

Name:
Jane Caroline Burt
692b8933

Degree:
Doctorate in Philosophy (Education)

Department:
Environmental Learning and Research Centre

Title of Research:
'Insecurity of Knowing'¹: Investigations into the rise of trans-disciplinarity as an emancipatory response and practice in the earth sciences.

Supervisors:
Prof. H.B Lotz-Sisitka, Dr L. Price and, Prof T. Palmer.

Estimated date of submission:
2017

¹ Taken from Patti Lather's paper, *Methodology-21: What do we do in the afterward?* (2013, pg 65). "...post-spectacular, dedramatized story, a deflationary aesthetic that points to the insecurity of knowing."

1. Introduction

Inter-disciplinary and trans-disciplinary research and practice are seen as a possible answer to making science more relevant to, what Hirsh Hadorn names, the 'life world' (Hirsh Hadorn et al., 2008). The arguments for a shift away from mono-disciplinary research are varied. They range from questioning the logic of traditional science practice and the exclusion of other knowledge systems (Visvanathan, 2010; Cornell, 2013), the lack of values in academic disciplines (Max-Neef, 2005), to major philosophical mistakes in Western philosophy which has led to a conflation of epistemology and ontology and thus the difficulty with synthesising knowledge from various disciplines (Bhaskar et al., 2010; Danermark et al., 2006; Lawrence et al., 2004). In each case alternative trans-disciplinary frameworks are suggested as a way of addressing these issues.

There are three main concerns that are cited as to why a trans-disciplinary approach is necessary:

- a) Research needs to be applicable to 'life-world' problems in an open system (Hirsh Hadorn et al., 2008; Bhaskar et al., 2010; Luks and Siebenhüner, 2007; Roux et al., 2010; Cornell et al., 2013).
- b) In order to address complex social problems in an open system we need to draw on multiple forms of knowing (Max-Neef, 2005; Hirsh Hadorn et al., 2008; Bhaskar et al., 2010; Canter et al., 2011; Lawrence et al., 2004; Roux et al., 2010).
- c) We need to be able to synthesise what is known (and different forms of knowledge) in a way that directly addresses these problems and leads to transformative action (Max-Neef, 2005; Hirsh Hadorn et al., 2008; Bhasark et al., 2010; Cornell, 2013; Nicolescu, 1999).

These three concerns point to a possible emancipatory and transformative approach to research whether implicitly or explicitly. This shift in the focus of research was first explored by critical theorists (Carr et al., 1983) and is now being taken up by multidisciplinary research teams in their attempt to make their work meaningful, responsive and change-oriented. Different disciplinary knowledge systems and methodologies are judged as useful not only in terms of their contribution to knowledge production but also in terms of how they can bring about societal change. It also shows a shift in an epistemological understanding from the acquisition of empirical knowledge to a process of meaning making that draws on multiple knowledge traditions and claims.

These three concerns also place knowledge and knowing at the core of what it means to do trans-disciplinary research. I propose that trans-disciplinarity has become a key signifier for transformative and possibly emancipatory research and practice.

In this research I intend to investigate a) how, why and in what different forms trans-disciplinarity has arisen in the South African social-ecological research arena. This is what Popkewitz would call 'a history of the present' (Popkewitz, 2008) in which history is used to interrogate the rationality of the present (Ferreira, 2007). In this case the rationality in question are the claims by theorists of different forms of trans-disciplinarity that trans-disciplinarity is a transformative and emancipatory practice. I will investigate this question with a critical literature review of current theoretical positions on trans-disciplinarity (Phase 1) and a critical discourse analysis (Fairclough, 2003; Fairclough, 2001; Fairclough, 1992; Price, 2007; Price and Sathiagnanan, 2005) of the proposals of two South African trans-disciplinary research projects (Phase 2). Finally I will investigate how trans-disciplinarity is being played out in research and practice by drawing on

one case study (Phase 3) again using critical discourse analysis on the documentation of a quarterly reflexive process. Methodologies will be underlaboured by a critical realist ontology (Bhaskar et al., 2010; Price, 2007; Sayer, 2000; Danermark et al., 1997).

2. The rise of the discipline

The discipline as a historically specific form is relatively new. Manneheim in 1937 recognised the possibility that knowledge could be constituted according to ideological positions (Shumway and Messer-Davidow, 2012). Disciplines have also become ‘a form of professionalism making way for the career of the knowledge-producer’ (ibid., 201). Hirsh Hadorn et al. (2008) write about societies the world over becoming what they term ‘knowledge societies’ in which disciplines remain a key focus of knowledge production.

