of the infection chain, if they are adequately trained.

It is worth noting that the South African Department of Defence is second behind the American military to prioritise environmental management (Smit, 2018a). As far back as 1977, the foundations of environmental literacy and awareness among the military were introduced with the formulation of environmental management guidelines (ibid.). This seminal work allowed for the emergence of debates on green soldiering or a green army (Godschalk, 1999; Smit, 2018b). Green soldiering connotes being aware and conscious of environmental sustainability when carrying out military duties (Godschalk, 1999). 'Green soldiers' therefore have the skill to preserve the environment while carrying out their operations. Since they would be environmentally literate, such knowledge could be proactively and systematically shared with the public.

A study conducted by Smit (2017) on the environmental awareness of the SANDF soldiers revealed that SANDF soldiers were indeed aware of the environment and their responsibilities towards it. Environmental literacy here refers to the positive attitude of soldiers towards the environment, to demonstrating expected "environmentally beneficial behaviour"; having the necessary knowledge and acting responsibly towards the environment (Smit, 2018a). Smit (2018a) pointed out that soldiers "interact with civilian populations as well as the environment during disaster relief operations and deployments outside the country". The study found that internal policies and directives regarding environmental literacy have been developed, but that their implementation and monitoring were problematic (Smit, 2018a).

The SANDF has an ambitious Military Integrated Environmental Management Programme, comprising six sub-major programmes, viz "environmental research, environmental education and awareness training, cultural resources management, ecological management, base environmental management, and environmental planning" (Magagula, 2020, p. 170). However, Magagula (2020) argued that these programmes will only be successfully implemented if the military collaborates with relevant academic and research institutions and state organs for skills, expertise, knowledge and capacity development. Magagula (2020) also argued that environmental education and training is central to environmental management. So far, unfortunately, the environmental education and training of SANDF soldiers has been found to be insufficient and superficial (Smit & Van der Merwe, 2018); with researchers arguing that the personnel needed more quality "environmental education and training" if they were to meaningfully contribute to the SANDF's environmental education agenda (Smit, 2018a).

We conclude that environmental education or training for SANDF soldiers is not absent, but insufficient. For soldiers involved in the fight against COVID-19, and for future pandemics and crises, an emphasis on environmental education during the pre-deployment

period will be helpful. Soldiers who are educated can educate community members around, for instance, personal hygiene and protective gear, keeping the environment clean, effective waste management or disposal, as key strategies to break the chain of the transmission. Therefore, through constructive and friendly social interaction with community members, soldiers are postured for a significant contribution to environmental education, responsibility, and citizenship. The military involvement in fighting COVID-19 could have been better harnessed, supported and provided with focussed environmental education training and evaluation had been conducted. Partnership with educational institutions and experts in the field of environmental and sustainability education, before and during military deployment, are among the military-civil society partnerships which could have made a difference.

Peacekeeping dividends and the fight against COVID-19

Peacekeeping missions are characterised by paradoxes and contradictions (Akonor, 2017). Troop-contributing countries in peacekeeping missions are faced with financial, political, and social cost and opportunities, and varying unintended consequences that are often negative, but, we argue here, can also be positive. Peacekeeping operations are fraught with fund misappropriation, corruption and unethical appointments to higher positions for financial gains (Aoi, De Coning & Thakur, 2007, p. 9). The culpability of peacekeepers in the 2010 cholera outbreak in Haiti (Agbedahin, 2019) and the 'ECOMOG babies' born to local women in Liberia, Sierra Leone, Guinea and Côte d'Ivoire (Aning, 2007, p. 141) are deeply problematic. But allowing unethical practices to overwhelm the scholarship of the benefits of peacekeeping, conceals minute but vital dividends or benefits. Accordingly, this viewpoint paper presents the account of an SANDF general which illustrates that the experience of individual troops could aid in domestic assignments such as the fight against COVID-19.

The account suggests that peacekeeping troops gain experience and insights when serving on missions outside their country, that could later serve as an asset for other military operations locally or internationally. In other words, we are considering the value of peacekeeping operations in capacitating the SANDF troops in the fight against COVID-19. This is based on an interview conducted by a journalist (Comins, 2020) with a former SANDF General in the United Nations peacekeeping mission in the Democratic Republic of Congo (MONUC). We try to answer the question: What have peacekeepers gained from "other people's wars" (Doss, 2020, p. 2) which could help their own country in a time of COVID-19?

The former SANDF officer was in the appropriate position to answer this question, having served in various peacekeeping missions in Africa, including Liberia, Sudan, Côte d'Ivoire (2009-2013) and the DRC in 2007 (Comins, 2020). The interview suggests that he had in the process gained much experience, and developed skills he could use during the fight against the coronavirus. As he pointed out,

Fighting the COVID-19 pandemic is not a war but about culture and education … COVID-19 is not about war. It is about culture and how to make people embrace different things culturally.

This officer understood the pandemic to be about culture and education. His peacekeeping mission experience in DRC with MONUC during the Ebola outbreak (UN News, 2007; World Health Organization, 2007) provided him with this insight. He had a "first-hand experience dealing with epidemics and has brought his knowledge of working with the UN's MONUC peacekeeping mission, during the 2007 Ebola outbreak in the Democratic Republic of the Congo, to his home province" (Comins, 2020).

The SANDF was deployed to DRC to help the police and create a climate conducive for people to adapt to the new 'culture' or new way of doing things, to break the transmission chain of the virus. Change can of course be resisted by communities (Yılmaz & Kılıçoğlu, 2013). The officer noted that besides the support given to the police,

the SANDF was actively involved in rural and township areas where myths about the virus abound and education on how to use basic hygiene was most needed … It was important to understand the culture and to use ancient practices – such as the cleaning of huts with cow dung to kill bacteria – as analogies for the modern hygienic practises of hand washing and sanitising, which are vital to beating COVID-19.

He further explained his insights as follows:

What made sense to me as an individual was that this is more about educating people to take responsibility because we need to take responsibility as individuals, which will determine whether this virus will spread or not, so let's use the defence force so they voluntarily change the culture.

He described how his peacekeeping mission during the Ebola outbreak prepared him to respond to the COVID-19 crisis:

Education, education, education. But you cannot force education, you can only persuade people of what lies before them. The only way to fight COVID-19 is to make people understand the dangers COVID-19 brings. You can arrest them every day but that won't make a difference. But you can educate one person and the entire family will wear masks and you can educate one person on hand washing. You don't have to be rich to wash your hands.

Professionally, he also acquired the skills needed to understand how to deal with myths and people's beliefs, to meaningfully participate in the socio-cultural, learning and change process, as well as to contribute. He noted:

Also, people in the townships, like KwaMashu said 'it's [the virus] a white thing, it's not for *amabantawami*' [my children], it's a Chinese thing, it's a US thing'. In Inanda people are living in a one-bedroom house with nine or 11 people, but in places like Glenwood people are more educated and there is space.

The above excerpt exposes the prevailing inequalities in South Africa, and the lack of education regarding coronavirus which knows no social status, age, class and race. It also demonstrates a cultural awareness on the part of the officer. During the Ebola crisis in Liberia, it was recorded that some military healthcare workers lacked cultural awareness, and this affected their intervention (Boland, 2017). Medical anthropologists and public health experts hold that "understanding community is as important as virology" while responding to disease outbreak (Boland, 2017, p. 5). Military forces can make their health expertise available to the public in humanitarian emergencies, including in areas that cannot be reached by civilian public health programmes because of their geographical location. Military healthcare workers often have the capacity to go to remote areas (Chretien et al., 2007, p. 174); in southern Africa instances of the SANDF reaching civilians in South Africa and Mozambique during severe seasonal flooding and providing medical assistance under these high-risk disaster conditions, are examples.

We acknowledge that this singular example of the dividends of the peacekeeping mission, which emphasises the educational efforts of soldiers during epidemics and pandemics, cannot be generalised to the entire SANDF deployment in the fight against COVID-19. A more systematic study of how peacekeeping can contribute to effective domestic operations is needed. All the same, this example serves as and constitutes a pointer to the relevance and capacity that the experience gained from working outside South Africa and handling health-related crises elsewhere can bring to domestic needs. Observing other cultures often helps one understand one's own and more familiar cultures, differently. This case also demonstrates the understanding of the importance of education in the fight against pandemics and epidemics. However, educational efforts of the military would not be effective without two other critical conditions, that is, civil-military relations and military professionalism.

'Social distancing' without 'social distance': The civil-military relations paradox during COVID-19

The societal perception of soldiers as men and women carrying weapons tends to undermine their other vital functions, for example, environmental education. One reason for this is the disconnection between armies and the rest of society. While each profession has its features, it seems the military either distances itself from the rest of the society, and/or the society does not see the military as being part of the society. This mental and physical disjunction is a real legitimacy crisis of the military profession. The lack of proper education regarding the multidimensional role and significance of the military could also be partly responsible for this anomaly.

Before exploring the importance of healthy civil-military relations in the fight against COVID-19, it is worth clarifying the problematic terminology 'social distance' or 'social distancing'. Social distancing, contrary to what is promoted to break the transmission chain of COVID-19, connotes people's experience of familiarity, suggesting 'nearness and intimacy'; or unfamiliarity, suggesting farness and difference "between themselves and

people belonging to different social, ethnic, occupational, and religious groups from their own" (Hodgetts & Stolte, 2014, p. 1776). It is often present in everyday life (Hodgetts, et al., 2011). From a professional point of view, a healthy civil-military relation means narrowing the distance; the only way to avoid a crisis of confidence and legitimacy. So, with COVID-19, 'physical distancing' is what is needed, not 'social distancing'. The latter term is however commonly used in public messaging.

Civil-military or civilian-defence cooperation has been considered key in the fight against pandemics (Kohn, et al., 2010) and in Complex Humanitarian Emergencies which require collaboration between the military and civilians (Ma et al., 2016). The Israeli partnership between the government, the military and civil society in the management of the influenza A(H1N1-09) pandemic represent a success story that should be considered by other countries. It established the possibility of a smoothly working interface between the health sector and the defence sector, to solve a medical problem.

Civil-military relation is a broad interdisciplinary area in social sciences concerned with the relationships between the military and civilian society. It deals with complex questions such as who controls the military and the relationship with civilian authorities (Feaver, 1999). Owing to the power of the military, civil-military relations are usually under threat. Feaver (1999, p. 214) explained the origin of this threat:

> Just as the military must protect the polity from enemies, so must it conduct its own affairs so as not to destroy or prey on the society it is intended to protect. Because the military must face enemies, it must have coercive power, the ability to force its will on others. But coercive power often gives it the capability to enforce its will on the community that created it. A direct seizure of political power by the military is the traditional worry of civil-military relations theory and a consistent pattern in human history.

Civil-military relations refers to how the military, that is, the armed forces, relate to and interact with the rest of the society which created it for its protection, its 'primary client' in Huntington's (1957) terms. Healthy civil-military relations are needed for the good functioning of society. While there are civil-military relations between the army and its 'mother' society; there are also civil-military relations in peace operations, with societies in other countries, with their own peculiarities (Gordon, 2007). One cardinal condition for a smooth relationship between the military and civilians is military professionalism.

Military professionalism and the fight against COVID-19

The term 'unequal dialogue' was coined by Cohen (2002, p. 262) to present how the conversation between army generals and political leaders remains unequal despite the frankness and bluntness of the generals. The political leaders' authority always prevails. While civil-military relations offer political leaders the opportunity or authority to control the military, the capacity and expertise of the military should not be undermined if operations such as the fight against COVID-19 are to be successfully carried out. Educational roles may be part of unconventional roles for the military in the fight against COVID-19.

The COVID-19 pandemic could monumentally shape institutions such as the army and discussions on post-COVID-19 military professionalism have become necessary. According to Caforio (2006, p. 3), the sociological approach is the most appropriate to study the military. Military professionalism is one cardinal aspect of 'military sociology', widely studied (Siebold, 2001; Caforio, 2006; Crabb & Segal, 2018; Heinecken, 2019). A thorough discussion on military professionalism is not possible here, however, it is raised because of its importance in reducing the distance between society and the military (Van der Mullen, 2000) which is considered key in the fight against pandemics (Kohn et al., 2010).

While it is important to delve into the ill-preparedness of the military in the fight against the coronavirus pandemic, it is also important to begin to enquire into how the pandemic could contribute to reimagining appropriate professionalism in the military, to ensure its domestic relevance, and draw it nearer to its 'mother society' or 'first client' (Huntington, 1957).

