Think Piece on Amanzi for Food: Working with Critical Realism to Inform a Situated Learning Framework for Climate Change Education

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Abstract

This study is developed as a think piece which deliberates the problem of transformative human agency in a curriculum setting. Using a critical realism perspective and schematic tools it examines the deliberative framing of an Amanzi for Food teaching garden as an education process for mediating the learning of rainwater harvesting. Working with Bhaskar's Transformational Model of Social Activity and using expansions of his 'four-planar social being' schema and its resolution in his 'social cube' model, the study contemplates the framing for a curriculum for the mediation of co-engaged social learning in the contexts of practical work in an agricultural college curriculum setting. In this way the research process is developed as an under-labouring review of the emerging curriculum in search of theory to inform pedagogy for mediating situated processes of transformative social learning.

Keywords: Amanzi for Food programme, rainwater harvesting practices, critical realism, co-engaged transformative social learning.

Orientation

The Eastern Cape province of South Africa as a historical site of high climate variability is said to be getting hotter and drier, with more extreme weather events that are being ascribed to the advent of anthropogenic climate change. The collaborative work on the Amanzi for Food programme revealed some existing knowledge practices that had enabled indigenous people to manage cattle and grow crops in an area of high climate variability but much of this knowledge was no longer widely known and practised in contemporary agriculture. This insight raised questions on collaborative learning and the curriculum mediation of human agency through learning-led change in times of climate change. To address questions of learning and change at the nexus of prevailing institutional knowledge and intergenerational knowledge practices, the study critically explores the emerging knowledge terrain to inform the development of a teaching garden for water conservation farming in the area.

This paper thus explores change-oriented environmental learning around rainwater harvesting practices emerging in response to climate change in the Eastern Cape of South Africa. To contemplate change as transformative processes at the local socio-ecological landscape level, the study opens by probing the challenging question of human agency and change in the social sciences. The purpose of this is to design a curriculum for emergent agency within

deliberative learning in a teaching garden that is being co-developed through the Amanzi for Food collaboration in the area. The study uses a critical naturalism[1] perspective and flowing from this, critical realist tools to shed light on the situated framing and resourcing of learning in the agricultural college curriculum setting examined: critical naturalism for a situated opening of social ecological processes of knowledge mediation, and critical realism perspective and tools for an under–labouring of anticipated processes of learning-led change to frame a curriculum response to increasing climate variation in the area.

Education and Agentive Change in a Globalising Modern World

The study emerged around the question of transformative human agency and a concern for how learning landscapes in curriculum contexts might be more fully constituted for and by co-engaged learners participating in collective processes of learning-led change.

In social research in the mid-20th century, little overt attention was given to human agency as this was assumed to be implicit within mediating social structures. In clarifying expanding human agency in this period, Norbert Elias (2000) traced patterns of sociogenesis and psychogenesis within 'civilising processes' over the long term. His early work on the history of manners in medieval Europe provided insights that informed a relational social processes perspective (process sociology) for the social sciences that was usefully critical of the analytical philosophy of the time. His 'triad of controls' (Figure 1) depicts a relational interplay of social controls (socio–political), biophysical processes (ecological) and self-restraint (personal disposition) in the emergent environmental conditions of the times.

Figure 1. A graphic representation of the Eliasian triad of controls
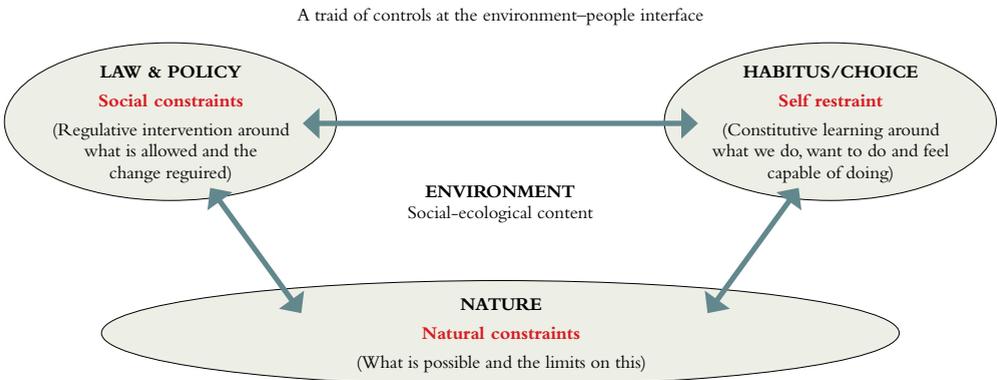
Source: Elias (2000)

