

Exploring Southern African Heritage Practices and Cultural Phenology for Framing ESD as Reflexive Learning to Change Together

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Abstract

This formative article on indigenous heritage and cultural phenology informs environment and sustainability education as reflexive processes of heritage-mediated, deliberative learning to change together. It shows how transformative learning can be informed by engaging with biocultural heritage that has shaped the southern African biomes as living landscapes. Drawing on historical and agroecological evidence, the article illustrates how local practices have shaped environments that support sustainable livelihoods and community well-being. It reviews evidence of how expanding agroecology practices successively 'tamed' the land, making village surroundings safe, healthy and productive. The heritage practices examined show how colonial Arcadian ideals, together with the empirical traditions of the natural sciences, shaped Education for Sustainable Development (ESD) as primarily a learner-led problem-solving approach. The study suggests that a broader view of learning and biocultural change can help reframe ESD as a more reflexive critical process, informed by biocultural heritage and connected to school disciplinary subjects knowledge.

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INTRODUCTION

The study suggests that histories of human social-ecological sustainability are a key dimension of environment and sustainability education. It uses biocultural heritage and temporality to illustrate Education for Sustainable Development (ESD) as situated learning. It also notes that, to rectify the colonial omission of indigenous heritage in schooling, education needs to move beyond an instrumental, imperial-colonial legacy and include evidence of the biocultural co-evolution of ‘living landscapes’ as a foundation for ESD in schooling. Processes of cultural phenology are examined as examples of indigenous heritage practices and associated seasonal temporalities. These provide an important foundation for ESD as a critical process that connects indigenous heritage with disciplinary knowledge through intersectional learning in school curriculum settings.

To bring the implications of the colonial omission of indigenous knowledge practices into clear focus, we have constructed a simplified process model around seasonal cultural practices (Figure 1). This model reflects indigenous biocultural patterns of ‘land taming’ as a long-term process that has shaped living landscapes through agroecological development over many centuries in the region.

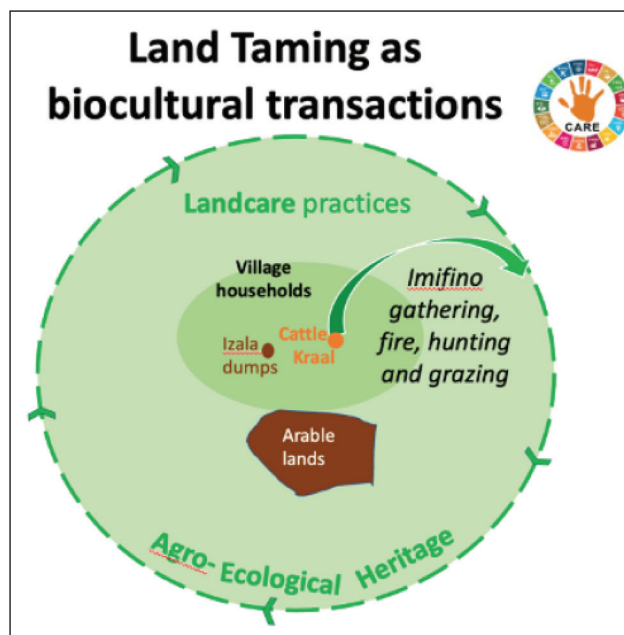


Figure 1. Land Taming as a Biocultural Process in Agroecological Heritage Systems.

This simplified process model for the co-evolution of living landscapes and landcare practices reflects indigenous temporalities and is used as a sensitizing tool for interpreting the examples of cultural phenology that follow. A key driver in the development of these agroecological practices was how communities adapted, survived and learned to thrive within a region of high climate variability.

Climate Variability in Southern Africa

The climate of southern Africa is notable for high climate variability with extended periods of drought. El Niño-Southern Oscillation (ENSO) events have driven climate variability in the southeast of the subcontinent. There was also a brief period of climate variability driven by the Little Ice Age in the late seventeenth century. Here, Frankopan (2023, p. 406) notes, with regard to the Little Ice Age (c.1550–c.1800):

It is important to underline that, in many cases, the unsettled and unusual weather conditions served to accentuate existing vulnerabilities rather than act as the primary cause of disasters.