Conclusion

This paper has examined the educational role of the military in combating the COVID-19 pandemic in South Africa. It proposes that the role of the military in response to the pandemic is diverse; beyond their traditional role of security, defence, intelligence and medical operations, the military can educationally sensitise communities about correct actions during public health crises and disasters. Contra the pessimistic view by scholars at the outset of the outbreak, the military has been contributing positively. Although there is evidence that some SANDF members have violated the Disaster Management Act regulations (Department of Defence, 2020; Powell, 2020; Skiti, 2020; South African Human Rights Commission, 2020), such violations should not completely negate the prospects of the multidimensional contributions of the military to communities and society at large.

The paper has also argued that soldiers who were previously deployed to peacekeeping missions outside South Africa, especially during disease outbreaks, could have a wealth of experience to use during public health crises like COVID-19. The understanding of the centrality of education and cultural awareness in the fight against epidemics or pandemics is crucial. For instance, experience and cultural insights that soldiers may have gained during peacekeeping and any other missions where they participated in operations against Ebola and cholera, could be an asset. The illustration provided in this paper attests to this. While not structured educational programmes, field experiences if properly reviewed and shared could have a catalytic effect on the fight against the pandemic. The paper, therefore suggests a systematic investigation into and harnessing of peacekeeping proceeds of this nature for greater domestic purposes.

Healthy civil-military relations would create an environment conducive for possible active participation of the military in education initiatives, through interactions with community members. This would allow for mutual understanding and trust between soldiers and civilians. Joint educational initiatives could be strategically and systematically embarked upon, as mentioned in the paper. There can be social distancing without civil-

military distancing. Continuous collaboration between the various professions and experts of the army and similar experts among civilians could strengthen social ties for the common good. A reductionist understanding and interpretation of the role of the army have been prevalent; soldiers are known only for their use of force and heavy ammunition.

The domestic relevance of the military has not been obvious, except their roles at borders and other strategic areas where their socially perceived function is reduced to that of drawing fire. A collaboration for instance between military engineers, medical personnel, and their civilian counterparts, could be beneficial to society in crises where human resources and safe physical access are issues. The professional zeal and acumen demonstrated by soldiers during post-war reconstruction, for instance, could be harnessed and used. The military in peacekeeping missions interact with communities to help; a wealth of skills and experience arises from this interaction which should be profitably channelled back home following the mission.

The paper also argues that, by building on the military's existing environmental management and environmental literacy initiatives, and better deploying, intensifying and expanding green soldiering, communities can benefit from soldiers' awareness and knowledge. Owing to the recent progressive awareness of environmental issues (a shift in perspective), and its multidimensional roles in times of crisis, the military could be considered a key role player in the quest for a sustainable environment. Drawing on the lessons learned, we argue that by widening and intensifying educational programmes such as green soldiering and green militarisation, harnessing peacekeeping dividends, and encouraging healthy civil-military relations and military professionalism, armies such as SANDF have much to offer in the fight against COVID-19 and other related pandemics or crises. Military professionalism requires soldiers to consider the mother society as not the enemy but their primary client, and this should guide all educational initiatives.

The paper has highlighted some aspects of the educational roles the military could play in protecting people and limiting 'the disruption of the public space' in the context of COVID-19. The pandemic is ongoing and new dimensions of this phenomenon will need to be inquired into. The paper thus serves as a springboard for further engagement with the issues.

It is worth noting that this paper is a transdisciplinary work. We acknowledge that the connection between environmental education and military operations has not been prominently made in the literature, theory, and practice of the field. Accordingly, this paper constitutes a novel contribution that does not seek to theorise the field, but to seize the moment and the current debates to examine the prospect of the role of the military in environmental education in broader public health crises. It offers an opportunity for the emergence of related learning and research involving strategic, multi-disciplinary, multi-sectoral, and multi-stakeholder engagement.

Notes on Contributors and their Contributions

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Percentage contribution

Areas of contribution	Author	Percentage contribution
Conception or design of the paper, theory or key argument	A. V. Agbedahin	50 %
	K. Agbedahin	50 %
Drafting the paper	A. V. Agbedahin	50 %
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Critical review of paper	A. V. Agbedahin	55 %
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Endnotes

1   In Japan, one term used for environmental education translates into "education against the disruption of the public space".

THINK PIECE

The Shifts to Online Learning: Assumptions, Implications and Possibilities for Quality Education in Teacher Education

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Abstract

With the advent of coronavirus disease (COVID-19) which has spread to the majority of countries across the world, the World Health Organisation (WHO) declared a global pandemic on 11 March 2020. Governments all over the world, including in southern Africa, introduced measures such as the banning of large gatherings, closure of borders, schools and institutions of higher learning to curb the spread of COVID-19. To ensure ongoing teaching and learning, institutions of higher learning made resolutions to transition to remote/online teaching and learning. While online education has long preceded the pandemic, the spiraling of COVID-19 all over the world resulted in the upscaling of online teaching and learning in higher education institutions. Mandatory online teaching and learning was a relatively new practice to most lecturers and students in southern Africa. Drawing on two case stories from Botswana and Namibia, this paper offers a think piece on the shifts to online learning, considering assumptions, implications and possibilities for quality learning in teacher education, through a reflection by teacher educators of environment and sustainability courses. The assumptions in online learning were that students and teacher educators had the capacity and infrastructure for remote/online teaching and learning. This paper thus opens up opportunities for institutions of higher learning to scale up their Information Communication Technology (ICT) infrastructure and support for both students and teacher educators for online teaching and learning which have the potential to improve on quality education during times of crisis.

Keywords: *Online teaching and learning, ICT infrastructure, Education for Sustainable Development (ESD), quality education*

Introduction

The World Health Organisation (WHO) declared a global COVID-19 pandemic on 11 March 2020 after observing that most countries had reported thousands of confirmed COVID-19 cases (WHO, 2020). By July 2020, in Africa, countries that were most affected were Algeria,

Egypt, Ghana, Nigeria and South Africa, with South Africa accounting for more than 70% of all cases on the continent (OECD, 2020a; OECD, 2020b). The number of cases continued to increase across the globe, with Africa predicted to be the most vulnerable continent to the coronavirus (World Economic Forum, 2020). Specifically, countries like Botswana, Namibia and Zimbabwe which border South Africa, were rendered vulnerable because of their high dependence on South Africa for labour provision, goods and services. The vulnerability was also due to the continent's weak health care system and a large immuno-compromised population owing to high prevalence of malnutrition, anemia, malaria, HIV/AIDs, tuberculosis, high rates of diabetes and poor economic discipline (World Economic Forum, 2020). The COVID-19 pandemic has also exacerbated the economic challenges already faced by many countries, with many people losing their livelihoods (United Nations, 2020).

Research and trials on different vaccines for coronavirus are underway (Defendi, Madeira & Borschiver, 2021). In response to the disease outbreak, governments around the world have taken measures inclusive of quarantine, travel restrictions, social distancing and lockdown, in a bid to suppress the spread of the virus (OECD, 2020b). These measures, while helping to control the spread of COVID-19, subsequently hit the global economy thereby pushing nations towards recession (OECD, 2020a; United Nations Human Rights, 2020). African economies, including Botswana, Namibia and Zimbabwe, already struggled with inadequate healthcare systems when COVID-19 hit the continent and the pandemic has significantly worsened economic conditions (OECD, 2020b).

In terms of education, COVID-19 has affected the education of over 1.6 billion children and youth (UNESCO, 2020; UNHCR, 2020), as governments all over the world enforced total or partial closure of schools to contain the spread of the virus (OECD, 2020b). As governments transitioned to home education, many children were disadvantaged as they experience uneven access to distance education and online learning opportunities and resources. The 2020 Global Education Monitoring (GEM) report provides an in-depth analysis on the key factors (such as learners' gender, attitudes, language, disability, ethnicity, poverty, migration and displacement) that cause exclusion of learners in education systems (UNESCO, 2020). The report revealed a state of exclusion from education as a result of the COVID-19 pandemic with estimates such as 40% of low and lower-middle income countries having not been able to support disadvantaged learners during the temporary school shutdown.

The COVID-19 pandemic has significantly affected institutions of higher learning with many universities and tertiary institutions having to close (World Bank, 2020). Over 91% of the students who had enrolled for formal education programmes have been affected by COVID-19 (Holmes, 2020). The effects of the COVID-19 pandemic were, however, experienced more intensely in lower and upper-middle income countries (World Bank, 2020). Most universities and tertiary institutions had to move to mandatory remote/online teaching and learning (Marinoni, Van't Land & Jensen, 2020). Remote/online teaching has experimented with radio, email, phone, television and mobile applications (World Bank, 2020). Remote teaching and learning is not new; most countries globally, including

Botswana, Namibia and Zimbabwe, offer online or distance education as a mode of study (UNESCO, 2005; Moore, Dickson-Deane & Galyen, 2011; NOLNet, 2016). However, institutions of higher learning were faced with issues related to equity, infrastructure, broadband capacity and pedagogic capacity challenges due to the sudden unprepared shift to online learning (Marinoni et al., 2020; World Bank, 2020).

It has been widely documented that Education for Sustainable Development (ESD) provides alternatives to reassess and evaluate education and learning during times of crisis, raising the importance of how knowledge, skills, values and attitudes are developed among learners and students (UNESCO, 2018). ESD enables learners to make informed decisions and take action on local and global challenges such as COVID-19. ESD has further been reported as a key enabler to the achievement of the Sustainable Development Goals (SDGs), particularly SDG 4 (UNESCO, 2018), thereby preparing the world for crises such as COVID-19 (UNESCO, 2020). ESD is committed to education being inclusive of all learners irrespective of their socio-economic backgrounds and gender (Pigozzi, 2010; Didham & Ofei-manu, 2018). ESD therefore suggests that the type of online learning offered during pandemics such as COVID-19 should promote the well-being of all people and should be inclusive.

Drawing particular examples from two countries in southern Africa, Botswana and Namibia, this paper offers insights into shifts to online learning, and the assumptions, implications and possibilities for quality teacher education. This has the potential to inform how governments, particularly of Botswana and Namibia, could reassess learning systems in order to provide quality education that meets the challenges faced during pandemics such as COVID-19.

Quality education and Education for Sustainable Development

Like most African contexts, quality has been at the centre of discussions about teacher education in Botswana and Namibia. Lotz-Sisitka and Lupele (2017) contended that for many years quality has been measured primarily through metrics of enrolment, retention and achievement. They further argued that in an attempt to define quality education in most African contexts, this has only expanded to:

> … set out the desirable characteristics of learners (healthy, motivated, students), processes (competent teachers using active pedagogies), content (relevant curricula) and systems (good governance and equitable resource allocation). (p. 10)

However, Lotz-Sisitka and Lupele (2017) viewed quality of education as a dynamic concept that evolves with time and changes in the social, economic and environmental contexts of a place. Issues of social justice and connections between learning and changing contexts, such as with the COVID-19 pandemic, need to be foregrounded. Tikly (2010, p. 1) defined quality education as:

> [education] that enables all learners to realise the capabilities they require to become economically productive, to develop sustainable livelihoods, to contribute to peaceful and democratic societies, and to enhance wellbeing.

Tikly (2010) further argued that quality education should be inclusive, democratic and relevant. UNESCO (2020) described quality education as including appropriate skills development, taking into consideration gender parity, and providing relevant school infrastructure, equipment, educational materials and resources, scholarships or teaching force. Barrett et al. (2006) reviewed literature on quality of education in low income countries and identified five dimensions of quality education which are effectiveness, efficiency, equality, relevance and sustainability. Building on their work, Nikel and Lowe (2010) undertook a conceptual review on the concept of quality education in low income countries. They developed a fabric model of quality in education which consists of seven dimensions: effectiveness, efficiency, relevance, equity, responsiveness, sustainability and reflexivity.

Lotz-Sisitka (2013, p. 29) asserted that quality education emphasises the 'sociocultural' or the processes of meaning-making that occur at the interface of existing experience and context in the teaching and learning processes; this is important for education to be relevant in responding to the emerging environmental and socio-ecological issues for sustainable development in that place. The role of ICTs in enhancing quality education can also lead to sustainability. This is indicated in SDG 4.7 which brings into focus ESD competences for quality education such as critical and systemic thinking, collaborative decision-making and taking responsibility for present and future generations (UNESCO, 2015; 2018), to be foregrounded in ICT based teaching and learning environments.