Insights into the processual dynamics of social change over time enabled him to note the emergence of a slight but still doubtful human agency capable of influencing trajectories of change.[2]

Donati and Archer (2015) in a time of much greater concern for human agency note that early sociological work did not yet have an adequate ontological framing for differentiating relational agency. Their work further tilts the earlier structure–agency conundrum in the direction of increasing human capacity to influence events, but it is still difficult to specifically dimension how and to what extent human agency can play out in learning-led change.

To clarify and frame human agency for this study on learning-led change in a curriculum setting, insights on increasing human agency were initially framed around an optimism that emerged in early empirical work on modernity and change after Heller and Fehér (1991). Their analysis of social conditions at a macro level into 20th-century Europe identified successive trajectories of change and an apparent increasing agency in civic governance after the Second World War. This allowed them to identify the emergence of widening political agency shaping the possibility for civic change that had not been readily apparent in earlier times. Their study tracked emergent patterns of the civil society stewardship and reflexivity within the social trajectories of the times. Across these they noted an expanding civil society agency for effecting change, noting in the one case of primarily youth learning that:

> The 'alienation generation' made a case for 'grassroot politics', for a kind of politics embedded in communities and ways of life on all levels of social stratification. It remains uncertain at this stage whether cultural relativization and pluralization will lead to the demise of rational policy-making or whether they will rather be the prelude of a more democratic and more rational form, or forms, of political action, a combination of the parliamentary system with a type of direct democracy. (Heller & Fehér, 1991:143)

These insights were posed without a view of the massification of education and the rapid expansion of new social movements that continued into the 21st century. Today one finds diverse processes of civic activism and curriculum frameworks[3] for collaborative environment and sustainability education. Heller and Fehér concluded that, at the time, there were insufficient data to extrapolate the possibility of increasing human agency. They also did not have sight of global corporatising trajectories that currently appear to be superceding human agency of and in the nation state and patterns of closer regional interdependence that developed around the turn of the 21st century. Reviewing patterns of globalisation that followed widening democratisation in the nation state, Donati and Archer note how

> Multinational and finance capital broke free of national bounds and cast off the shackles of geo-local restraint: of the unions, of accountability to parliament, of the law of 'the land' and of normative regulation. (2015:12)

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2   His reading of evidence of agentive change was more modest than that of Heller and Fehér (see below).

3   Here the study notes how modernist education practices have proliferated. These have been constituted as a diversity of implicit and explicit framings (curricular) for collective learning, models of process for human agency constituting social learning and change within diverse formal and informal settings.

Today, within these globalising processes of decoupling corporate power from the nation state, the rise of civic social movements and the framing of global civic agendas for learning-led change reflect a continuing optimism and increasing urgency for agentive change in the Southern African contexts of our environment and sustainability education work in a post-apartheid state. In South Africa, following the relatively peaceful transition from apartheid, one now finds alienating civic processes in service delivery protests and in the recent emergence of decolonising calls amongst student movements as expanding civil society social learning collectives begin to contemplate restorative socio-ecological justice and future sustainability. It is contemplating the possibility of emerging agency and mediating processes of learning in civil society collectives that is of interest in this paper. Here one finds institutional responses like the teaching garden curriculum initiative under review as mediating interventions to foster the learning-led agency needed for effecting water conservation farming in response to immanent climate change in the area.

A sense of the agentive processes in learning-led change and their emergence in and through learning transactions in curriculum settings will be made more explicit with the critical realism perspective and process tools of Roy Bhaskar (2016).