This seems to be the case in which extensive periods of drought and associated famine coincide with the first Chimerenga, a period of sociopolitical upheaval (Chigwedere, 2015). In this way, a period of global climatic rearrangement associated with the Little Ice Age appears to have contributed to famine, health risk and sociopolitical upheaval as a polycrisis among the Ziwa on the Manyika Plateau of Eastern Southern Africa (Holmgren & Heiss, 2000). Similarly, ENSO cycles of drought can be linked to sociopolitical upheavals associated with cycles of famine and Eastern Frontier border wars with the Xhosa in South Africa. These historical events and the biocultural processes that accompany them highlight the need for a clearer historical understanding of the relationship between climate, culture and landscape.

Reframing the Colonial Narrative on Climate and Landscape in Southern Africa

Working with the Eliasian sensitizing concept of village 'survival-units', Norbert Elias used this sociological descriptor in preference to 'tribe' to avoid colonial inscriptions and as a sensitizing construct for uncovering the relational dynamics within the early African social figurations in Ghana. This work was to inform his later empirical work on civilizing processes in Europe (Reicher et al., 2022). We use the sociological constructs 'survival unit' and 'figuration' throughout this study as these help avoid notions of 'tribe' or 'race' that came to characterize colonial scholarship in relation to indigenous peoples (Elias, 1964/2022). To uncover the relational dynamics in early social figurations on developing social-ecological and political landscapes of the region, the study examines how the exclusion of culture from the ecological sciences helped to shape a colonial disposition in which both the impact of indigenous peoples and that of modern humans have been framed as the primary causes of the sustainability challenges of the present day. The study does not dispute the empirical evidence of environmental degradation and emerging risk. It does, however, point to limitations in how conservation, environment and

sustainability education have been configured as problem-solving imperatives without adequate reference to historical biocultural evidence.

Cultural phenology is explored as an evidence-based way of reading and interpreting patterns of social-ecological changes in southern Africa. The study illustrates how the evidence of early cultural phenology paints a rich picture of how the livelihood struggles of early people shaped living landscapes that have changed with innovation, socio-economic expansion and population growth driven by the widening use of fossil fuels and by increasing pollution and disease control within colonial modernity.

The Recent Emergence of Phenology as an Empirical Field of Study

The modern-day climate crisis has been a driver of the recent surge of interest in phenology as a field of study. Phenology emerged as a relatively small field of ecological research in the late 1950s and concerns the timing of recurring biological events within a specific environment. These include events such as flowering, fruiting, animal migration and breeding cycles, all of which are closely influenced by seasonal climatic conditions (Dreyer et al., 2006).

Phenology has since developed into a key area of scientific research on climate change, as it provides landscape-level data on seasonal variability and change. Hudson and Keatley (2016) provide an overview of research processes for tracking phenological changes using empirical scientific methods that often bracket out cultural histories.

Armatas et al. (2016) demonstrate how traditional phenology knowledge can inform adaptive management in agriculture, but this is rare, as the scientific method often brackets out cultural dimensions to focus on natural annual cycles of biological processes.

CULTURAL PHENOLOGY IN AFRICAN SURVIVAL UNITS

The figuration sociology sensitizing concept of a 'survival unit' by Norbert Elias (Reicher et al., 2022) is used to critique the omission of 'culture' from utopian ideals of wild nature in ecological studies. Notably, human impact on nature is commonly framed as unnatural and destructive in the conservation sciences, which in turn informs environmental education field studies.

It is also evident, for example, in how current ecological studies of changing phenology patterns are researched as impacts of anthropogenic climate change. Here, research and education could be more explicitly centred on cultural phenology and climate change, including indigenous peoples' historical sociologies and seasonal historiographies. The inclusion of intergenerational voices and knowledge is essential in this regard. Southern African figurations have lived within seasonal regularities and high climate variability over centuries, extending into the present context of increasing climate extremes.

In this study, the seasonal cycles and practices of early southern African 'survival units' are read as dynamic and evolving temporalities, a form of cultural phenology grounded in seasonal practices within indigenous social figurations that developed in relation to cyclical environmental change over time.