ESD is described as holistic and transformational education which addresses learning content and outcomes, pedagogy and the learning environment through technology mediated innovations that scale up teaching and learning (UNESCO, 2018) even during challenging periods such as the COVID-19 lockdown. ESD empowers students to be 'global citizens' who can engage and assume active roles, both locally and globally, to face and to resolve global challenges and ultimately to become proactive contributors to creating a more just, peaceful, tolerant, inclusive, secure and sustainable world (UNESCO, 2015; 2018). A sustainable world can be enabled through re-orienting teacher education as a vehicle towards the achievement of ESD competences (UNESCO, 2015). Re-orientation of teacher education to promote sustainability means that education can contribute to sustainable development and a sustainable future for nations like Botswana, Namibia and Zimbabwe in the face of their sustainability challenges such as COVID-19. SDG 4 within the framework of ESD provides focus on distributed teaching and learning processes (Edwards, 2011) in that it emphasises education and wider community links and issues of context, place and relevance (Silo & Ketlhoilwe, 2020).

ESD learning processes within the SDG focus should not only be about pedagogies of empowerment, but also about epistemological changes in the way in which knowledge is viewed and worked within teacher education settings (Silo & Ketlhoilwe, 2020) to create

agency that is distributed across the community of learning (Edwards, 2011). The idea that is at the centre of the distributed agency involves a capacity for educators and students to work together to strengthen purposeful responses to complex environmental and social problems (UNESCO, 2018) that can arise from pandemics like COVID-19. This expands the tasks being worked on by recognising the motives and the resources that others bring to bear within a constant dynamic process (Evans et al., 2017). The aim is to achieve quality in education through innovations in teacher education, that should include quality technology mediated teaching and learning processes.

SGD 4 emphasises the integration and implementation of ESD in education contexts, including the provision of professional development for teachers with a view to enhancing the delivery of quality education for all school learners by 2030 (UNESCO, 2018). Implementation of ESD is heavily reliant on the appropriate application of teaching and learning methods as well as on relevant sustainability learning content (Laurie et al., 2016). Armstrong (2011) argued that an ESD orientation is underpinned by a constructivist epistemology whereby learning is not only characterised by a learner-centred pedagogy but also by active engagements and social interactions. ESD pedagogies are intended to stimulate students to be inquisitive, analytical, critical thinkers and decision makers (UNESCO, 2018). The role of ESD in contributing towards the improvement of quality education was highlighted by Didham and Ofei-manu (2018, p. 92) who wrote:

> Because of its emphasis on the importance of student-centred learning pillars and the progressive reframing of pedagogies, ESD is viewed as a powerful tool for reforming education systems and achieving overall improvements to the quality of education.

The relationship between quality education and ESD has been widely documented (UNESCO, 2015; Laurie et al., 2016; Lotz- Sisitka & Lupele, 2017, Didham & Ofei-manu, 2018; UNESCO, 2018; Silo & Ketlhoilwe, 2020). Both quality education and ESD are future oriented; they promote common skills, enable learning as connection, involve critical thinking and action competence, make education relevant, promote innovative teaching methodologies and promote learning outcomes that empower students to address local and global pandemics such as the COVID-19 (ibid.). Online teaching as the new pedagogical norm in response to the lockdowns resulting from the pandemic, provides new opportunities for enhancing quality education and ESD.

Online teaching: Assumptions and possibilities

While online education has long preceded COVID-19, and has been growing steadily for more than a decade (UNESCO, 2005; Moore et al., 2011), the advent of COVID-19 all over the world has resulted in rapid re-orientation (UNESCO, 2013) of the education system from a face-to-face mode to upscaled online teaching (Marinoni et al., 2020). Following the COVID-19 outbreak, one common trend in education systems globally has been to respond to the pandemic with emergency online protocols, marking the rapid transition of face-to-face mediation to online learning systems (Murphy, 2020). According to Moore et al.

(2011), online learning is commonly described as providing "access to learning experiences via the use of some technology" (p. 130). 'Wholly online learning', according to Oblinger and Oblinger (2005), encompasses a range of technologies such as the worldwide web, email, chat, new groups and texts, audio and video conferencing delivered over computer networks to impart education (Dhull & Sakshi, 2017). The fundamental change to online mediation has had a dramatic impact on the relationship between teachers and learners. Online pedagogy now focuses on the activities of the learner and sees teaching primarily as a means of support, with the teacher as a facilitator (UNESCO, 2005).

Though most countries in the SADC region (Botswana, Namibia and Zimbabwe included) have emphasised the importance of ICT integration in education in their policies and national development plans (SADC, 2012), the pandemic has made implementation even more urgent and mandatory. In terms of ICT integration in education in, for example Botswana, the Ministries of Basic Education and Tertiary Education, Research, Science and Technology have committed to implement, amongst others, the Education and Training Sector Strategic Plan (ETSSP, 2015), which is expected to greatly change the human development landscape by introducing new strategies and reforms. These include the national domesticated SDG 4 indicators that emphasise the utilisation of ICTs (Botswana National Commission for UNESCO, 2018). The Botswana ICT policy (2004) states that successful integration and sustainability of ICT in the education system requires a supportive policy environment and framework at the national level. The Botswana government invested successfully in the roll-out and implementation of e-Centres across the country, as platforms for bringing e-services, which include e-Health, e-Education, e-Commerce, and e-Government, especially to rural communities (Botswana Government, 2017).

Similarly, the Namibian government has acknowledged the significant role that ICT can play as the country moves towards a knowledge-based society aspired to in Vision 2030 and its development plans (Republic of Namibia, 2004; 2016; 2017). To contribute towards the realisation of Vision 2030, the Namibian ICT policy for Education emphasises the need for all teachers to be exposed to ICT in order to improve the quality of education through integration of ICT in the teaching and learning process to facilitate learning for the benefit of all learners (Ministry of Basic Education, Sport and Culture (MBESC) and Ministry of Higher Education, Training and Employment Creation (MHETEC), 2001-2006). In addition, institutions of higher education, such as the University of Namibia (UNAM) have introduced eLearning policies aimed at responding to the University's major challenges of efficiency, equity and quality of learning, and at enabling students to pursue education in a flexible learning environment outside of a conventional classroom setting (UNAM, 2018).

Thus, in terms of online learning before COVID-19 related lockdowns, Botswana and Namibia had some basic ICT policies in place that could be used to spearhead online teaching and learning. The assumptions on the upscaling of online or eLearning during the lockdown period in the different countries, inclusive of Namibia and Botswana, is hinged on the premise that the 21st century has seen an increased demand in the use of ICTs.

In terms of ESD implementation, Mireku (2016) indicated that the use of ICT lends itself to more learner-centred settings, enabling students to collaborate with their peers and engage more deeply with content and practical skills. Willis, Weiser and Kirkwood (2014) observed that educators can integrate technology and media in ESD through activities that encourage children to explore, create, solve problems, communicate, collaborate, investigate, and demonstrate their learning about the world outside their classrooms. However, despite policy emphasis and the benefits that ICT can offer to ESD, before COVID-19, not all educators had made the shift from traditional conventional ways of teaching to the use of ICTs as teaching and learning tools. Where ICTs are used, there are many challenges. This can be attributed to factors such as inadequate infrastructure and lack of capacity (Mireku, 2016). Too often, online facilitators do not take their lesson preparations as seriously as they could, and this lack of commitment has a profound and negative effect on the quality of online learning (Mireku, 2016). Moreover, the learner is challenged to own, manage and schedule their learning (Mtetwa, 2020). This can be a difficult task for some students who, for the first time, may be experiencing the ability to control what was typically controlled by the facilitator.

Case examples of online teaching implementation

Based on personal experiences of two educators, two case stories from Botswana and Namibia, on online teaching and learning during the COVID-19 lockdowns, are presented.

University of Botswana

In the face of the COVID-19 pandemic, Botswana went into total lockdown for a period of six weeks. The University of Botswana called on staff to either intensify or initiate technology mediated teaching through existing online platforms like Moodle, the university official Learning Management System (LMS). The Centre for Academic Development (CAD) which coordinates and maintains the university LMS, was tasked with the responsibility of up-scaling the teaching staff's capacity and to assist in the virtual system of teaching and learning with clear instructions with no compromise on quality in this mediation. Other suggested modes of mediation included WhatsApp, Zoom and other platforms. Even after the university opened again there was an emphasis on online teaching and learning especially for classes with large numbers and with international students who had travelled to their home countries and were unable to return due to travel restrictions. Students were provided with 2GB mobile data to enable them to access the internet from home. This sudden move to online learning highlighted some challenges, assumptions, implications and possibilities for quality education and SDG 4 in the teaching of courses in Environmental Sustainability Education.

The two environmental education courses covered here were taken by pre-service students as single semester content courses with some sections of the courses being methods in teaching environmental and sustainability issues. The courses have ten and eleven students registered. Key components of the courses are teaching and learning with

continuous assessment and a single examination at the end of the semester. Each course has three contact hours in a week and the courses need to have a balance of the various delivery components as suggested by Moorhouse (2020). This includes a balance between lecturing, discussions, students' presentations, micro-teaching and field trips but with an emphasis on experiential learning. As with other courses, the courses are to a large extent designed to be delivered face-to-face with the course lecturer acting as a facilitator in a highly dialogic classroom (Moorhouse, 2020). The course lecturer uses WhatsApp mainly as an instant messaging platform to facilitate out-of-class communication (ibid.), emails and LMS for online content dissemination and storage of readings and materials which are mainly PowerPoint presentations.

The sudden national lockdown meant students stayed at home; some travelled to their home villages across Botswana where access to internet is a challenge. But because face-to-face contact mediation had stopped and the courses had to be delivered online, the course lecturer immediately used WhatsApp to inform students about the new mode of communication for lectures during the lockdown period. Though all students were registered on the WhatsApp platform, from the two courses taught, only four of eleven students, and three of the ten students responded to this message. From those who responded, only three students agreed that teaching and learning could continue online while the other students described the challenges they were facing regarding internet access. Connections often depended on minimal signals which did not allow clear communication between the course lecturer and students. These were some of the messages from the students:

> Student A from Course 1:
> Good morning maa'm. I tried to submit my assignment, my only challenge is that I do not have access to internet. I went to the village internet café but it is closed.

> Student Y from Course 2:
> Hello ma'am I've completed my assignment, but problem this side is network that's why I haven't submitted mine but I've asked someone to submit for me later today…

Issues such as these illustrated above resulted in time being wasted and sometimes observable signs of frustration from both the lecturer and the students. Generally, communication and discussions with students were characterised by total silence and brief responses from a few. This was a disappointment for the lecturer especially with fast-moving developments on the environmental, social, economic and political impacts of COVID-19 with obvious links to the SDGs, both positive and negative. This would have been a good opportunity for discussions with students regarding their reflections on these impacts, enhancing SDG 4's main imperatives. After lockdown, students able to meet face-to-face generated insightful debates, unlike international students who were unable to participate effectively partially due to the lecturer's lack of experience and skills on online platforms. Giving online feedback was also a challenge for the lecturer. Where online assessment was used, particularly for international students, there could have been adverse effects on the consistency, honesty and gradings of these students. For example,

in one case of an international student, network glitches during test writing meant the student needed more time to complete her test than the rest of the students. After the test, face-to-face assessment allowed students to co-create more meaning in their interactions and discussions (Yang & Carless, 2013; Ryan et al., 2019) which highlighted the challenges and opportunities that COVID-19 presented in socio-ecological and economic contexts. An example was the assignments and tests that required students to interrogate challenges and opportunities presented by COVID-19 in local and regional contexts. Feedback from the course lecturer and students generated more intense yet worthwhile debates during the face-to-face interactions in alignment with SDGs, than the online interactions with international students.

University of Namibia

In response to COVID-19 Namibia went into lockdown for 35 days. This affected all institutions of higher learning including the University of Namibia (UNAM). One of UNAM's resolutions to COVID-19 was to transition to remote/online teaching and learning. This meant students had no access to face-to-face teaching and learning and to the university's physical resources such as libraries and computer laboratories. Online learning is not new to UNAM. The university offers open and distance learning as "an approach to learning that focuses on freeing learners from constraints of time, space and place, while offering flexible learning opportunities" (NOLNet, 2016, p. vi) offered through the Centre for Open and Distance and eLearning (CODeL). CODeL contributes towards UNAM's vision and mission by providing high quality open and distance learning programmes through the use of innovative technologies and blended learning approaches (CODeL, 2017). The main platform for learning for CODeL, and thus the University, is the Moodle Learning Management System (LMS).