Foucault’s work on disciplines calls attention to the power and control that is held within the discourse of a discipline. The power and control of these disciplinary discourses have, according to Foucault, come to dominate modern life (Foucault in Shumway and Messer-Davidow, 2012). For trans-disciplinary research and practice to become an emancipatory force in the world it may need to traverse these powerful discourses before practice can even begin to address what Hirsh Hadorn et al. (2008, vii) call the mismatch between knowledge and action that has instigated the need for a trans-disciplinary approach.

3. Trans-disciplinarity: Multiple definitions and positions

There are many different definitions of trans and inter-disciplinarity. According to Balsiger (in Lawrence and Després, 2004) there is no complete history of the term and, like other concepts that call for working beyond disciplinary silos, there is no consensus as to what we mean when we speak of trans/inter or multi-disciplinary work.

There have been various attempts to define trans-disciplinarity and related concepts such as inter-disciplinarity. In most cases trans-disciplinarity is seen as something to aspire towards with concepts such as multi-disciplinary and inter-disciplinary being seen as the predecessors of trans-disciplinarity or the first steps towards trans-disciplinarity (Max-Neef, 2005).

Some writers have tried, if not to adopt a standard definition, to trace the shared aims and/or reasons given for adopting a trans-disciplinary approach. Lawrence and Després (2004) highlight key aims of trans-disciplinarity which could be interpreted as being a description of what trans-disciplinary knowledge is and how it is produced: a) The mode of knowledge production as challenging the complexity of science and the fragmentation of knowledge through non-linear, hybrid and reflexive approaches to knowledge production, b) Knowledge is negotiated, c) Knowledge is understood to be context-specific and local as well as specialised, d) Knowledge is intersubjective and thus produced collaboratively, e) It is knowledge for action and therefore links need to be made across not only disciplines but also professions and social contexts.

Other writers such as Price (2013) and Hirsh Hadorn et al., (2008) have begun comparing different definitions or at least making clear statements about what writers and practitioners understand the concepts to mean. Price (2013) in particular compares the conceptual framing of Max-Neef [a framework that is referred to in both the proposals that will be analysed for this PhD] and Bhaskar’s framework of the laminated totality (Price, 2013; Bhaskar, 2010). It is hoped that this PhD study will build on this work, however, the aim will not be to provide an exhaustive list of definitions but rather to develop an

understanding of how different orientations to trans-disciplinarity have emerged and what this means for emancipatory and transformative research and practice in the earth sciences. I will investigate three approaches to trans-disciplinarity which can be found in the social-ecological systems literature. These are: the global change discourse, complexity theory and critical realism.

4. Adopting a critical realist position on inter-disciplinarity

It is important to clarify from the start that I have adopted Bhaskar's (2010) definitions for the purpose of analysis. According to these definitions the term inter-disciplinary describes the synthetic framing and trans-disciplinary means the creative deployment of models, analogies and insights from a variety of different fields and disciplines (Price, 2013, 52-76). This does not mean that in Phase 1 I will be comparing other definitions of inter/trans-disciplinarity to Bhaskar's definitions, rather it means that I will use these concepts when analysing research findings from the RESILIM O study. This is a necessary complication of the study. The research object of this PhD study is the concept of inter-disciplinarity and trans-disciplinarity as a transformative research practice and yet there is no one agreed upon definition for these concepts. Different understandings have arisen out of different thought and practice traditions. The first object of this study will be to engage with an historical investigation into the emergence of these multiple forms of trans-disciplinarity (Phase 1). To do this I need to state upfront which definitions I currently find most useful.

5. Trans-disciplinarity and the earth sciences

Over the last 50 years the human perception of the planet we live on has changed drastically. It was viewed as 'a planet of plenty' now one is more likely to hear about 'a planet under pressure'. The conference title, 'a planet under pressure', was coined by the largest gathering of global change scientists leading up to the United Nations Conference on Sustainable Development, a conference dedicated to how the earth sciences can deal with a human society at risk because of human activity (Planet Under Pressure Conference, 2012).

Policy briefs prepared for this conference highlighted trans-disciplinarity as necessary to understand the links between "human well-being, ecological systems, socioeconomic systems and pathways towards sustainability" (Duraiappah, et al., 2012, pg. 2) where the aim of trans-disciplinarity is to identify knowledge gaps. These statements highlight two things: firstly, that the way in which research has been done is not sufficient in this new context of a 'planet under pressure' and secondly, it is an acknowledgement of the inseparability of the social-ecological. This captures a global frustration at the many messy problems we face in the world today and how research is falling short of addressing these problems (ICSU, 2010).

The International Council of Science (ICSU) Earth Systems Science for Global Sustainability Programme highlights grand challenges and research priorities that are expressed differently to earlier reports. State of the environment reports by international institutions focused on research questions based on different environmental issues (ICSU, 2010). In the global challenge report the challenges "cover a diversity of topics but are united as elements of a systems approach that examines how the coupled social-environmental system is changing (including the dynamic responses of people and the environment) and what actions and interventions may alter the environmental and social outcomes" (ibid., pg. 9). The challenges are arranged around social-ecological processes rather than key ecological issues for example, 'responding' is one of five grand challenges. The research objective linked to this challenge is to "determine what institutional, economic and behavioural changes can enable effective steps toward global sustainability" (ibid., pg 9).