The Evolution of Seasonal Cycles of Land Care and Living Landscapes

In his book, *The Lie of 1652*, Patric Tariq Mellet (2020) describes how notions of race have become embedded in ways that make it difficult to understand the dynamics of cultural integration and exchange that preceded colonial modernity. This insight is supported by genealogical evidence of how the boundaries between early survival units in southern Africa were far more fluid than they are today. Chigwedere (2016) points out:

When one invading clan invaded and took over another clan's territory, it knew too well that it had defeated the living and not the dead of its victim. It did not fight their dead; it was not in conflict with their dead. Therefore, the invading master must avoid doing anything to affront the dead component of its victims. (p. 64)

In this context of ancestral recognition, the 'dead component' of ancestors was tied to ancestral ceremony practices aimed at mediating seasonal climate uncertainties. Chigwedere illustrates this further by noting that

Because the Bantu communities believed that their ancestors influenced the cosmos, the Dziva Hungwe Kalanga ancestors were believed to have the power to shape the patterns and amounts of rainfall across the land they controlled. (p. 64)

By way of example, both the seasonal ceremonies of the invading Mbire and the defeated Dziva Hungwe were evident in the Great Zimbabwe stone settlement. Chigwedere points out that the defeated Dziva Hungwe clan, those who had tamed the land, were accommodated on the eastern side of the rising sun. On the west side, the Mbira Nyai ancestry, as victors who adored the moon, had shrines and held their ceremonies to celebrate the harvest, ward off calamities and mediate the rains of the forthcoming summer season.

These records of early socio-genesis in southern Africa are included here because they illustrate how outsider readings of heritage through a Western victors/vanquished lens have a limited explanatory value. We have gone into some detail here as these insights are necessary for a situated grasp of cultural phenology and the temporalities of seasonal knowledge practices associated with these.

This perspective shows how contemporary notions of fixed ethnic identity are, in part, outcomes of earlier experiences of indigenous peoples living in a dynamic social-ecological context. These contexts, shaped by interactions with diverse landscapes and abundant wildlife, contributed to the development of ecological idealism. This perspective underpinned ideals of holism in nature and early experiential learning in natural settings.

How Empirical Ecological Idealism Muted Indigenous Biocultural Heritage

A narrow vantage point on phenology and climate is found in modern environmental science methods, which often bracket out human-nature relationships, positioning environmental education as an experiential learning process in 'nature' separated from culture. As noted earlier, this has, until recently, positioned humans primarily as drivers

of environmental problems and solutions, without adequate recognition of how early indigenous cultures actively shaped the habitats of southern Africa within and as part of the living landscapes that sustained them.

Many current phenology studies on climate change remain situated within this framing, focusing on seasonal regularities to track real-world changes in the timing of recurring life-cycle events. While this evidence has been important in highlighting environmental risk and informing the need for climate change education, it also reinforces a narrative of risk and a modern human condition intervention. The scope and depth of the challenges rightly point to an urgent need for problem-solving and change practices to mitigate and adapt to climate change.

However, developing in this way and out of a sustained colonial fascination with wild nature, the educational practices in the natural sciences have come to flag humans and not the patterns of change in colonial modernity as an anthropogenic cause of climate change to be resolved through education. The study does not dispute the value of scientific data in informing understanding of climate change. Rather, it highlights how a legacy of ecological idealism in the sciences has been slow to engage with African historiography as evidence of intergenerational socio-ecological practices that sustained livelihoods and well-being prior to colonial and modern transformations.

Cultural Phenology as an Object-Congruent Capital for ESD

Building on the preliminary research on African cultural histories and climate change reported in O'Donoghue (2019), this study examines how ecological and climate research could have considered, for example, the early cultural phenology sustaining cattle cultures on the Manyika Plateau, which spans part of Eastern Zimbabwe and Western Mozambique in southern Africa. Diverse and developing agroecological systems had evolved here. Slash-and-burn (Chitemene) agriculture was widely evident in heavily forested areas that opened into woodland savanna. Pesanayi et al. (2019) describe how the open woodland and the nutritious grasses of the Mukuvisi provided shade and fodder for cattle in the hot and wet summer months when the nagana cattle disease was rife in the lowland savanna areas. As the range of the nagana health risk receded during the dry winter months, people would burn areas of taller grassland to open the pastures as the trees lost their leaves, and the warmth of the winter sun kept their cattle warm in the cool winter months. During these times, it was also possible to take the cattle to graze on the lower-lying savanna grasslands, when the tsetse fly carriers of the nagana health risk were restricted to the moist river valley areas. They needed moist leaf litter for breeding when the summer heat and moisture returned after the dry winter months.

The Ziwa and other survival units in dispersed village communities thrived on the upland pastures for many centuries until the rise of the Rozvi, around the time of the first Chimurenga of 1675–1695 against Portuguese colonial expansion (Chigwedere, 2015). Three annual rituals characterize the cattle cultures of southern Africa: in September (supplication for rain), February (first fruit crop harvest) and July (gratitude for providing adequate rain without pestilence).