Emerging Education Processes of Deliberative Nexus Learning

Our educational work of the last 25 years at the Environmental Learning Research Centre (ELRC)[4] developed from early nature-based environmental learning and expanded into diverse co-engaged trajectories which now emphasise collaborative social learning in relation to environmental degradation, social justice, the green economy and future sustainability. Current projects being initiated by the ELRC with diverse institutional and civil society partners include Amanzi for Food, a networked learning initiative developed in response to increasing climate variability in the Eastern Cape province of South Africa. The social learning materials and education practices for the programme emerged within a start-up process of course-mediated learning that was co-developed with the staff of a rural agricultural college as well as some non-governmental organisations and civil society groups in its rural surrounds. The course-based start-up of the local learning network was activated with the support of the rainwater harvesting manuals of the Water Research Commission. These were used to support deliberative nexus learning[5] towards increased rainwater harvesting and social learning processes with participants initiating 'change projects' in their institutional settings and in local contexts of food gardening.

In a recent review of course-supported Education for Sustainable Development processes in Amanzi for Food, I was struck by the diversity of perspectives, along with some compelling evidence of expansive learning and change. We noted, for example, how a rainfall-event

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4   The ELRC at Rhodes University was centred on research on environmental education in the 1990s and developed into environment and development education with the advent of global calls for development education that gave way to Education for Sustainable Development and now to Global Citizenship Education.

5   Deliberative nexus learning refers to collaborative learning at the intersect (nexus) of local matters of concern and future sustainability in co-engaged processes of learning-led change.

approach to food security had the potential for a better alignment of cyclical seasonal food production activities within the increasingly variable seasonal cycles and unpredictable rainfall events in the region. What we also found in a preliminary review of education research on expansive social learning and associated change projects (Lupele, 2017; Tshiningayamwe, 2015) was a sense that the case evidence reflected compelling insights into the collaborative framing of learning processes to inform future curriculum design work in the agricultural college. Here it was apparent that we needed a fuller grasp of co-engaged learning mediation, emerging learner agency and the wider socio-ecological, economic and political mechanisms influencing change.

A Co-Engaged Framing of the Contours of a Teaching Garden for Situated Learning

The Amanzi for Food project developed through a course-based training programme where participants learned on the collaborative course whilst working on a change project in their local setting. The college lecturers (Fort Cox) initiated changes in their curriculum practice by beginning to include rainwater harvesting in their teaching and by planning to have the students visit demonstration sites where local farmers were initiating water conservation farming practices in their local context.

In an early curriculum deliberation, we noted that, as teachers mediating student learning, we had an incomplete sense of the learning that the students would need to have developed for a deep understanding of the agricultural practice of rainwater harvesting. This learning of core concepts was necessary so that they might more fully understand and appreciate what would be shown to them by the local farmers. We thus resolved to map out the materials, knowledge and practices that had been accumulating as the course-based start-up of the Amanzi for Food project unfolded. The accumulating knowledge practices would then be included in a teaching garden as practical learning activities in the college curriculum to inform students prior to and alongside field excursions for them to learn about, in and from the water conservation practices being developed by local farmers.

Mapping Emerging Knowledge Practices to Frame a Curriculum for a Teaching Garden

Figure 2 reflects the rainwater harvesting and conservation farming practices which emerged through the Amanzi for Food initiative. It served to scope what might be included in a demonstration and research 'teaching garden' at the college.

Figure 2 reflects the interplay of water capture and delivery with composting and soil–water management for the growing of vegetables. An unusual dimension of this mind map is the inclusion of Nguni heritage practices that were explored with local households and small–scale gardeners. These included:

- *Gelesha*, a traditional winter practice to prepare lands for the forthcoming rainy season;
- *Izala/ututhu*, a daily waste disposal composting process in homesteads;

- *Imifino*, the practice of retaining edible wild plants (weeds) in a homestead garden; and
- 'Taking the forest'[6] when moving plants from a forest to a homestead.