This shows that research scientists in the earth sciences are reviewing the role of research. There is an acknowledgement that multiple knowledges are needed to comprehend and respond to these challenges. Below I highlight some shifts and challenges in the earth sciences landscape that may be addressed by a trans-disciplinary approach to research, which I will probe in more depth in the study in relation to the emergence of trans-disciplinary approaches to research.

5.1 The management of natural resources

..., managing the planet has a nice ring to it. It appeals to our fascination with digital readouts, computers, buttons and dials. But the complexity of the earth and its life systems can never be safely managed. ... What might be managed, however, is us: human desires, economies, politics and communities (Orr, 1994, pg. 8).

Berkes and Folke (2000) attribute the failure of traditional resource management to two things: human greed and short-sightedness; and that resource management science is flawed as a system of thought and practice.

One of the flaws has been managing ecosystems as if they are separate from society. This approach ignores the huge impact human activity (both political and economic) has on the biophysical world and has been one cause of the devastating and massive changes in natural systems (Berkes and Folke 1998; Folke 2006) such as the fires that overran the Yellowstone National park in the United States in 1998 (Cundill and Rodela, 2012, 6). Another example is how water was allocated in South Africa during apartheid. The political regime of the time prioritised the allocation of water to land owners who were large-scale white farmers. This was known as having riparian rights in the National Water Act of 1956 (DWAF, 1956). The focus of water management was on building the infrastructure to ensure that water was available for economic use. This example from South Africa shows how the management of resources are shaped by powerful political and economic regimes that have a huge impact on how resources are managed, shared and used.

The second flaw is that our understanding of ecosystems and thus the knowledge we draw on to manage these ecosystems is often only based on the western scientific knowledge tradition. This, according to Berkes and Folke (1998), has led to a renewed interest in local and indigenous practices, as many that have been successful at balanced ecosystem management, have been undermined, ignored or replaced. Globalisation has also led to the homogenisation of options for societies and individuals because traditional, local economies are infiltrated by commercialisation, privatisation and industrialisation leading to a loss of local structures which are usually based on social relationships generated over decades and even generations (Duraiappah et al., 2012).

Acknowledging and understanding what encourages sustainable living is particularly pertinent given that there has never been an age on this planet where human action has 'become a powerful natural force in its own right' (Zalasiewicz et al., 2010). The challenges resulting from this powerful human force are beyond one discipline's knowledge (and indeed beyond the ability of academically generated knowledge) and skill to understand and this 'demands collective reflection and action' with all sectors of society (Mergill in Munnik and Burt, 2014; du Toit et al., 2013).

5.2 Knowledge production, representation and application

It is widely assumed that environmental problems will be solved by technology of one sort or another. Better technology can certainly help, but the crisis is not first and foremost one of technology. Rather it is a crisis within the minds that develop technology. The disordering of ecological systems and of the great

biogeochemical cycles of the earth reflect a prior disorder in the thought, perception, imagination, intellectual priorities and loyalties inherent in the industrial mind. Ultimately then, the ecological crisis concerns how we think and the institutions that purport to shape and refine the capacity to think (Orr, 2004, pg. 2).

5.2.1 The compartmentalisation of scientific and professional knowledge

One of the failures of environmental management has been a narrow understanding of how valid and valuable knowledge is produced and how this can be applied in practice. Lawrence and Després, (2004) argue that our incapacity to deal with complex environmental problems is due partly to the ‘compartmentalisation of scientific and professional knowledge, to the sectoral division of responsibilities in contemporary society, and to the increasingly diverse nature of the societal contexts in which people live.’ (ibid. pg. 388). They call this the “applicability gap” (ibid. pg. 388) which is not only linked to a lack of economic and political commitment but ‘the narrow vision of so called experts who do not address fundamental issues but only topics isolated from their societal context’ (ibid. pg. 388). To address this they point to four obstacles that need to be overcome: a) ontological frameworks that do not embrace the complexity of the natural and human made environment; b) epistemological positions that value rational and utilitarian approaches to the management of human and natural ecosystems; c) the specialisation and bureaucratisation of knowledge and expertise; and d) the lack of communication between professionals, politicians, interest groups and the public (ibid. pg. 399).