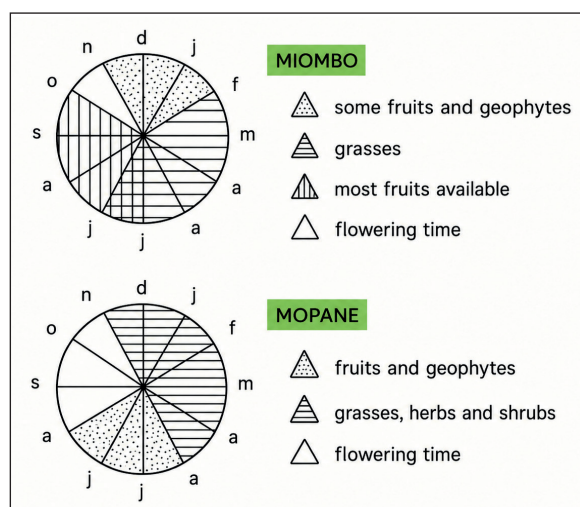


Figure 2. Seasonal Phenology Patterns in Miombo (Highveld) and Mopane (Lowveld) Ecosystems.

Source: Adapted from Morais (1987), based on historical records and ecological field observations.

Morais (1987) drafted the phenology graphs (Figure 2) from historical records, ecological texts and his fieldwork in the region. Drawing on Malaisse (1978), Morais notes that the Miombo is a 'fire climax' forest habitat that transitions from dense, dry forest into mosaic landscapes of open woodland and savannah grassland with at least 50 edible plants used by indigenous peoples. This figure illustrates seasonal patterns of phenological change in Miombo and Mopane ecosystems, including flowering periods, grass growth, and fruit and geophyte availability. The seasonal phenology of the diverse cattle people and their associated agroecological systems had developed as the savannah woodland was transformed into a mosaic landscape, where much of the Tsetse fly-supporting moist river valley thicket was displaced by more open, cattle-supporting grassland that reached down into the Lowveld for winter pasture. Read from the Lowveld vantage point, anthropogenic fires and shifting agriculture had, over millennia, served to minimize health risks and to transition the Miombo forest thicket into savanna grasslands that supported expanding herds of ungulates across the diverse savanna grasslands and thickets of southern Africa. These herds of wild animals fascinated the colonial mind for their amazing diversity, which became the terrain for the empirical development of the ecological sciences that contributed to the revelation of the wonders of natural systems and processes against the destructive march of modernity.

Our purpose in drawing together evidence on climate adaptation and health risks is to open up a decolonizing space for climate change education to be enacted as a transdisciplinary process of emancipatory reorientation. Here, emancipation is deep learning that transcends a colonial heritage of othering that painted African people as a prime cause of the intermeshed socio-ecological, economic and political problems that confront wildlife

Agroecology: Limpopo and coastal littoral region (inc. Thonga)												
Seasonal food /activity	J	F	M	A	M	J	J	A	S	O	N	D
Wild fruits	c	c								c	c	c
Hunting					x	x						
Pumpkin / calabash		w	c	c	c	p	p					
Maize	w	h	h	h	h	s					p	p
Sorghum		w			h	h	h	s			p	p
Cassava				h	h	s		hcp		h	sp	p
Sweet potato					cl	s				cl	s	
Beans and peas	p											p
Prepare new fields						burn	burn	cl	cl	p	p	p
Key: c-collect x-hunt cl-clear p-plant w-weed h-harvest s-store												

Figure 3. A Phenology Mapping of Two Habitats on the Manica Plateau.

Source: Adapted from Morais (1987).

conservation in the region today. We hope to open up a cross-cutting concern for cultural phenology as a window for learning about cultural practices, climate and sustainability, informed by the historical record of early cultural practices and by work in biocultural sustainability studies.

The study explores how regional cultural historiographies of food production in southern Africa, a region characterized by high seasonal climatic variability, were closely tied to and dependent on phenology over hundreds of years of high climate variability. This agroecological seasonal stability is reflected in Figure 3. In line with this, Delius et al. (2016) lift the veil on the mysteries and exclusions surrounding the stone settlements of the Bokoni. They provide the beginnings of insights into the sustainable agroecological livelihoods of the Bokoni, which were dispersed and disrupted during a period of regional upheaval that led to the colonial era in southern Africa.