Figure 2. A mind map of the knowledge practices
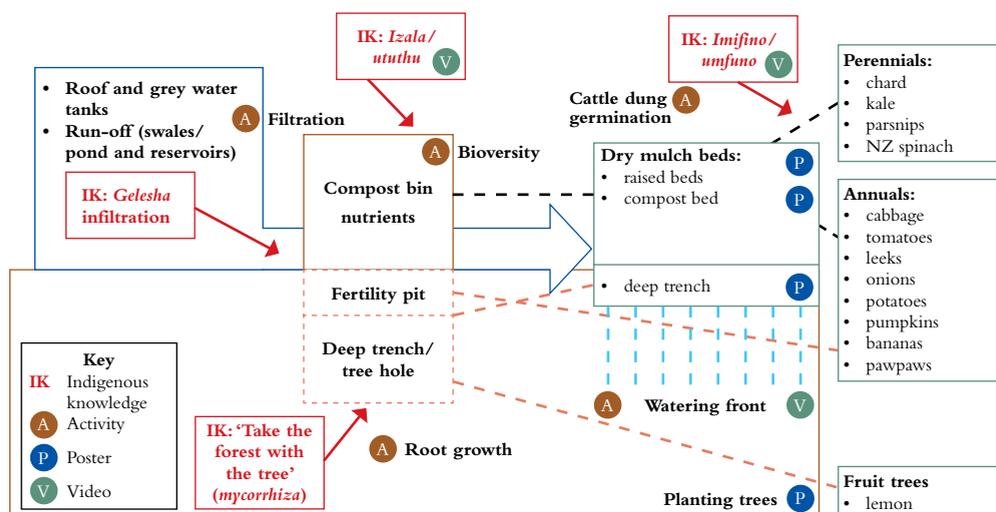
These heritage practices were contemplated against a wide array of agricultural science and associated modern farming processes to be learned so that students would have the concepts to be able to read and deliberate the logic of the agricultural practices at local sites of rainwater harvesting and food gardening.

The mind map was used to model a teaching garden that would include drip irrigation as the currently most efficient way of providing water to plants in semi-arid farming contexts. For the developing curriculum of practical work for the students to experience and be engaged in explanatory work, we clustered the materials into core practices of nutrient (compost) and water provisioning, with all of the associated socio-ecological processes necessary for ensuring local food security.

At this stage we also held an open day where college lecturers engaged students in the planning of the teaching garden along with local farmers who were invited to participate. In one sense this was a dry run to see what engaged the students and to establish how it might be possible to frame a curriculum that was both locally relevant and practically engaging. We also needed theory to model learning processes that might inform our concern for enhancing agency and learning-led change. Here we explored the critical realism of Bhaskar for emancipatory models of process to inform and research the emerging curriculum design for the proposed rainwater harvesting teaching garden at the college.

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6   This practice would ensure that mycorrhizae (soil flora) were retained to support moisture retention, nutrient transfer and root growth.

Conceptualising Expanding Perspectives on Human Agency and Learning-Led Change

Roy Bhaskar's Transformational Model of Social Activity (TMSA) frames a process model[7] for education that he developed through his work on critical realism as an emancipatory critical project. He worked with the notion of a laminated system to expose how enduring relations emerge over time ('space–time flow').

On the 'four-planar social being' as a process model, Bhaskar notes that:

> […] all social activity and all social being, occurs simultaneously on the four dimensions of:
> a)   *material transactions* with nature,
> b)   *social interactions* between people,
> c)   *social structure*, and
> d)   the stratification of the *embodied personality*. (2016:53, emphasis added)

Bhaskar's early TMSA was expanded into a perspective on a 'four-planar social being' that came to be represented in a 'social cube' (Figure 3). This schema presents as open and interacting models of process, 'where agents are always acting in a world of structural constraints and possibilities that they did not produce' (Bhaskar, 2016:55). Here agency is emergent in laminated systems that tend to govern, condition and circumscribe purposeful practices in embodied systems.

The schema in Figure 3, with its four interacting dimensions (a, b, c, d), was useful for distinguishing inscriptions framing the diverse knowledges that participants were bringing into learning transactions among local food gardeners, small-scale rural farmers and college lecturers. Read as diverse processes producing and interacting within social structures and shaping human agency in each context helped us to map some of the knowledge practices steering (governing) and framing (circumscribing and conditioning) purposeful water conservation farming practices with emergent properties and effects.