COVID-19 has necessitated the need for increased remote teaching using eLearning solutions, in particular the use of Moodle LMS. Teaching and learning online meant lecturers would be facilitating learning by sharing learning materials (such as notes, schemes of work, reading materials, PowerPoint presentations, pre-recorded lessons and assessment activities) through Moodle LMS and by conducting discussions in the form of on online sessions or using any viable social media platforms. UNAM in collaboration with Telecom Namibia (the national telecommunication operator) offers students TN Mobile Pocket Wifi (with monthly data of 10-14GB) at a special rate annually. During COVID-19, through this collaboration, Telecom Namibia also offered special data packages to UNAM staff exclusively. Each data package included: a Pocket Wifi, a 4G, 5GB monthly data (for a period of 12 months), subsidised and affordable bundles after monthly bundles are depleted and free unlimited access to UNAM ICT resources. However, being new to the virtual learning environment, both lecturers and students needed continuous eLearning support. Staff offering online support remotely were increased. Lecturers were invited to training on how to create and upload materials and assessments online and other technical issues regarding the use of Moodle LMS. The next section highlights the challenges, assumptions

and opportunities associated with online mediation of the Integrated Environmental Education course in one of UNAM campuses. The course is taken by pre-service students in the Faculty of Education as a year-long course and includes sections on methods in teaching environmental and sustainability issues. The course has 77 students registered.

The Integrated Environmental Education course focuses on the knowledge of the natural environment, nutrition, health and safety measures (UNAM, 2020). During online teaching and learning, the course lecturer posted materials (PowerPoint presentations, videos and audios) on Moodle LMS and in most cases had communication with students on WhatsApp. Of 77, 73 students had access to WhatsApp but less than 30 students responded to communications. Students found WhatsApp easily accessible even though limiting with large files. The approach to online learning posed challenges to students in terms of access to technology (laptops or smart phones, connectivity to the internet) as well as sufficient resources to purchase data from service providers. Some students had little or no access to technology, data, or internet connectivity. This is reflected in the student extracts below:

> *Student B*
> Good morning mam, can you please download the notes for me, my network is very poor, can't access Moodle.

> *Student C*
> TN-mobile is not available throughout the country. Most villages don't have it.

> *Student D*
> I have not been able to access any materials because I was at the village with no internet and no-one have a smart phone, only my mother who is always at work.

Assessment is a key component of teaching and learning (UNAM, 2020). During remote teaching and learning, assessment was undertaken online. The lecturer used alternative modes of assessment such as students recording themselves doing practical activities or submitting online individual assignments. Quizzes and tests with objective questions such as multiple choice, true or false and matching questions were given. Although the lecturer had a choice for subjective questions such as essay type items, considering individual students' internet connectivity and data availability, more objective questions were given to ensure that students were able to complete the online assessments in allocated time. Due to limitations in terms of size on Moodle LMS, the videos and audios uploaded were limited. Group work was also limited. Students experienced challenges to complete online assessments. This is reflected in the extracts below:

> *Student E*
> Mam it is not fair because not everyone have access to internet, why should some students be excluded for things beyond their control? Moodle is always misbehaving and TN-mobile is too slow and it takes time for things to load. Imagine waiting for 10 minutes to move to the next question and you just have 40 minutes for the test...

Student F
We have network issues and no data, the test must run for the whole day or two days because some of us only have connection after midnight – we don't have internet access at the same time because of the location where we are.

Due to the above, the tests were open for a whole day to accommodate all students depending on their connectivity; in some cases, they were postponed because students did not have access the internet. The lecturer posted questions for discussions on Moodle LMS for students to reflect on issues of hygiene, nutrition and safety during COVID-19. Students gave very brief answers and often did not respond to follow-up questions, resulting in limited or no discussion.

Implications of online teaching on quality of education

A rapid assessment of the experiences of COVID-19 disruption to the teacher education institutions exposed many significant short- and long-term challenges facing higher learning as shown in the two cases of Botswana and Namibia. This includes diminished resources for institutions, personal and academic challenges for institutions and students, demand for improved infrastructure to support continued distance and blended learning models, reduced mobility placing pressures to improve regional and local tertiary institutions, and more (World Bank, 2020). This resonates with Mukute et al. (2020) who researched education in times of COVID-19 in Southern Africa (see previous edition of this journal, Volume 36). From an SDG 4 perspective, issues of accessibility to education are central to quality education (UNESCO, 2015, 2018). From the two case examples, it was evident in the transition to online teaching and learning that it was assumed all students and course facilitators had access and capacity to online platforms. However, it was clear during the COVID-19 lockdown that there was unequal access to education for student teachers in Botswana and Namibia. As argued by Willis et al. (2014), while most course facilitators were able to engage with ICT, not all students were able to access teaching and learning resources, due to lack of access to ICT infrastructure (Mireku, 2016; UNESCO, 2020) which negatively impacted on the quality of education (Lotz-Sisitka & Lupele, 2017). The content taught was not problematic but the pedagogical processes and assessment strategies were (Armstrong, 2011), in terms of meeting SDG 4's indicators on accessibility to tertiary education. Laboratory experiments and practicals were not easy online and this was one area that needed capacity enhancement. COVID-19 lockdown revealed that challenges also included lack of holistic quality assurance systems for online teaching and learning in the two cases presented. This resonates with research by SADC (2012) that although many countries in southern Africa introduced open and distance learning that uses eLearning platforms, there are ineffective quality assurance systems. Quality, according to Lotz-Sisitka (2013), in these two cases would be the meaning-making that occurs at the interface of the students' and facilitators' online experiences and context in the teaching and learning processes for education to be relevant in responding to COVID-19 and all it entails. This

could include not only the technical and resource challenge experiences, but also the social and emotional experiences that challenged both the facilitators and the students in the process of online mediation (Zhu & Liu, 2020).

Despite the above challenges, the COVID-19 pandemic provided Botswana and Namibia opportunities to translate their ICT policies into practice by reflecting on online teaching and learning for ESD as a mandatory mode of lesson delivery and assessment. For this to be a success, however, there is a need for:

- improved evidence-based policy-making mechanisms and more user-friendly digital learning systems (Zhu & Liu, 2020);
- capacity building of both course facilitators and students inthe use of online tools and systems;
- opportunities to explore flexible teaching and learning opportunities;
- an increase in innovation in the field of teaching pedagogies as well as delivery modalities of teaching and learning; and
- reviewing of assessment approaches in order to build on the experience (Marinoni et al., 2020).

For long-term integration of online teaching and learning in institutions of higher learning in the two countries, quality which requires conceptual and philosophical rethinking of nature of teaching and learning needs to be considered. This includes looking at the new roles, as well as the connections among teachers, learners, and teaching materials, in the digital mediation learning communities (Jandric et al. 2018; Zhu & Liu, 2020). This might require rich theoretical and analytical insights that cultural historical activity theory (CHAT) can provide as a conceptual framework for collaborative learning in online mediated environments. Meaning needs to be socially negotiated in the constructive alignment of both facilitators and students' roles with digital tools in use, mediation rules, the universities' digital learning communities, and their objects in the various contexts (Kaptelinin & Nardi, 2006; Rambe, 2012).

Many educators believe the socio-constructivist viewpoint that CHAT draws from (Engeström, 2001) can usefully contribute to student-centred learning. This implies to support effective learning and promote student satisfaction in online courses, a community participating in online mediation activities must be developed (Cacciamani et al., 2019). Therefore, conceptualising the activities relating to online mediation in these two institutions can help the institutions to understand their activities as they unfold, in particular, the underlying systemic tensions and contradictions (Kaptelinin & Nardi, 2006) that give rise to the challenges encountered by both facilitators and students in the online mediation processes. The emerging tensions and contradictions can lead to opportunities for the construction and adoption of new approaches, strategies, assessment procedures, teaching methodologies, resources and tasks, in line with Engeström's (2001) expansive learning, that could result in the expansive transformation of the structure of the online

mediation activity in these two cases. This will ultimately also enhance the opportunities to support distance learning in the event of emergencies like COVID-19 and provide the potential to scaffold student cognitive learning processes to promote quality online academic engagement (Engeström, 2001; Rambe, 2012) for students to access quality lifelong learning opportunities (Marinoni et al., 2020).

Conclusion and recommendations

It is evident that COVID-19 exposed inequalities among students in institutions of higher learning as observed from the two case stories from Botswana and Namibia. The pandemic further exposed that ICT and ICT infrastructures are essential for teaching and learning. The pandemic has revealed that although technology mediation is now a common practice in higher education institutions there is little evidence of significant impact on teaching and learning practices, therefore giving the institutions of higher learning an opportunity to rethink their online mediation systems and approaches to enhance quality. This change will not happen quickly and there is scope to mediate teaching and learning differently. With adequate support, students and staff can continue learning and teaching, although physically apart. This requires an investment in ICT and ICT infrastructures, capacity building of both students and staff, provision and affordability of ICT gadgets and data. The experiences as shown in this paper also provide a professional reference base for online teacher education, which leads to opportunities for a framework for enhancing competencies for teacher educators in conducting online teaching and the development of other standards to enhance quality. This can be done in collaboration with international and national ICT organisations for training and provision of infrastructure.

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Percentage contribution

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Conception or design of the paper, theory or key argument	Tshiningayamwe	40 %
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Drafting the paper	Tshiningayamwe	40 %
	Silo	35 %
	Dirwai	25 %
Critical review of paper	Tshiningayamwe	40 %
	Silo	40 %
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Teacher Professional Development and Geography Teachers' Pedagogical Practices for Climate Change Education

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Abstract

Education for Sustainable Development (ESD) was added to the South African Geography school curriculum when the Curriculum Assessment Policy Statement (CAPS) was implemented from 2012. Many in-service teachers who qualified prior to 2014 did not cover this concept during their initial teacher education qualification because it was not part of the curriculum at that time. To address this deficiency, a teacher professional development (TPD) module was developed by the Fundisa for Change programme and offered to a selection of in-service high school Geography teachers. Transformative learning theory helped to understand the pedagogical practices used by teachers after attending the Fundisa for Change teacher professional development programme, in particular the use of a learner-centred approach. Using a small-scale, qualitative and interpretive case study method, the influence of this short TPD course on the teaching of climate change in the Geography CAPS curriculum on teachers' pedagogical practices was investigated. Data were collected through semi-structured interviews, document analysis and lesson observations. Data were analysed using both inductive thematic and deductive analysis. Findings from this small sample of five teachers and their practices suggest that despite attending the programme, most of the participating teachers did not sufficiently integrate climate change education in their Geography classroom practices. The majority of the research participants did not implement the learner-centred teaching methods covered in the course. It is therefore recommended that a teacher professional development programme should be incorporated into longer-term and preferably *ongoing* professional development programmes so as to adequately foster climate change education in classroom practices.

Keywords: *Geography, Education for Sustainable Development (ESD), climate change education, teacher professional development, learner-centred pedagogies*

Introduction and background

This paper is drawn from a larger study on the influence of a short teacher professional development course in Education for Sustainable Development (ESD) in Geography teaching

in secondary schools (Thenga, 2020). ESD was added to the Curriculum Assessment Policy Statement (CAPS) (Department of Basic Education, 2011) curriculum from 2011, meaning that most in-service teachers did not cover this content in their initial teacher qualification. The Geography specific aims in CAPS address the commitment towards sustainable development and making judgements about social and environmental issues (Department of Basic Education, 2011). To respond to this challenge, the Fundisa for Change programme was used to train secondary school Geography teachers using the *Teaching Climate Change* manual. Fundisa for Change is a South African national programme that aims to develop teachers' knowledge and skills, strengthen the teaching of environmental concepts in schools and encourage teachers to develop values and ethics needed for a more just and sustainable society (Fundisa for Change, 2013). Fundisa for Change is a collaborative programme established by a range of partners including the Department of Environmental Affairs and Tourism, Rhodes University and other higher education institutions, the South African National Biodiversity Institute, the GreenMatter Programme, to enhance transformative environmental learning through teacher education within the CAPS framework (Fundisa for Change, 2013). It aims to develop teachers' subject knowledge, teaching and assessment practices (Fundisa for Change, 2013). Fundisa for Change used climate change to address environmental and sustainable development concerns in different topics in the Geography CAPS curriculum.

The Intergovernmental Panel on Climate Change (IPCC, 2015) defines climate change as the state of the climate that can be identified by the changes and variability of its properties that persists for a long period. Ferguson (2019) argued that climate change refers to the alteration of the composition of the atmosphere which is attributed directly and indirectly to human activities. According to Anderson (2012), climate change education offers an opportunity for people to act in order to reduce the impacts of climate change. Anderson (2012) further argued that climate change education is geared towards learning how to change lifestyles, economies and social structure that are based on excessive production of greenhouse gases.