The graphic that Morais (1987) developed from the earlier anthropological work of Earthy (1933) vividly illustrates how early survival units had cultural practices that were closely aligned with the phenology within seasonal cycles, as well as being subject to the rigors of high climate variation in the region (Figure 3). Figure 3 has been structured so that it can be read alongside a sense of how human survival units in the region had developed from early gathering and hunting practices, as a very early and slow process of landscape transformation (land taming). In the 1930s, when the people of Limpopo informed the cultural phenology data, the region was in the process of developing socio-economic and cultural upheaval within a period of increasing structural inequality and social reorganization.

Reading African Agroecological Settings to Inform ESD

Few texts enable us to probe the complex contours of change that developed within the advances of colonial modernity in southern Africa. One of the research challenges we face here is accentuated by Norbert Elias (1991), who notes that people in present-day realities cannot access and grasp the sociocultural and political realities within earlier social figurations. Pointing to some of the challenges of language and representation as a means of grasping historical realities in developing figurations, Bakhtin et al. (1981) note how

Language is not a neutral medium that passes freely and easily into the private property of the speaker's intentions; it is populated—overpopulated—with the intentions of others. Expropriating it, forcing it to submit to one's own intentions and accents, is a difficult and complicated process. (pp. 293–294)

Despite these challenging realities of meaning-making, the heritage we hold and the languages we use can enable us to activate our dialogic imaginations as solid foundations for learning-led innovation, in ways that must remain open to correction. In our dialogic meaning-making, we can thus learn together to grasp and critically generate reality-congruent ideas within transformative learning transactions. In this way, shared life experiences, heritage and biographies are the intertwined fodder for deliberative action learning towards reimagining more socially just and sustainable futures together.

Van Onselen (1997), in his biography of South African Sharecropper Kas Maine (1894–1985), provides us with insights into the unfolding complexities of exclusion within the march of colonial modernity. He uncovers how Kas Maine found himself immersed in the intermeshed and blind processes of marginalizing exclusion within a social system of racial exclusion and rapid change on the central plateau in South Africa. Van Onselen recounts the biography of Kas Maine:

It is the story of one family, its patriarch, a family complicated as families are, and its battle against disintegration under the twin pressures of South Africa's racial politics and a rapidly modernising world. (van Onselen, 1997, biography dust cover)

This work captures the complex sociocultural, economic and political terrain of marginalizing change for sharecropper farmers in the industrial capital of the modern state. Here, within the emerging political economies of the time, they found themselves landless and outside the mainstream economy, on relatively poor land in areas designated for the other and apart from the mainstream. The alignment of livelihood and health activities became disembedded from earlier social phenology, and the next generations were oriented within education systems that inducted them into foreign cultural mores and competencies to correct deficits and emerging problems through awareness creation, imperative to reimagine a more sustainable future. In this article, we recognize the current heritage of landless marginalization but focus on how climate change education practices might be reorientated to recover an excluded heritage, so that it can serve as

a foundation for deliberative action, learning towards more just and sustainable futures. To support learning towards a change like this in the co-engaged company of others, climate change education needs to develop as more inclusive expansions of current teaching and learning practices with the re-inscription of indigenous heritage as a foundation for transformative learning.

Southern Africa as an Area of Social–Ecological Adaptation to High Climate Variability

Many of the traces of early landscape practices and the associated knowledge in southern Africa were obliterated by the empirical knowledge conventions of early colonial sciences. These disavowed any value in indigenous practices after this knowledge had been written into the empirical canon of the modern institutional sciences. Within this, indigenous people experiencing land degradation were painted as ignorant and in need of education, an instrumental process of inductive awareness creation to bring about behaviour changes. Within this, there was little, if any, room for the inclusion of intergenerational knowledge practices, as these were seen as at the root of unsustainable landcare practices that were degrading land productivity and contributing to biodiversity loss.

Today, there is ample evidence to deconstruct this colonial view of environmental health and the landcare practices of indigenous people, reinstating and developing earlier knowledge practices that were consigned to the margins of modernity, with the conservation and ecological sciences informing future sustainability.

Reframing the Conservation Canon of the Colonial Empirical Sciences

In recent decades, indigenous scholars have been ‘uncovering and recovering’.