I initially read Bhaskar's juxtaposing of material, social interaction, structure and embodied personality from the vantage point of the Eliasian insights on sociogenesis and psychogenesis in his work on 'civilising processes' over the long term in Europe. This framing resonates with the earlier struggle to contemplate human agency in civic processes of change, mapping out how

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7   The expansive works of Roy Bhaskar are notoriously difficult to read as he created new language to escape and transcend much of the conventional wisdom in prevailing philosophical works. Norbert Elias was similarly critical of philosophical conventions that he wholly rejected in the development of a process theory for sociological enquiry. Bhaskar similarly used process modelling but used it to under-labour and transcend the relativist limits of prevailing philosophical perspectives. Using a familiarity with some of the conventions of process sociology and Eliasian work with theory as 'sensitising constructs', I approached work with the perspectives of Bhaskar with critical caution. I read his work as an emergent oeuvre of increasing complexity and sophistication intent on providing process tools for 'realising' much of the ideological mix that developed within and through the political economy and ideological critiques from the use of critical theory in education in the latter period of the 20th century.

Figure 3. Social cube model of process
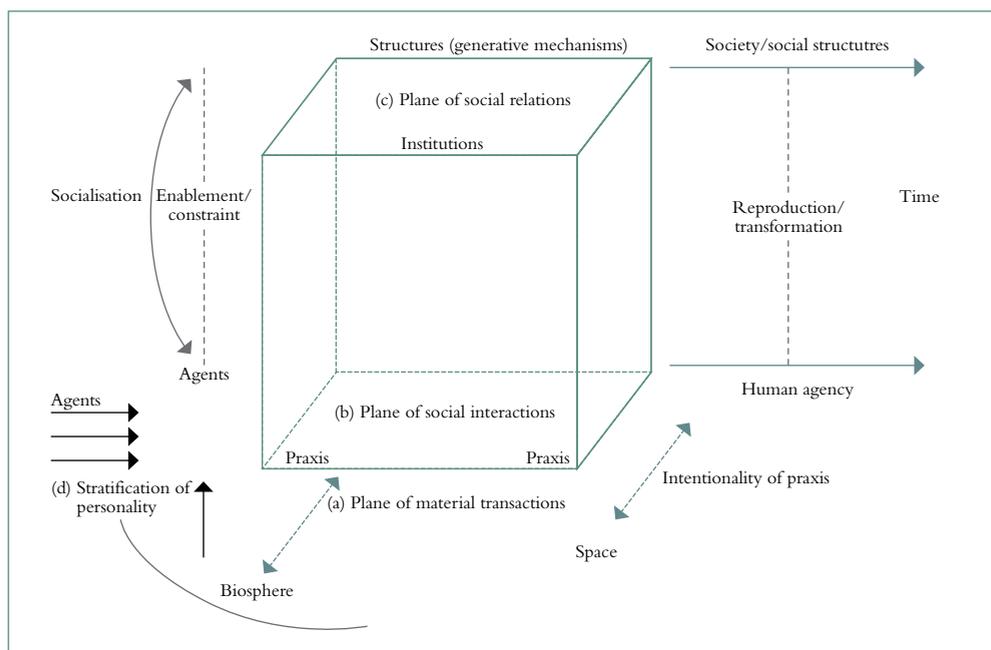
changing social interactions, structures and material transactions shape embodied personality[8] in deliberative learning interactions.[9]

This perspective allowed me to probe how the scientific grasp of water conservation farming had been constituted in the college and embodied in its lectures within the conventions of agriculture as an institutional knowledge practice framed within a scientific disposition somewhat blind to the intergenerational knowledge of outsiders. Similarly, alongside this, it was possible to read the emergence of embodied intergenerational conventional wisdom in indigenous knowledge practices, much of which was lost on the margins of colonial and modernist trajectories of exclusion or modified within wider knowledge conventions steering the expansion of commercial agriculture in rural areas. This allowed me to contemplate how interacting streams of embodied knowledge practices had been interacting and were often mutually edifying in emerging learning exchanges within the developing Amanzi for Food collaboration.

At this juncture it was important to note that central to Bhaskar's work was an emancipatory intent that resonated with our interest in agency and change. His work embodies an emancipatory theory of change that includes an emergent expansion of human agency as mapped out in the opening of this paper and thus an enhanced possibility of collaborative social learning producing the agency to foster changed food security.