The research question that guided this paper was: *What teaching practices do teachers resort to when teaching environment and sustainability content knowledge?*

Literature review

Teaching and learning for sustainable development requires teachers to adopt a more transformative stance (Smith, 2013), where learners are encouraged to think critically and reflect on issues around them. Smith (2013) further posited that teachers need to develop appropriate pedagogies that enable them to "understand the need for learners to develop skills to question the embedded cultural values, actively identify and assess, communicate and resolve real environmental problems" (p. 261). Teachers therefore need to be empowered so that they are confident to use pedagogies that are appropriate to teach for, and about the environment and sustainable development effectively. This paper focuses on teachers who were trained through the Fundisa for Change programme; their teaching

pedagogies were analysed to determine the extent of transformation or improvement in their teaching after attending the climate change education course.

Climate change and climate change education

This section contextualises climate change and climate change education given that they have been defined in the introduction above. According to Anderson (2012), climate change causes hazards which include heat waves, flooding, droughts, intense tropical cyclones, rising sea levels and a loss of biodiversity. These hazards increase vulnerability to disasters resulting in economic and environmental losses. Vulnerable groups such as communities living in poverty in low income countries with poorly functioning education systems, and poor governance are hardest hit by climate change (Anderson, 2012). Codero, Centeno and Todd (2020) noted that the use of education as a climate change mitigation technique is still untested, but its potential to reduce carbon emissions may be realised based on the educational approach utilised. Fundisa for Change is guided by and proposes a transformative learning framework on teachers' practice, which seeks to further influence learner understanding and action.

Stevenson, Nicholls and Whitehouse (2017) maintained that climate change education involves preparing young people for a rapidly changing, uncertain, risky and possibly destructive future. Stevenson et al. (2017) further proposed that the goal of climate change education is to prepare learners for an uncertain future by helping them gain knowledge, skills, dispositions and values that will enable them to deal with future challenges. This requires teachers to use teaching and learning approaches that empower learners to adapt and be resilient to change. Monroe et al. (2019) argued that climate change education should focus on making climate change relevant and meaningful for learners, and that the activities or interventions must engage learners and result in a shift in their beliefs and perspectives.

Anderson (2012) asserted that climate change education fits well within the ESD agenda because it emphasises the empowerment of communities and citizens, engages with issues such as human rights, poverty reduction, sustainable livelihoods, environmental education and gender equality in an essential manner. Vogel, Misser and Vallabh (2013) argued that the CAPS Geography curriculum topics in the Further Education and Training (FET) phase can be taught using climate change units, namely, energy exchange, resource use and change, and responses to energy exchanges and climate change. For instance, the Grade 11 topic on energy balance can be classified under 'energy exchange'; the impacts of droughts and floods, and resource use and sustainability are classified under 'energy resource use and change'; while people's responses to droughts and floods are classified under 'responses to energy exchange and climate change' (Vogel et al., 2013). Empowerment of learners requires them to obtain relevant skills such as critical thinking, problem solving and collaboration which can be used to deal with uncertain futures. There is thus a need to build the capacity of teachers in order to improve their content knowledge and teaching practices for the benefit of learners.

Teacher professional development programme

Teacher professional development (TPD) refers to in-service teacher education that can improve teachers' subject content knowledge and hence their teaching practices. Several researchers have examined TPD courses internationally and in South Africa in order to understand their effectiveness in the process of teaching and learning (Steyn, 2008; Darling-Hammond & McLaughlin, 2010; Ono & Ferreira, 2010; Avalos, 2011; Ferreira, 2014; Patton, Parker & Tannehill, 2015). These researchers found that TPDs strengthen teachers' content knowledge and skills. Avalos (2011, p. 10) argued that TPD "is about teachers learning, learning how to learn, and transforming their knowledge into practice for the benefit of their students' growth". This means that TPD has the potential to transform teachers' knowledge and skills to improve learners' performance.

Avalos (2011) and Patton et al. (2015) classified TPD programmes as either individual or collaborative. Individual teacher development focuses on personal and professional growth of independent teachers (Patton et al., 2015) while collaborative programmes focus on the development of teachers as a community or in partnership with one another (Avalos, 2011; Darling-Hammond & McLaughlin 2011; Patton et al., 2015). Fundisa for Change is a collaborative programme that aims to develop teachers in partnership with one another. Some TPD programmes are occasional and are referred to as short intervention programmes in this paper. Such programmes rely on experts that are external to the Department of Basic Education. Steyn (2008) argued against short intervention courses highlighting that their simplistic and technical view of teaching make people assume that teachers' knowledge and skills could be improved by using external experts. Ono and Ferreira (2010), Steyn (2008) and Nawab (2017) all maintained that short intervention programmes are less likely to result in improvements in the teaching and learning process when compared to continuous programmes because they are isolated from classroom situations. The Fundisa for Change programme which offered a Climate Change module was an example of a short programme which was isolated from the classroom situation.

TPD programmes can take place on or away from the school site. Ferreira (2014) contended that development actions that are implemented away from school settings might help teachers experience things in new ways and can contribute to incidental learning. This implies that the location that is chosen to host the TPD might have an influence on teachers' learning. The Fundisa for Change short intervention course was established to upgrade and develop in-service Geography teachers' knowledge and skills on environmental learning away from their school sites in 2016; it was conducted over a period of five days and was hosted at the Delta Environment Centre. The programme was conducted in the context of content knowledge, teaching practice, assessment and values in education, but this paper is mostly concerned with teaching practice.

Transformative teaching strategies

CAPS aims to produce learners who are able to identify and solve problems, and make decisions using critical and creative thinking (Department of Basic Education, 2011).

UNESCO (2012) suggested that the use of a variety of teaching techniques helps learners to develop skills and capacity to learn and think critically. UNESCO (2012) further stipulated that the utilisation of a variety of teaching techniques implies that the needs of individual learners are likely to be considered in planning and delivering lessons. To this end, teachers are expected to attend to diverse needs of learners during the teaching and learning process. Development of skills to teach for and about ESD is one of the aspects that motivated Fundisa for Change to offer training to the secondary school Geography teachers through a short intervention course.

Ferreira (2014) distinguished between teaching styles and argued that the pedagogies that are required to teach for and about ESD should be different from traditional teaching styles. Kalumba (2017) agreed and stressed interdisciplinary, holistic, enquiry-based, experiential and action-oriented methods in teaching ESD. Further, Mokuku and Jobo (2017) emphasised the importance of outdoor learning, experiments and peer tutoring in environmental learning. Laurie et al. (2016) affirmed this view as they showed that teaching practices which are associated with ESD stimulate students to ask questions, think critically and make good decisions about the environment. Thus, teachers should have the ability to use a wide range of pedagogical approaches in order to teach environment and sustainability effectively. Monroe et al. (2019), in reviewing research, identified effective teaching strategies for climate change education as those designed to engage learners such as those associated with experiential, inquiry-based and constructivist approaches. They further stated that deliberative discussion, interaction with science and scientists, addressing misconceptions regarding climate change and working on school and community projects, is effective when teaching controversial topics.

However, Borg et al. (2012) and Raselimo and Wilmot (2013), from observations on teaching approaches mainly used in Swedish schools and Lesotho respectively, found that most teachers do not utilise learner-centred approaches in their classroom practice. This means that even though learner-centred approaches are deemed to be useful for learning, teachers do not always use them in the classroom. The teaching approaches that teachers do use may be linked to the resources they choose for topics within the curriculum.

Theoretical framework

Mezirow's (1991; 1997; 2000; 2003) transformative learning theory was applied to understand and explain pedagogical practices used in secondary Geography classrooms in relation to the knowledge gained from the Fundisa for Change teacher professional development programme. Cranton and King (2003) argued that the core of transformative learning is that we make meaning through our experiences. They further argued that the process of meaning making develops our frame of reference. According to Mezirow (2000), a frame of reference is the structure of assumptions or expectations through which we filter ideas formed within or outside our consciousness. Mezirow (1997) argued that frames of reference are made up of 'habits of mind' which are broad habitual ways of thinking, feeling and acting. These habits of mind determine our lived experiences and actions. In the Fundisa

for Change programme, teachers were expected to transform their pedagogical practices in teaching for and about ESD after attending an intervention course. The transformation of pedagogical practices requires teachers' frames of reference to be transformed or expanded.

In order to change frames of reference, individuals need to challenge their existing meaning schemes in relation to new experiences. Mezirow (2003, p. 58) argued that "transformative learning is learning that transforms problematic frames of reference to make them more inclusive, discriminating, open, reflective and emotionally able to change". This means that transformation of frames of reference grants individuals the right to choose, to be open to different viewpoints and to include other points of view in such a way that they make meaning and can reflect on those views for change to occur. Therefore, teachers should shift from using traditional teaching approaches to learner-centred approaches. That shift would mean that their frames of reference have been transformed.

The transformation of frames of reference involves learning, critical reflection and reflective discourse (Mezirow, 2000). Cranton and King (2003) were of the opinion that transformative learning takes place when teachers critically examine their practice and acquire alternative ways of understanding what they do. Learning new meaning and critical reflection based on the knowledge obtained from the intervention course may enable individuals to examine and possibly change deeply-held assumptions. The purpose of employing transformative learning theory in this paper was to indicate how participating teachers transform their teaching practices for teaching ESD after attending a course.

In the next section, the methodology used to investigate the influence of the course on teaching approaches used by the educators is discussed.

Methodology

The study was conducted using an interpretive qualitative research design. Merriam (2002) argued that interpretive qualitative research allows researchers to learn how individuals experience and interact with the social world and the meaning they derive from it. This study sought to understand teachers' experiences of classroom practices after the course. The case study approach was employed with multiple embedded cases to substantiate the results by comparing and contrasting findings (Vohra, 2014). The Fundisa for Change teacher development course was the main case, while the five participating teachers at different school sites were cases embedded within the main case. Fourteen secondary school teachers participated in the Fundisa for Change course in March 2016. Five of these teachers were purposively selected to take part in the study to establish if they were implementing what they had learnt in their classroom practices.

Data were generated through:

- the analysis of the *Teaching Climate Change* manual (a manual used by the Fundisa for Change programme for training Geography teachers);
- one-on-one semi-structured interviews with teacher participants were conducted once; and

- three lesson observations per teacher participant.

This was done in order to ensure triangulation (Creswell, 2012) and validate the responses from different sources. Data were generated in August and September 2017 and January 2018. Semi-structured interviews were chosen because they allowed the researchers to interact with the participants in the process of generating data and enabled probing of key points. The interviews were conducted to establish classroom practices before and after the course in order to determine if participants transformed their practices after the course. Three lessons were observed per teacher in Grade 11 and 12 classes to obtain in-depth interpretation of classroom practices. To preserve anonymity and confidentiality, the participants are referred to as Teachers A, B, C, D and E.

Thematic content analysis which is a method of identifying patterns or themes of meaning across datasets in relation to the research questions (Ngulube, 2015) was applied in the analysis of data. Codes and themes were identified inductively and deductively (Boyatzis, 1998). Inductive analysis means that themes are generated from the data, whilst conclusions are drawn from the previous known facts or definitions, based on the theory in deductive analysis (Javadi & Zarea, 2016). Inductive analysis considered the intended outcomes of the course, what participating teachers said during interviews, and what teachers did during lesson observations. Deductive analysis was conducted through determining evidence of transformative learning in the teaching strategies used by participating teachers to teach for and about ESD after the course.

Findings

The findings are structured according to the themes derived deductively from the research questions. These are discussed in terms of the five cases embedded into the Fundisa for Change intervention course. The participating teachers learned different teaching strategies from the intervention course which included experiential, active and investigative teaching strategies as shown in Table 1. Each teaching strategy was linked to skills that could be developed in learners. The participating teachers were expected to use the teaching strategies taught in the intervention course to teach environment and sustainability or to use other learner-centred approaches in their classroom practices.