These words were used by my colleague, Soul Shava, and by many of the environment and sustainability education researchers at the Environmental Learning Research Centre, Rhodes University. Their work has uncovered insights to inform climate change education indigenous knowledge practices. At the landscape level of cultural phenology, it is notable that seasonal patterns of migratory grazing were aligned with the annual ebb and flow of the Nagana cattle disease. The diary of Magema Fuze (Edgecombe, 1982), for example, gives an account of the Zulu use of smoke to protect cattle that Magema related to Bishop Colenso when they encountered buffalo (‘others’) on their trek to visit the Zulu king. He wrote of the practice of lighting a fire and the use of dung to ‘make it smoke upon the oxen’:

Why this now, people do it that way, when cattle arrive at the place of others, they may not come to take their sickness. (p. 169)

The Zuurveld climate migrations in the Eastern Cape, like these practices, were not always strictly aligned with the seasonal phenology, but were also influenced by climate

variability, which the scientists now ascribe to the ENSO. Closely tied to these dry-season migrations of the Xhosa was the seasonal climate practice of *ukuGalesha*, in which the lands were cleaned and prepared to absorb the light winter rains, building soil moisture in anticipation of the coming summer rainy season. Within these macro-cultural processes of phenology alignment, a myriad of seasonal practices were inscribed in ceremonies and patterns of food production and harvesting that ensured the survival and thriving of the diverse indigenous cultures of the region.

These examples illustrate how indigenous knowledge practices were closely attuned to seasonal variability and environmental change, offering important insights for contemporary climate change education.

IMPLICATIONS FOR CLIMATE CHANGE EDUCATION PRACTICES

These insights have important implications for how climate change education can be designed and enacted in practice. Rather than approaching ESD primarily as a problem-solving activity, this study suggests that educators can draw on cultural phenology and biocultural heritage to support more contextually grounded and participatory learning processes.

One practical approach is to engage learners in observing and documenting seasonal changes in their local environments. These observations can be linked to indigenous knowledge practices and scientific understandings of climate variability, enabling learners to connect lived experience with disciplinary knowledge. Such activities can support systems thinking by highlighting the relationships between ecological processes, cultural practices and historical change. Cultural phenology can also be used to design learning activities that connect curriculum content to local contexts.

For example, educators can work with communities to map seasonal cycles, explore agroecological practices or examine how communities have historically responded to climate variability and environmental risks. This also promotes intergenerational learning, as such an activity will include interactions among learners and their elders within the community. These approaches support more inclusive forms of knowledge engagement and help to foreground intergenerational learning.

In classroom and community settings, integrating biocultural heritage into teaching can support reflexive learning by encouraging learners to critically engage with multiple knowledge systems and their relevance for sustainability. This can enable learners to move beyond an abstract understanding of climate change towards more meaningful and action-oriented learning.

By connecting indigenous heritage with disciplinary knowledge, climate change education becomes more place-based, inclusive and responsive to learners' lived realities. In this way, ESD can be strengthened as a transformative learning process that supports both understanding and action in the context of climate change (Chikamori et al., 2019).

The Regeneration of Biocultural and Climate Heritage on Plural Epistemic Landscapes

Most of these knowledge practices, as the cultural phenology of long-term duration, were lost over time through colonial processes of exclusion. Today, recovered indigenous knowledge practices are being reinscribed in the emerging field of indigenous knowledge systems (IKS). Here, IKS and Western science have often been positional, reflecting similar processes of appropriation and exclusion evident in colonial times.

In modern, more inclusive schooling settings, the recent emergence of critical realism, as developed by Roy Bhaskar, offers a way to integrate institutional knowledge and indigenous knowledge practices (Schudel, 2017). Figure 4 is an open model of the process for bringing heritage practices and curriculum sciences together in dialogic learning actions. It illustrates how heritage knowledge and disciplinary knowledge can be brought together through dialogic learning processes to support integrated and contextually relevant ESD. The RRREI(c) schema supports learners in working across these knowledge systems to re-describe knowledge in relation to the contexts in which they find themselves.

For example, the indigenous practice of wrapping plant roots in humus can be understood alongside biological science explanations of soil moisture retention and plant health in areas of high climate variability. The logical common sense of this shared understanding of causal relationships enables learners to reduce ambiguity and develop open explanations that can inform practices such as habitat restoration.