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8   Embodied personality can be read as how we come to see ourselves and how this comes to be stratified in social processes of psychogenesis (Elias, 2000).

9   This is not unlike the Eliasian triad of controls. Bhaskar adds a useful emphasis on material transactions that tended to be too implicit in early Eliasian narratives.

In our learning interactions, this had become evident in the positive resonances between farmers and scientists in exploratory exchange at the nexus of scientific knowledge and indigenous knowledge practices. The learning exchanges here commonly gave rise to deeper insights into how and why water conservation farming was relevant as a response to an apparent increase in climate variation and extremes in the region. There were many instances of co-engaged learning that brought insightful 'pulses of freedom' in the Amanzi for Food programme as new insights developed within an accumulation of potentially enhancing knowledge practices for better rainwater harvesting and improved local food gardening.

Notable here was the practice of *gelesha*, the clearing of fields to enhance the penetration of winter rainfall so that there was some useful soil moisture to enable ploughing, especially when the summer rains were late in a drought year and the cattle had lost too much condition to till the lands. Here activity, concepts, space–time dimensioning and relations were all important. It was useful to reflect on how Bhaskar notes in his 'four-planar social being' schema how these processes have pre-eminent/fundamental (cardinal) limits that are:

- *Activity dependent (1[10]) within material transactions* as purposeful acts that produce material value that is
- *Concept dependent (2), informed by the conceptual structures of an agent's beliefs* with a
- *Time–space dependent (3) inscribed in historicised* social activity *(3)* but liable to social transformation with a
- *Social relation dependent (4) where established structures and articulations are* socio-culturally inscribed within structures that develop when agents engage in activities and occupy positions within interdependent ontological process of
- *Relational – social structures that are materially present in persons and are the results of their implicit and explicit actions (5) which carry an*
- *Internally complex (6) and interdependent (7) importance that stems from the relative richness or modularity of structures and skills (competences) in comparison with events and acts […] consequent upon ontological stratification.* (Bhaskar, 2009: 88–89; my bold of signifier with integrative extracts and summaries[11])

We noted how these processes might be used to contemplate and better frame curriculum transactions for mediating social learning interactions and thus learning-led change. Here agency is emergent and relational within learning progressions that can produce competence where situated curriculum processes were mapped out together, as in the Amanzi for Food programme.

It is not a trivial matter that Bhaskar emphasises how:

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10 The bracketed numbers in this progression reference forward to the review later in this text.

11 I worked with the numbering as this was useful for the referential mapping of the processual dimensioning that Bhaskar framed in his schema as models of process or sensitising concepts for contemplating how things are in the real world. This is not a trivial matter as the abstractions come to be inscribed with meaning that can contribute to an explanatory grasp of learning transactions.

It should be noted that (conjunctive) ontological features (5) − (7) are not peculiar to the social field; nor is (3) unless taken as 'historicity' in conjunction with (1) and (2) and (4). (3) immediately situates a quasi-endogenous modality of change. (2009:89)

The insights on situated and emergent modalities for learning-led change here allowed us to note his qualifying proposition that:

The essential insight of the Transformative Model of Social Activity is that the social structure is neither foreign to nor something chosen by agents; rather it is what they reproduce or transform in the course of the more or less routine conduct of their everyday lives, as historically specific and axiologically necessary means and media. (Bhaskar, 2009:89)

Read in this way and in relation to the agricultural college case evidence, it is possible to note how the historically constituted practices and purposeful beliefs of co-engaged social agents might come to be activated and actualised (articulated) within a teaching garden as a site of emergent, collective learning.

Here we needed to research the use of appropriate pedagogical materials (means and media) for mediating an onto-epistemic constituting of learning as collective relational conjunctions (5–7 above). Here also, learning conjunctions and an associated transformative agency can be contemplated as situated, emergent and deliberatively constituted in curriculum processes of learning-led meaning-making as an activity-dependent process that 'the possibility of critical naturalism' narrated in critical realism discourse as:

- **Purposeful material activities** (1) where learning transactions with
- **Concept dependent dialectic processes** mediate a clarified grasp of key ideas (2) that are
- **Historicised contextual structures** (3) within a time-space dependence that is emergent within
- **Co-dependent social relations and identity** (4) constituted within meaning-making interactions.