Table 1: *Teaching strategies taught in the Fundisa for Change course*

Approaches to teaching	Teaching strategies	Skills development
Experiential learning	Experiential learning	Learners experience the world through senses or emotions
	Investigative methods	Help learners to collect information from different sources
	Information transfer	Can take the form of class notes, lecture, brochure, poster, field trip or experiment. Mostly combined with other methods
	Deliberative methods	Provide different viewpoints, scenarios or possible futures for learners to think, predict or debate about
Active meaning making	Scenario (using case studies)	Involves making predictions
	Learning by doing	Project work on vulnerabilities and practical activities that can make communities resilient
	Fieldwork and collaborative research	For research purposes
	Role play and debate	Help learners explore and put themselves in the shoes of other people and then report findings
Integration of methods	Combining investigative, deliberative and learning by doing	Learners collect information from different sources, provide different viewpoints, scenarios or possible futures for learners to think, predict or debate about and do practical activities or projects
	Critical deliberation	Helps in negotiations
	Values clarification	Involves dialogue – learners are encouraged to challenge their views and values

Table 2: *Teachers' responses – Data from interviews*

	Teaching methods used before the course	Teaching methods used after the course
Teacher A	Textbook based method, where she read lesson material directly from the textbook for the learners	Learner-centred teaching methods (but she could not elaborate on the learner methods she used)
Teacher B	Textbook based method	Learner-centred teaching methods (but she could not elaborate on the learner methods she used)
Teacher C	Textbook based method and fieldwork within the school	Textbook based method and fieldwork within the school
Teacher D	Information transfer	Information transfer, research, fieldwork, smartboard and cellphones
Teacher E	Story-telling, pictures and videos	Story-telling, pictures and videos

Evidence from lesson observations revealed that what participating teachers said during interviews was aligned with what transpired during observations of teaching and learning in terms of teaching strategies.

Figure 1: *Data from lesson observations*

Teacher A	Teacher B	Teacher C	Teacher D	Teacher E
Relied on reading for information in the three lessons she taught in the Grade 11 class. The lessons that Teacher A taught were on the concept of sustainable development, monsoon winds and fohn winds.	Used reading for information, information transfer, class discussion, dialogue, and question and answer methods to teach the informal sector and travelling disturbances	Used reading for information, class discussion, group discussion, and question and answer methods when teaching the Grade 11 section on South Africa's long-term strategy using conventional energy sources and another lesson on drought. Teacher C used the same methods in teaching anabatic and catabatic winds to the Grade 12 class.	Used information transfer, class discussion, dialogue and questions and answers when teaching resource use and sustainability to the Grade 11s. In a Grade 12 class, Teacher D employed information transfer, class discussion and the question and answer teaching strategy.	Made use of writing notes, explaining the notes and asking question when teaching lessons on trade and development and using resources in Grade 11. In the third lesson observed, Teacher E was observed teaching soil and soil profiles, and she made use of fieldwork observation within the school yard, media and reading for information.

It was evident that most of the participants relied on reading from the textbooks, discussion and information transfer. Of the five participants, Teacher E tried to apply various learner-centred teaching approaches which would enhance learners' understanding. However, one cannot tell whether she learned this from the course or not. Consequently, four of the five participants' teaching strategies do not reflect change since they continued using the methods they used before attending the course.

Discussion

Borg et al. (2012) contended that traditional teaching from the front of the class was still a common teaching method in Swedish schools, even though it is utilised in combination with other approaches. Borg et al. (2012) further argued that the commonly used teaching methods in teaching sustainable development in Swedish schools are discussion, lectures, small group research, interdisciplinary work and class debates. The teaching strategies used in Sweden were possible because of the smaller class sizes in developed countries as opposed to larger class sizes in developing countries. In a study conducted in Lesotho, Raselimo and Wilmot (2013) found that teachers after ESD training did not adopt teaching strategies

that encouraged learner participation. Most teachers participating in our study at the time of data collection did not implement learner-centred teaching strategies, except Teacher E who did implement a few of these methods. It seemed most participating teachers were reluctant to try the methods taught in the Fundisa for Change course or did not know how to apply them. Participating teachers were comfortable with the way they were teaching. They also did not know how to apply the methods because the course which introduced the methods did not give them a chance to practice what they learnt during the course. They would have preferred a hands-on course with practical activities, which they could have taken directly into their classrooms. Applying transformative teaching strategies in teaching climate change education might help because learners are engaged on issues that are more relevant and meaningful to their lives (Monroe et al., 2019). Anderson (2012) stated that engaging learners in teaching climate change education helps in empowering them and their communities.

Steyn (2008), Ono and Ferreira (2010) and Nawab (2017) all argued that short teacher professional development programmes are unlikely to result in transforming classroom practices. To ensure that learners acquire knowledge and skills that promote sustainable development, teachers need to transform their thinking and action, which will in turn transform their classroom practices. The Fundisa for Change short intervention course was not sufficient to bring about change in teaching approaches and the use of a variety of resources in teaching for and about ESD. This paper supports the views that have been advanced by Steyn (2008), Ono and Ferreira (2010) and Nawab (2017) that professional development is more effective when it is a continuous process.

Conclusion

This paper explored the influence of the Fundisa for Change short TPD course on pedagogical practices for ESD. Teachers who participated in this course were exposed to a variety of learner-centred teaching approaches and different resources that could be used to teach for and about ESD. While the course sought to transform teachers' practices in order to develop learners' skills and critical thinking, its effectiveness was doubtful. Attending the Fundisa for Change course required teachers' frames of reference and pedagogical practices to be transformed or expanded. However, it would seem that simply attending the course was not sufficient to transform most of the participating teachers' frames of reference as envisaged by Mezirow (1991). This conclusion is based on the lack of change in teaching practices following the course. This could be because of the rigid structure of the curriculum where teachers were focusing on satisfying its demands instead of innovating and changing their teaching approaches. Only one of the five teacher participants varied their teaching approaches and resources in teaching for and about ESD. This suggests that teaching practices could be better supported through a follow-up TPD session where teachers could be invited to share ideas and experiences of what works and where they struggled and need help. Teachers could also be encouraged to bring examples of their work and experiences, for discussion in a constructive learning environment.

Rising temperatures and consequent climate change are serious problems facing future generations since extreme weather events become worse and occur more frequently. These are sufficient reasons alone for educators to be equipped to teach their learners effectively about the problems humanity has caused, and measures urgently needed to bring about change.

Notes on Contributors and their Contributions

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Percentage contribution

Areas of contribution	Author	Percentage contribution
Conception or design of the paper, theory or key argument	Thenga	70 %
	Goldschagg	10 %
	Ferguson	10 %
	Mandikonza	10 %
Data collection	Thenga	100 %
Analysis and interpretation	Thenga	70 %
	Goldschagg	10 %
	Ferguson	10 %
	Mandikonza	10%
Drafting the paper	Thenga	70 %
	Goldschagg	10 %
	Ferguson	10%
	Mandikonza	10 %
Critical review of paper	Thenga	40 %
	Goldschagg	20%
	Ferguson	20%
	Mandikonza	20%

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Learning to Adapt in a Global Pandemic of COVID-19: Insights to Support Vocational Education and Training (VET) in Southern Africa

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Abstract

The COVID-19 pandemic impacted all education sectors significantly during the full global lockdown between March and June 2020, including the Vocational Education and Training (VET) sector. During this period, the authors jointly led nine researchers who were postgraduate students in six Southern African Development Community (SADC) countries (Botswana, Eswatini, Mozambique, South Africa, Zambia and Zimbabwe). Due to the restrictions during the lockdown, these nine researchers conducted a literature review and thirty interviews in local communities in these six SADC countries. This included both VET colleges as well as individuals in informal, small-scale and entrepreneurial activities. The authors refer to the qualitative data gathered by the interviews with these interviewees as 'stories of adaptation'. In this paper we used these 'stories of adaptation' to explore the links between learning to adapt and expertise, and to consider how together these constructs offer insights into how VET can be strengthened to better support local communities.

Two research questions were asked: (1) how do the notions of adaptive capacity and expertise as conceptual constructs help to understand vocational learning in a global pandemic? and (2) what insights can be drawn from the 'stories of adaptation' to strengthen the role of VET in local communities? Through a thematic analysis of the 'stories of adaptation', three key findings emerged: (1) capacity to adapt is a multi-level and multi-pronged construct; (2) use of digital platforms as well as local networks were key enabling mechanisms for adaptation; and, (3) learning and expertise are embedded in the capacity to adapt. Thus, we argue that building a responsive VET system for the SADC region is achievable by strengthening the nexus between learning, expertise and adaptive capacity.

Keywords: *adaptive capacity; expertise; global pandemic; vocational education*

Introduction

Vocational Education and Training (VET) has an important role to play in Africa's development (McGrath, 2012; McGrath et al., 2020). VET has a strong relationship to skills for livelihoods. The coronavirus pandemic (COVID-19) is a global shock that has negatively

impacted on global education, including the VET system. The need for the VET system to adapt through the current global health crisis has become critical (UNESCO-UNEVOC, 2020). This has led to an analysis by the Southern African Development Community (SADC) of the impact of the pandemic on different sectors, including education (SADC, 2020).

The current pandemic is changing the way we live, work and learn and the need for education, including the VET system, to become responsive during such situations is a global imperative. This is the time that we must educate differently for "complexity, change, uncertainty, vulnerability, and resilience" (Talanquer et al., 2020). This paper builds on a recent study (Ramsarup, Ojo & Jenkin, 2020) which was part of a bigger study called Researchers Challenge in SADC #OpenupYourThinking.[1] Our study examined how the Vocational Education and Training (VET) system in the southern African region fared during the lockdown in May and June 2020.

Specifically, this paper acknowledges that VET has an important role to play in supporting livelihoods in local communities. Two research questions are asked as follows: (1) how do the notions of adaptive capacity and expertise as conceptual constructs help to understand vocational learning in a global pandemic? and (2) what insights can be drawn from the 'stories of adaptation' to strengthen the role of VET in local communities? In answering these research questions, the paper explores how what the authors called 'stories of adaptation' contribute to the development of expertise which is central to VET. This helps us to draw out implications for strengthening the role VET plays in local communities.

Context, data and methods

The COVID-19 pandemic presented an unprecedented situation globally. UNESCO data in June 2020 claimed that over one billion students were physically unable to attend school, training institutions and universities in 144 countries due to the global lockdown (UNESCO-UNEVOC, 2020). This context premised the initiative, referenced in the endnote, by JET Education Services and the UNESCO Regional Office for Southern Africa with other partners to engage SADC researchers to study how different groups and institutions responded to the COVID-19 pandemic in the region. Through this initiative, six thematic areas were identified. The authors jointly led one of the themes, *Theme 5: Intersecting perspectives on transforming education for sustainable futures: Vocational Education and Training (VET) & COVID-19 in Southern Africa,* during the height of the lockdown.

The research was conducted online as a 'researcher bootcamp'. Theme 5 involved working with nine researchers who represented six countries in the SADC region: Botswana, Eswatini, Mozambique, South Africa, Zambia and Zimbabwe. At the time, the nine researchers were undertaking postgraduate studies across the SADC region in different disciplines. Thirty interviews were conducted between May and June 2020 remotely (through voice and data calls including using WhatsApp voice notes, especially if the network was problematic in the interviewee's location). We referred to the interview accounts as 'stories of adaptation'. These stories illustrated how individuals overcame barriers to maintaining their livelihoods during COVID-19.

The research adopted a qualitative approach through the use of these 'stories of adaptation', the interviewees' accounts, as qualitative data. In addition to this, a literature review was conducted by the researchers on the overview of VET in their respective countries, with particular reference to policy and the impact of COVID-19. This literature review provided insight into how TVET colleges had responded (or not) during the pandemic. The table below summarises the interviews conducted across a cross-section of individuals involved in informal, small-scale and entrepreneurial activities, and TVET colleges during the COVID-19 lockdown in the six SADC countries.

Table 1: *Summary of the 'stories of adaptation' including a cross-section of the activities by number and location*

Interviews as 'stories of adaptation'	Number of individuals interviewed	Location
Informal metal manufacturing	5	Harare, Zimbabwe
Small-scale farming	3	Cape Town, South Africa
	1	Lusaka, Zambia
Soap manufacture and ingredient production	4	Nampula, Mozambique
Recycled waste entrepreneurs	4	Lusaka, Zambia
Tuck-shop ownership	3	Francistown, Botswana
TVET colleges	6	Manzini, Eswatini
	1	Nampula, Mozambique
	3	Durban, South Africa
Total number	30	

A thematic analysis was carried out on the data collected by the nine researchers and authors of this paper.

Literature

Vocational Education and Training (VET) "traverses the education-work border" (McGrath, 2011, p. 36), is about intermediate skills necessary to maintain livelihoods in Southern Africa (McGrath, 2005) and is critical to a nation's socio-economic context (Akoojee & McGrath, 2004). The link between education, work and livelihoods is central to the VET system, and the role of VET in strengthening local communities. We recognise work by Powell and McGrath (2019), which argued that when researchers discuss a specific institutional structure, they utilise the term 'TVET'. However, this paper uses the larger viewpoint on VET as a means of integrating living-working-learning.

This paper required a lens that enabled us to explore how people adapted during the COVID-19 lockdown. For this, we found the construct of adaptive capacity useful. Adaptive capacity has many different dimensions, but there seems to be consensus on the ability of a system, institutions, groups or actors to cope and adjust to changing circumstances (Phuong et al., 2018). Adaptive capacity can be broadly understood as the ability of people and institutional systems to cope with incremental and rapidly changing conditions (Smit & Wandel, 2006).