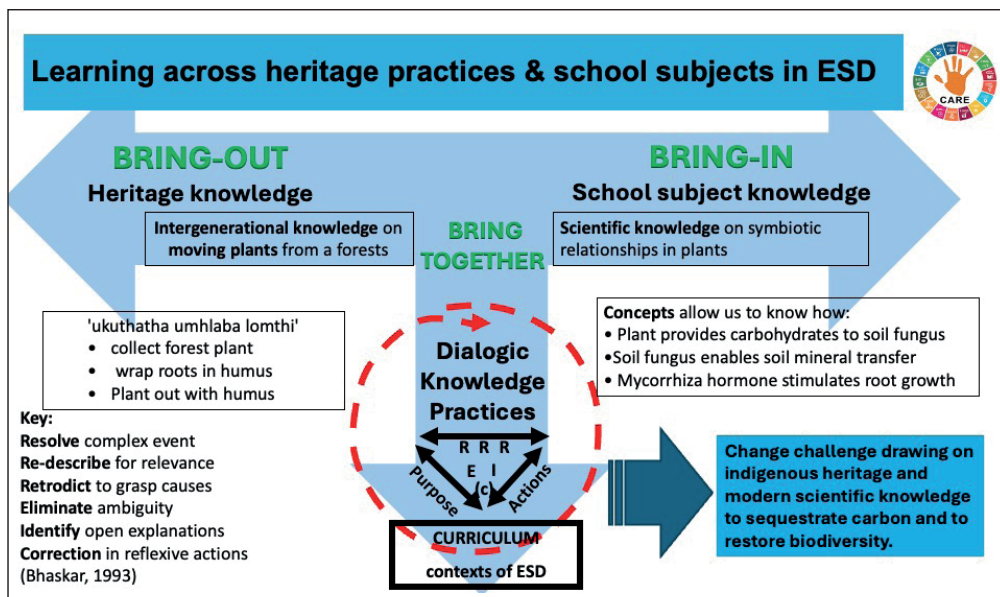


Figure 4. Learning Across Heritage Practices and Disciplinary Knowledge in ESD.

In his *Dialectic: The Pulse of Freedom*, Bhaskar (2008) addresses not only the realist mediation of knowledge but also an associated process of deliberative transformation as an emancipatory meaning-making. In this way, after Fanon (1986), critical realism can open up emancipatory spaces of 'discursive temporality' as border spaces of knowledge negotiation in meaning-making processes for social justice and future sustainability. These processes move beyond earlier colonial epistemic spaces of exclusion. In Figure 4, the learning related to climate change and environmental health is illustrated through practical activities such as tree planting for carbon sequestration and habitat restoration. These learning actions can help learners refine and apply knowledge across both heritage and disciplinary domains in school curriculum settings.

A REVISED LIVING LANDSCAPE PERSPECTIVE ON BIOCULTURAL SYSTEMS OF LANDCARE

Contrary to the primitivist inscription of indigenous people, there is mounting evidence that our landscapes were social-ecological co-creations that developed over many hundreds of years. Within these patterns of change, the savanna wildlife in nature reserves proliferated as a result of human 'land taming' activities. This insight overturns the colonial narrative of indigenous people as disruptors of nature and wildlife conservation. Many indigenous communities are now crowded on the fences of nature reserves. The challenges associated with this problem are the outcome of the appropriation and exclusionary patterns of colonial administration into the modern era. These inscriptions are not easily resolved without evidence that reinscribes them as co-creators of the African savannas within which wildlife proliferated. Developing patterns of cultural phenology enabled indigenous peoples to survive and thrive in southern Africa, a region of high climate variability. The climate change and health risk challenges we face today can be read as an expansion of earlier climatic and health challenges to inform ESD today.

Phenology as a Temporal Foundation for ESD

Insights into the cultural phenology of earlier indigenous peoples can provide an important knowledge resource for engaging climate change, supporting efforts to mitigate extreme events, and aligning human practices with the living systems we all share. This remains a key challenge in advancing ESD as a transformative process towards more just and sustainable futures together.

Addressing this challenge requires us to both respect and critically move beyond the current Western imperial legacy of empiricism and ecological idealism in scientific research. This, in turn, enables us to read the living landscape of southern Africa as historically shaped anthropogenic mosaic systems of woodland and savanna grassland habitats within which more just and sustainable ways of living can be fostered. Such an orientation opens up possibilities for responding more effectively to the complex climate and health challenges emerging in late modernity by recognizing the interconnections between cultural practices, ecological systems and human well-being. In this way,

cultural phenology can serve not only as a record of the past but also as a living generative resource for re-orienting climate change education towards more responsive, inclusive and sustainable futures.

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