The work with the perspectives and tools of critical realism is enabling us to frame the proposed teaching garden in learning sequences that resonated within locally situated knowledge practices and where learning was mediated as an open-ended process of deliberative enquiry and research.

Towards an Onto-Axiological Chain Enabling Transformative Agency

In this way Bhaskar (2009:xxv) allowed us to begin to contextually model onto-axiological chains[12] for education as MELD dialectical processes; realist socio-cultural

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12 Onto-axiological chains refer to being in the world (ontology) and being impelled by an aesthetic, moral or ethical sense of it being important to do something for the common good.

learning progressions. The implicit curriculum/pedagogical model of process that began to emerge here has a realist, intersubjective opening (1M – first *moment)* around 'What is?' Here something determined and finished, Bhaskar notes, can open into dialectical deliberation at a 'founding edge' of deliberative learning (2E – negativity) around 'What is not?' These processes can then extend to a relational constituting of wholes where 'absences' can be resolved within a realising 'totality' at an emergent level (3L – totality) around 'How things could/should be?' The open-ended model of process or learning progression can 'dimension' and shape transformative agency (4D – constituting transformative agency as a 'product in process') and enabling praxis where participants enact 'What can be and is possible to be achieved?'

This abstract model of process or schema was useful for reflecting back on learning instances like *gelesha*, where useful insights emerged in the Amanzi for Food programme. For example, it was possible to note how questions around 'what is' (1M) and 'what is not' (2E) commonly collided around the possibility of new or changed practices (3L) that participants were able to take into their farming practices (4D). At one stage, there was considerable debate around mulching, intercropping and weeds. It was noted that just as mulch reduces weeds so does the intercropping of pumpkins, both providing shade for the soil organics that hold moisture whilst inhibiting the growth of weeds. This insight enabled participants to contemplate what was possible and optimal in home gardens and fields, namely mulching, intercropping or both. It was also useful for the curriculum team to reflect on what might be necessary to support these sorts of deliberative learning flows for students working on learning tasks and research in the proposed teaching garden.

In this way, the MELD schema enabled us to map out possible curriculum progressions for learning-led change as a potentially transformative process. Here, what is, what is not, what should/could be through to what can be enacted/achieved, was contemplated as a progression for framing curriculum materials and activities in situated learning as open-ended and co-mediated and learning-led processes of change. Schudel (2017) uses critical realism to frame a similar learning progression using the MELD schema.

Towards a Situated Curriculum Rationale

In overview, here one has transformative meaning-making contoured for collective learning-led change within an open ontological–axiological chain developing around established experiences, dispositions and beliefs (1M: What is). Within these primarily endogenous processes, one can frame and mediate open questions, uncertainties and contradictions to inform dialectical processes of deliberative learning (2E: What is not). These processes can, in turn, serve to constitute collective learning transactions that may serve to resolve absences/gaps within an emergent sense of rainwater harvesting practices as a coherent totality for agriculture in the area (3L: What should/could be). The learning here can then emerge within a transformative agency (4D: What can be) to be enacted in learning-led change as students come to experience and assess local examples of rainwater harvesting on a field trip to local farms and homestead gardens.

In this way one has useful models of process for framing the contours of open-ended learning progressions. Going back to the 'four-planar social being' schema where we started in work with critical naturalism and critical realist tools, insights emerged that can be developed around an engagement with material activities related to rainwater harvesting (1 – activity dependent[13]). These activities can surface contradictions for learning the concepts associated with practical rainwater harvesting technologies and activities (2 – concept dependent) that can then be contemplated within historicised and idealised images of totalities over time that are also informed by case materials and activities that may serve to resolve gaps/absences in earlier deliberations (3 – time–space dependent). The learning progressions here can open the way to new relational co-dependences and a deeper grasp of rainwater harvesting (4 – social relations dependent) that might come to be inscribed in student identity as competent agricultural scientists who have the background knowledge to advise on improved ways of doing things that are purposefully relevant (5–7 – relational, which carries into ways of knowing and doing things that are contextually complex and interdependent)[14] and that can be freedoms producing.