Whether viewed at a collective or individual level, adaptive capacity involves learning. In other words, the 'capacity to learn' is the most important element and always has a positive effect on increasing adaptive capacity (Eakin et al., 2011). Individual perspectives of adaptive capacity focus on individuals' societal knowledge and technical skills (Bos, Brown & Farrelly, 2013), and their ability to harness and combine system attributes in adaptation processes. An important necessary condition for understanding the collective perspectives of adaptive capacity is the need for enabling social learning (e.g. knowledge co-production, co-management, sharing knowledge and skills, changing attitudes/behaviour) (Bos et al., 2013).

In this paper, we used the construct of expertise to give meaning to the learning journey in the adaptive processes of the local communities. Expertise is used as an overarching term to conceptualise the relationship between work and VET. The concept of expertise embodies both the practical and theoretical components involved in the performance of work of all kinds.

Largely, expertise arises from VET and VET supports the development of expertise. This occurs across a continuum of overlapping processes that feed into each other (Guile & Unwin, 2019). Guile and Unwin (2019) identified a number of features of expertise found in the literature. In this study the most relevant features of expertise are individual, collective, cross-occupational, socio-material and practice-based. These features of expertise enabled us to examine how expertise is conceived and developed across occupational boundaries and national systems. They bridged a divide between 'explicit' and 'tacit' forms of knowledge. Drawing on the work of Barbour, Sommer, and Gill (2016), Guile and Unwin (2019, p. 31) argued that expertise or the "application of knowing to solve problems" involves a combination of the dimensions. These dimensions are: *technical* (specific knowledge required to perform); *arcane* (rules, history – as in a 'community of practice'); *interpersonal* (relational aspects of practice); and *embodied* (physical conduct of work and the space in which it takes place).

Traditional conceptions of VET tend to focus on the 'technical', with some attention given to the 'arcane', and separate the 'interpersonal' from practice, as in so-called generic or soft skills. Attention to the 'embodied' aspect of expertise may be given, although not necessarily articulated, and may be encompassed by a more generalised notion that there is a tacit realm to any area of expertise (e.g. trainee carpenters are encouraged to keep running their hands along a piece of wood to test for imperfections, or chefs are encouraged to 'feel' the moment when a sauce starts to thicken) (Guile & Unwin, 2019, p. 31). Thus, the use of expertise underlabouring adaptive capacities provided us with the descriptive tools

to articulate the knowledge and practices embedded within the adaptations observed in the study.

Emerging findings

The analysis of the data is presented in this section as key emerging findings. These emerging findings are clustered as follows: (1) capacity to adapt is a multi-level, multi-pronged construct; (2) use of digital platforms as an enabling mechanism for adaptation; and (3) learning to adapt and dimensions of expertise are complementary as depicted in the stories of adaptation below. These are presented with extracts from the 'stories of adaptation' below.

Capacity to adapt is a multi-level, multi-pronged construct

This paper required a lens that enabled us to explore how people adapted during the COVID-19 lockdown. For this, we found the construct of 'adaptive capacity' useful. As earlier indicated in the literature, adaptive capacity has many different dimensions and can be broadly understood as the ability of people and institutional systems to cope with incremental and rapidly changing conditions. The first finding depicts three levels of representation for capacity to adapt which includes individual capacity to adapt, adapting to a focus on the local collective/community, and system adaptation as seen in vocational education system support. Each of these levels is discussed in detail below, along with excerpts from the interviews.

a) *Individual capacity to adapt*

All researchers reflected on the adaptive capacity of the individuals they interviewed. In the main, they indicated that individual capacity played a significant role in an individual's ability to respond and adapt to the immediate shock of the severe lockdowns across the region. For example, two interviewees, an informal metal worker and a waste recycling entrepreneur, expressed how quickly they were able to reorganise and adopt different mechanisms for the way they sold the products they grew, made or retailed.

> "I used to get my scrap metal from broken down machines on farms, but with COVID-19 I acquired non-functional machines locally from peers or material from local scrap yards and suppliers." *[Informal metal worker operating in Harare, Zimbabwe]*

> "We used to have exhibitions to sell most of our products but now we use online channels to sell our baskets and buyers can place orders." *[A waste recycling entrepreneur from Lusaka, Zambia]*

In the same way, a soap-maker and tuck-shop owner used their own agency and experience to solve problems during the lockdown drawing on their individual capacity to adapt.

"I saw all the waste coconut, and drew on my chemistry degree to make soap – understanding the setting time, the sequence and time for adding ingredients, and the intensity of the boiling fire." *[Soap-maker from Nampula, Mozambique]*

"My financial preparedness by saving money, and how to run a business helped me during lockdown." *[Tuck-shop owner in Francistown, Botswana]*

All those interviewed illustrated their individual ability to draw on their existing know-how and ability to learn new technical skills. They adjusted their practices to cope with the challenges created by the lockdown. A good example of a combination of these abilities to learn was reflected by a soap-maker.

"I learned from seeing my mother producing coconut oil. When I studied chemistry, I realised that I could do more with coconut. I did my experiments from reading books and watching related videos and it really worked." *[Soap-maker from Nampula, Mozambique]*

This demonstrates how the individual interviewee's adaptive capability aided in their capacity to learn and adapt.

b) *Adapting to a focus on the local collective and community*

Across the different 'stories of adaptation', we were also able to identify a leap from the individual ability to adapt to that of adaptation while leveraging on interpersonal networks and relationships in communities. These networks and relationships supported and enabled local enterprises that developed due to travel and consumer restrictions. As noted by one of the interviewees, "community is critical" *[Smallholder farmer in Cape Town, South Africa]*.

Other interviewees expressed similar understanding of the importance of the community's ability to think and act collectively. Small-scale farmers, tuck-shop owners, metal workers and waste entrepreneurs increasingly relied on localised or walk-in sales, or access to local materials in their communities.

For example, one of the interviewees in Botswana noted their ability to adapt was informed by their local customers who indicated their preferred goods for purchase, such as "small products like soft drinks, toilet paper, face masks and also electricity. Some perishable goods such as vegetables and meat were also in high demand" *[Tuck-shop owner in Francistown, Botswana]*. This ensured tuck-shop owners sold goods that were most likely to be purchased by local customers during lockdown. This enabled them to continue to generate income during lockdown. Survival capacity was also witnessed in adaptations to procurement practices, which shifted to local suppliers. As illustrated by an interviewee in Zimbabwe, "sometimes I call my friends who own their own [local] companies to assist me … they will sell me some material" *[Metal worker in Harare, Zimbabwe]*.

Additionally, community knowledge sharing and learning were viewed as crucial for coping, such as connecting with social media or local industry communities. These are expressed in the extract below by the different interviewees.

"I got in touch with farmers willing to share knowledge and experience … I saw on various social media how other people and businesses came up with ideas to limit social interaction. I applied these ideas on the farm and with customers. [Through this] food organisations heard about the farm through social media platforms and reached out." *[Small-scale farmers in Cape Town, South Africa]*

To better illustrate the important significance of the community's collective adaptive capability, two interviewees pointed out the need to learn from one another throughout the lockdown. There was one individual who explained how leaning on personal experience assisted in coping.

"I talked to other tuck-shop owners, and learnt from them." *[Tuck-shop owner in Francistown, Botswana]*

"I learnt from my parents and guardians." *[Small-scale vegetable grower from Cape Town, South Africa]*

The importance of capacity to adapt as a distributed competence among communities could thus be traced within the stories and this collective expression of capacity to adapt is essential to understanding VET in local communities.

c) Vocational education system support

This section draws on data from the literature review of TVET responses to the pandemic in the six countries and the interviewees from TVET colleges in three countries. It was observed that the VET support system struggled to provide consistent educational provisioning during the lockdown's peak and struggled to react at national level within the countries and at college levels. Only South Africa seems to have had the infrastructure necessary to facilitate online education and learning, although this was scattered. The nine researchers involved struggled to obtain national recovery plans, or publicly available information on VET to ascertain national responses to the pandemic. Government attention generally seemed to have been dedicated to the provision of basic and higher education in the region.

Infrastructure and digital capabilities (physical and competence) were two of the most major obstacles experienced at sector level. The primary digital capacity constraints identified were: students lacking access to computers or smartphones (Mozambique, Zambia); the high cost of internet services and data (Zambia); a lack of knowledge regarding the use of technology platforms and smartphones (Zambia); and internet accessibility (especially in rural areas and informal settlements throughout the SADC region). From the institutions' viewpoint, digital limits were infrastructure-related, and the ability to provide courses remotely, particularly technical components, proved troublesome. Financial constraints prevented VET institutions in Eswatini, Mozambique, and South Africa from providing students with computers, cellphones, or data. Capacity for remote delivery of courses was also a challenge, particularly for technical components in South Africa, Mozambique, and

Zambia. Insufficient teacher capability to exploit digital platforms was identified as an issue for the TVET College in Zambia.

Only two colleges interviewed across the six countries highlighted how they had adapted and used their facilities and practical know-how to capitalise on the sudden demand for masks and sanitisers during lockdown.

> "The use of skills and entrepreneurial ventures resulted in students and colleges sewing face masks and protective overalls and making sanitisers. This turned into small businesses and provided the student and TVET institutions with practical experience." *[Senior education specialist at a TVET college in Durban, South Africa]*

> "We've got lots of practical rooms which we can use for example jewellery design. The room was locked for four years. Now the students are making masks in these rooms. We can be proud about this. Students are learning how to come up with their own designs." *[Head of Programmes at a TVET college in Durban, South Africa]*

The three levels of representation for adaptability as presented above, which include individual adaptability, adaptability with an emphasis on the local collective/community, and vocational education system jointly support adaptive capacity as a multi-level, multi-pronged construct. The levels are also iterative and interconnected.

Use of local networks and digital platforms as enabling mechanisms for adaptation

According to the interviews, there was an exponential growth in the usage of digital platforms during the lockdown. Smartphones were mostly utilised to communicate, obtain knowledge, purchase supplies, and sell things, as evidenced by the various statements of the interviewees.

> "I used WhatsApp to communicate quickly with other farmers to deal with urgent issues when social distancing and travel restrictions stopped me from meeting them." *[Small-scale farmer, Lusaka, Zambia]*

> "I used social media more to share information with farmers." *[Small-scale farmer, Cape Town, South Africa]*

> "I learnt to use social media to collect the coconut waste by calling the coconut seller. I also used an electronic transaction to engage with the carrier." *[Soap-maker, Nampula, Mozambique]*

> "I learnt how to use social media as a tool for advertising my goods." *[Waste recycling entrepreneur, Lusaka, Zambia]*

The findings emphasise the critical need of having access to local networks within communities and being able to employ digital tools (online media platforms and applications) in order to cope with a crisis of this magnitude, such as the COVID-19 pandemic. There is evidence, as presented in the extracts earlier, that a number of the interviewees have online presence through the use of social media platforms such as WhatsApp. Some of them used

this to continue to sell their goods or crops. In addition to this, they relied on their local networks during the lockdown to cope. To put it another way, when social separation and travel constraints prevented individuals from meeting in person, they drew on the networks within their communities and on smartphone apps like WhatsApp to enable them to adapt.

Learning to adapt and dimensions of expertise are complementary as depicted in the stories of adaptation

From the 'stories of adaptation', we were able to extract work tasks, skills and knowledge as depicted in Figure 1 below. These helped to illustrate and understand the learning processes central to the 'development of knowing to solve problems,' which is the essence of expertise (Guile & Unwin, 2019). The different 'stories of adaptation' focused on individuals having a particular trade or job, such as soap-makers, small-scale farmers, tuck-shop owners or metal workers, and the technical tasks they presented related directly to the specifics or technical dimensions of their job. For example, for the soap-maker such tasks included the making of soap from coconut waste. In the interview account of the waste recycling entrepreneur producing bags from plastic waste, one of their tasks included the knitting of plastic. For the tuck-shop owner, this included the buying and selling of goods.
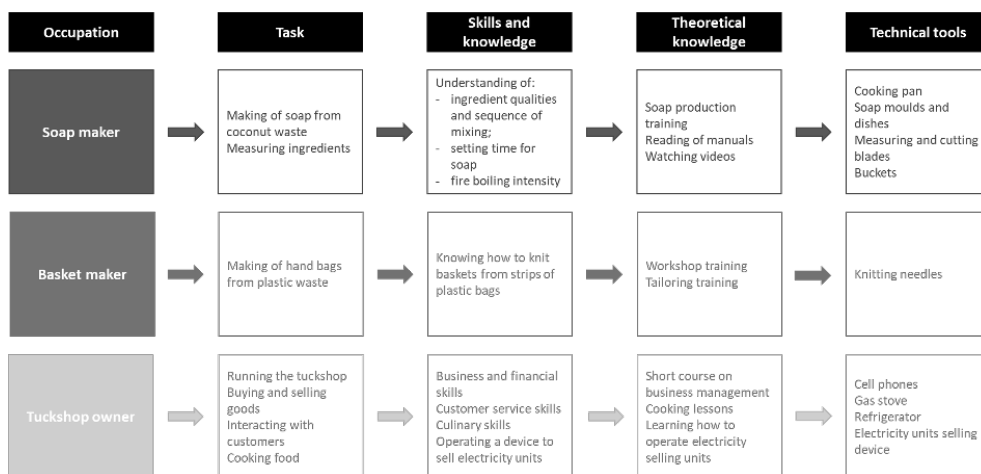
Figure 1: *Illustration of 'stories of adaptation' where the relationship between tasks, skills and knowledge is shown (Ramsarup, Ojo & Jenkin, 2020, p. 32)*

However, many of the individuals interviewed also mentioned tasks that could be considered non-specific, and, therefore, generic – making them applicable to more than one task or job. Examples include business and entrepreneurial, research, and customer services skills. These tasks are associated with knowledge skills which will have been obtained more informally or tacitly (for example, on the job learning and through the use of certain tools).

Further analysis helped to show the combination of dimensions of expertise embedded in the interviews to adapt, and showed the **technical dimension** i.e. the specific knowledge required to perform work tasks. In the soap manufacturing interview, for example, there was an emphasis on the need to understand ingredient properties, the sequences necessary to combine them, and knowing when to add the ingredients. Additionally, the degree of intensity of the boiling fire and the soap setting time are all critical. In the case of the waste recycling entrepreneurs, the basket maker needed to know how to combine wires with bottle tops to make a functional shopping basket, and the floor polish maker needed to know the quantity of paraffin and colour to add to the melted mixture of plastics (Ramsarup, Ojo & Jenkin, 2020).

The **arcane dimension** as the rules of practice was evident in the small-scale farmer from Lusaka, Zambia. As an example, drawing on the interview, knowing and understanding disease regulations, animal vaccines or fertiliser requirements are all important. Evidence of new rules of practice adoption were also witnessed, from adopting sanitisation and social distancing protocols, and travel restrictions.

"Levels of hygiene had improved through heightened adoption of sanitations protocols." *[Waste recycling entrepreneur from Lusaka, Zambia]*

"During the first days of the lockdown I had to acquire a permit to travel to the wholesale market." *[Smallholder farmer in Cape Town, South Africa]*

Interpersonal dimensions involve the relational aspects of practice and were observed in the interviews. An example is: "I acquired the knowledge through a product recycling association" *[Waste recycling entrepreneur from Lusaka, Zambia].* For smallholder farmers, these dimensions included engaging with participants in food relief programmes, community leaders and social media/news. This relational dimension emerged as central to how information was acquired during the height of the lockdown.

Linked to the interpersonal dimension is the access to local knowledge, in terms of geographic location. This proved a significant indicator for knowledge access during the COVID-19 restrictions. Given the travel restrictions imposed on local businesses during periods of lockdown, local community knowledge – like speaking to those within the same job role or operating in the same sector (e.g. farming) – appears to have been a valued and important source of knowledge generation and acquisition.

The **embodied dimension** – the physical conduct of work and the space in which it takes place – was more difficult to ascertain. This was due to the researchers not being allowed to conduct site visits, and therefore observe the physical conduct of work. As such, it was not reported.

The data thus illustrates that through examining capacity to adapt, we were able to surface dimensions of expertise, thus enabling us to link development of expertise and capacity to adapt.

Table 2 that follows summarises the three key findings that emerged from the data analysed for this paper.

Table 2: *Summary of the emerging findings from the data*

Emerging findings	Summary
Capacity to adapt is a multi-level, multi-pronged construct	Adaptability may be defined as consisting of three levels: individual adaptation, adaptability for the local community, and support for the vocational education system. These levels are also iterative and interrelated.
Use of local networks and digital platforms as enabling mechanisms for adaptation	An online presence and local networks were vital for the interviewees to develop the capacity to adapt. Digital platforms like WhatsApp proved useful for facilitating communication regardless of geographic or social isolation.
Learning to adapt and dimensions of expertise are complementary as depicted in the stories of adaptation	The relationship between tasks, skills and knowledge, theoretical knowledge and technical tools are embedded in the 'stories of adaptation' showing strong links with expertise. This has significance for VET where expertise development is central to the role of VET.

The next section discusses these results, linking the research questions and the literature earlier presented in this paper.

Discussion

Drawing on the conceptual construct of adaptive capacity, and Guile and Unwin's (2019) dimensions of expertise, it was possible to explore the interplay between the individual, the collective community and the VET college's adaptive capacity during the severe restrictions imposed at the onset of COVID-19 pandemic. This discussion highlights how the interviewees developed the capacity to learn to live with uncertainty and change, while specifically highlighting adaptive capacity through the lens of knowledge, learning and expertise.

The data illustrated that the capacity to adapt was multi-level and multi-pronged. The three levels identified were adaptability at the individual, the local community and at the VET system level. What was common in the varied ways in which adaptive capacity emerged was the strong sense of adaptation as the use of knowledge to solve issues which Guile and Unwin (2019) embedded as core to expertise. Such competencies identified from the 'stories of adaptation' include, for example, the ability to focus and solve problems to sustain an income when COVID-19 restrictions limited access to market. The types of activities implemented by those interviewed to illustrate such fortitude and ability to adapt included: the identification of different means for marketing their products, such as the use of social media; the hiring of a driver to deliver products when previous modes of logistics and delivery were restricted; and the purchase of Personal Protective Equipment (PPE) to comply with safety measures to continue trading. For those selling a craft, some showed use of local networks and many highlighted that online access proved critical for survival; for those that did not have the means to access the internet or social media to sell their goods, this proved to be a barrier to continue to do business.

This ability to apply knowledge to solve problems, according to Guile and Unwin (2019), involves a combination of dimensions of expertise – technical, arcane, interpersonal and embodied. Guile and Unwin (2019) suggested these dimensions of expertise will comprise tasks associated with knowledge and skills, which will have been obtained more formally, or tacitly e.g. on-the-job, and through the use of certain tools. We argue that while expertise is central to VET, adaptation cannot happen without learning. As individuals, communities or systems adapt, new learning is taking place. Therefore, acknowledging the role learning plays in adapting and building expertise is important for a better VET system.

The type of learning underpinning the development of expertise that surfaced was dynamic and contingent where meaning and status are constantly in flux as was necessary in the pandemic; these fixed and rigid ideas about theory and practice should hence be guarded against. It also looks at the development of expertise across a "continuum of overlapping processes that feed into each other: the initial process of formation, the refreshing and updating process, and the reformulation process' (Guile and Unwin, 2019, p. 33). Perceiving learning and expertise processes as a continuum as depicted in the stories is a way to discourage narrow tasks, and competence-based notions of vocational learning that characterises most VET systems.

The real-life experiences evident in the stories show that while learning to adapt is happening at different levels, the learning focus is largely cross-occupational. Different occupations were represented in the stories and the need to link theory to practice is imperative. The analysis of the 'stories of adaptation' further helps us to see expertise as relational and distributed which mitigates the dualistic framings common in VET like formal and informal learning, practice and theory, knowledge and skill, institution and community. As such, VET must pay attention to how these are framed within the dominant learning processes.

Learning and expertise within VET is critical to strengthening VET. This is supported by Guile and Unwin (2019). The authors argued that "each process needs to be underpinned by a concept of expertise that enables an individual to understand that: (a) they are engaged in a multi-faceted process of learning that will draw on different sources and types of knowledge (including their own), and (b) their expertise will be formed through practice and in relation to other people and different technologies and be subject to shifting formulations and value judgments" (Guile & Unwin, 2019, p. 33). If VET systems can support the development of this kind of learning, which is central to expertise, this will strengthen the VET system and ultimately enable VET to play a more meaningful role in supporting local communities.

The stories of adaptation also presented the importance of digital platforms as the operational space to bring together the nexus between learning and expertise. We acknowledge the role of access to digital platforms as combining features of 'cross-occupational and socio-material' elements (Guile & Unwin, 2019, pp. 29-30). Within these stories there is overwhelming evidence of the use and importance of digital platforms, including how the original research was conducted using digital platforms such as Google Drive and WhatsApp for communication, and through the stories on how individuals used such platforms for work and trade. Examples of the latter included making payments,

selling goods, accessing suppliers of raw materials, connecting and sharing knowledge. The World Bank alluded to the use of digital platforms and technologies during the first phase of the pandemic in aiding businesses to stay open, thereby making society more resilient (Lampietti, Abed & Schroeder, 2020). Digital tools can also be considered as boundary crossing tools that enable the opportunities to facilitate learning and the ability to better adapt for the multi-level, multi-pronged nature of capacity to adapt presented previously.

It was also evident that non-formal VET grew during this time, with numerous local initiatives emerging alongside efforts to support local economies (Ramsarup, Ojo & Jenkin, 2020). This need prompted the agentic desire displayed in lead agents in stories for new knowledge and skills. This precipitated the need for relevant occupational programmes and curriculum reinvention. For example, a number of calls were made by those interviewed for vocational courses which focused on providing practical knowledge and skills, such as sewing, cooking, gardening, farming (e.g. how to plant crops and maintain soil fertility) and operation of advanced or computerised machines. Such practical skills and knowledge would enhance current practices (e.g. diversifying products, ensure skills are up to date or to improve the success of crop production and yields). Technical skills are specific to the occupation and, if made available, are likely to improve the sustainability of livelihoods, especially during a shock to the system.

However, upon investigation, the mechanisms that emerged during the severe lockdown by VET institutions to support and sustain livelihood enterprises are unclear. While respondents could articulate types of knowledge and skills they would like to use in future to strengthen enterprises, they were unclear about where and how they could receive such capacity development within their local communities. In addition, they often struggled to articulate what such a potential pathway may be – particularly the metal workers in Harare. Thus, links between these emergent enterprise opportunities and an emergent VET pathway appear unclear because signposting of learning pathways in the vocational context seemed unclear to interviewees.

During the time of the initial wave of the pandemic, there appeared to be several calls for VET to 'reinvent' itself. However, clear guidelines and national interventions are not yet visible as much of the discourse is rhetorical and without a substantiated pathway to action. Such a pathway, or reinvention, could potentially use this COVID-19 shock to the system to:

- Reform the curriculum (see recommendations below);
- Increase VET focus on occupational programmes relevant to communities as relevant to research, curriculum and teaching and learning;
- Build and enhance partnerships with local communities, industry and local government;
- Become responsive to skills needed to cross boundaries e.g. digitalisation;
- Build more clear entry level pathways that connect to livelihoods.

If we strengthen the VET system, the resultant impact will enhance and strengthen the livelihoods of individuals and local communities. We argue that building back a better VET system is possible through this type of responsiveness.

During the initial hard lockdown, the refocus on the local (particularly local products, economies and waste) as a resource illustrated the re-emergence of local sources and resources in the communities studied. Links between VET institutions and livelihoods in communities therefore need to be explored further as they hold important lessons for supporting adaptive capacity in communities and understanding how to better connect livelihood opportunities into the formal VET system.

Conclusion

In this paper, we have argued that the interplay between adaptive capacity, learning and expertise that surfaced from 'stories of adaptation' collected during the pandemic provided an understanding of the VET system in local communities. The paper provided critical insights to building a more responsive and adaptive VET system, and to better understand how to build back better through and after the global shock so that VET can play a stronger role in local communities.

Acknowledgements

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Percentage contribution

Areas of contribution	Author	Percentage contribution
Conception or design of the paper, theory or key argument	Ojo	40%
	Ramsarup	40%
	Jenkin	20%
Data collection	Ojo	35%
	Ramsarup	35%
	Jenkin	30%
Analysis and interpretation	Ojo	40%
	Ramsarup	40%
	Jenkin	20%
Drafting the paper	Ojo	45%
	Ramsarup	45%
	Jenkin	10%
Critical review of paper	Ojo	45%
	Ramsarup	45%
	Jenkin	10%

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Endnotes

1   Researchers Challenge in SADC #OpenupYourThinking
https://www.jet.org.za/news/join-the-researchers-challenge-in-sadc-openupyourthinking

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