One of the problems in working with the perspectives of critical naturalism and their development into critical realist schematic tools is that the language and modelling can present as overwhelmingly complex and abstract at times. Some perseverance and the use of codes and numbers to model progressions has been useful for me so I have explicitly left these embedded in the texts above. This has allowed the under-labouring of our work with process models for an immanent critical review of the often complex and fast-moving processes in deliberative meaning-making. Work with the schematic tools and concepts of critical realism has also allowed us to 'rewind' to an earlier stage or to 'rerun' a progression to reflect on ways that learners reacted and reflected in the activity, the concepts associated with this, how these played out in time and space, the socio-cultural relations implicit in these processes and how the relational dynamics involved are shaping the agency to know how best to explore working on water conservation farming practices in a given context of climate change.

This critical realist review of mediating knowledge practices for constituting a teaching garden as a co-engaged learning space enabled the framing of an open-ended curriculum model of process for constituting local learning materials and practices to mediate learning-led change.

Synthesis

Following the teaching garden workshop, and to begin to frame a practical curriculum for rainwater harvesting with local food security, a set of questions was used to help participants to navigate the open-ended teaching and learning progressions in situated

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13 The numbers 1–7 that follow reference back to the bracketed numbers in the 'four-planar social being' schema.
14 See Bhaskar (2009), providing a clarifying expansion of MELD where an enchanting spirituality can add a useful dimension towards a well-rounded grasp of rainwater harvesting in the locality.

curriculum activities around rainwater capture, nutrient and water delivery for rainfall-event food production at a village and small farm level. Here participants might ask:

- What purposeful and *practical transactions* are needed for competence in:
  - rainwater capture and storage for
  - water transfer to root-level soil water delivery?
- What *concept-dependent interactions* (experiences) are necessary for a grasp of:
  - nutrient provisioning using composting
  - capillary action?
- What *historical and contextual propositions* articulate to make learning relevant?
  - *Gelesha* (soil water ingress)
  - *Izala* (humus and nutrient provision)
  - *Imifino* (dung-seeded edible plants)
- How will the practical enacting and modelling of concepts in co-dependent agricultural practices shape student identity as agricultural professionals?
  - Practical tasks
  - Research projects

To mediate learning activities that will engage and realise these questions in both learning streams (rainwater harvesting and nutrient provisioning), we are framing practical learning tools and activities for collective learning in the learning garden at the college:

1. What can we already determine together based on what we already know?
2. Are there any questions and uncertainties (absences) that need to be resolved?
3. What could be changed (absented) for the practice to be more complete?
4. What can realistically be done to transform existing food-growing practices?

After deriving these theory-led tools from the initial teaching garden workshop, we are now mapping out open-ended research tasks to be explored by students, both in practical garden work and on fieldwork with local farmers. It is still early days in the curriculum development process but Roy Bhaskar's 'possibility of critical naturalism' and his critical realist tools are providing us with some better-informed ways of constituting situated learning progressions that are potentially transformative. They also enable research processes as sensitising concepts that 'descend from the abstract to the concrete'[15] in the production of knowledge in the onto-epistemic struggles of being and becoming an agricultural extension worker. Perhaps this is why Bhaskar concluded his life work on critical realism in an education faculty.

An interesting outcome of this curriculum work has been the constituting of water capture teaching gardens as a local response to climate change. This is particularly notable as

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15 Theoretic explanations are preceded by descriptions that require concepts which have been derived within cultural propositions that have been mediated in a real world and over time. Here critical realism provides schema as abstract models of process that can derive descriptive narrative data for the possibility of theoretical explanation to help us steer how we might best learn to change when confronted by contradictions (absences) in a changing world.

rainfall events variability is becoming a key driver of agricultural activities and the farmer and household gardener support by extension staff. Seasonal rainfall was never particularly predictable in the Eastern Cape of South Africa and hence the practice of *gelesha* but we now have the capacity to assess rainfall event soil moisture and water capture to model cropping regimes. In this way, innovative scientific work in teaching gardens can support collaborating farmers and gardeners to strengthen cropping regimes and irrigation practices so as to enhance household food security.

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