5.2.2 The production and application of knowledge cannot be separated from context

Human rights researcher Shiv Visvanathan critiques traditional science by challenging the idea that the production of knowledge can be separated from culture and context (Visvanathan, 2010). His critique goes to the heart of the politics of knowledge production. He questions whether science led to the development of India or to its demise and poses the question that the grass-roots science movement had to face, “... whether the ... crises (one being the Bhopal gas tragedy) was because of bad science, bad politics and bad technology or was the problem also inherent in the logic of science and technology?” (ibid., pg 2). He argues for a more democratic framework for science that challenges the view of the citizen “as a consumer and not an inventor of knowledge” (ibid., pg 3). He summarises the critique of science as voiced by grass-roots movements as the following: a) a human rights issue because development projects ‘marginalised or cannibalised’ the cultures of local people; b) a need for a science that sees nature as more than ‘an object, an experiment or a resource’ but as a way of life and where nature is more than a ‘mode of production but a mode of thought’.

Protesters linked to these development movements in India realised it was not just a protest against development projects, such as the building of a dam, but a protest against the narratives and epistemologies of science. “How do non-violent movements search for a non-violent science?” is the question that Visvanathan asks us to consider (Visvanathan, 2010, pg. 4).

5.2.3 Trans-disciplinary researchers rethink science, knowledge and application

Cornell et al. (2013) redefines science as any form of knowledge about the world that we live in and the systematic process of inquiry that pursues further understanding of the planet. In this definition science is more “than a set of rules and practices organized for understanding the world, but is part of a chain of reasoning, interaction and action within knowledge systems” (pg 61). Luks et al. (2007) define trans-disciplinarity as a process whereby non-scientific actors are included in knowledge generation and implementation. Scientists are not the advisors to policy makers who then make the decisions, rather there is

a mingling of the creation of knowledge and decision making (ibid. pg. 419). This is nothing new to practitioners of action research where the generation of research knowledge is inseparable from action and the participation of those who act (Kemmis et al., 2004), and it is not surprising that action research features strongly in trans-disciplinary approaches to research (Hirsh Hadorn et al. 2008).

Under this definition, scientific knowledge also refers to knowledge production that emerges out of everyday practice and is not bounded by a discipline or educational institution (Cornell et al., 2013). This raises questions of how knowledge is validated and produced. Cundill et al. (2005) faced this challenge when involved with the global millennium ecosystems assessment. One of the main challenges they faced in what they called the democratisation of knowledge (by adopting participatory approaches to gathering evidence) was how to validate the data produced from both scientific studies and interactions with local communities (that produced knowledge based on people's long term engagement with a local context and landscape sometimes referred to as indigenous knowledge) and, the 'transaction costs' of working outside a purely scientific system. What the researchers faced was the question of validity. Often in these cases local or indigenous knowledge is validated by comparing it to scientific knowledge. If the two knowledges concur this gives validity to the claims made by local people. But it is also politically astute to get scientific knowledge validated by a broad range of stakeholders as then scientists can make the claim that their knowledge has been accepted by multi-stakeholder groups in the area thus increasing its status and validity. There is a danger of this form of research becoming a disguised version of extractive research in a participatory wrapping with scientists 'gathering' validity, to ensure that studies are accepted as democratically generated, just as one would gather evidence. These tensions will need to be carefully explored in trans-disciplinary work.

Visvanathan does not see what he calls 'the externalist idea' of community involvement and participation as enough. He sees the challenge as one of 'cognitive representation' (Visvanathan, 2010, pg 8). What is needed is an engagement with people with the understanding that knowledge and the discourse of knowledge is inseparable from people's activities and the landscape within which these activities take place. Knowledge that exists in context cannot be translated into another discourse. Acknowledging this and working at this level is what Visvanathan calls cognitive justice, 'a constitutional right for different systems of knowledge to exist as part of dialogue and debate' (ibid., pg. 8). This is not a blend of expert knowledge and ethnoscience but a recognition of plural knowledge systems where knowledge exists in relation to livelihoods (ibid.).

The idea of cognitive justice suggests that there is a link between survival and forms of knowledge. It not only includes the rights of dissenting scientists within a dominant paradigm, but also the rights of alternative epistemologies and alternative sciences (Visvanathan, 2010, pg 8).

Cornell et al. (2013) add to this debate by separating out knowledge from knowledge systems. Scientific or research knowledge then becomes just one form of knowledge that informs and produces knowledge in a much broader knowledge system. Knowledge systems are described as 'a network of actors connected by social relations that dynamically combine knowing, doing and learning to bring about specific actions for sustainable development' and that it is these relationships that shape the flow of knowledge (ibid. pg. 61). For Cornell et al. (2013) the biggest challenge is not so much the different knowledge systems but bridging the gap between knowledge and action. Addressing this gap means engaging in open-ended social learning processes and by viewing learning both temporally and spatially. They also argue that there are many challenges to this kind of trans-disciplinary research both because it challenges traditional knowledges

(traditional knowledge does not refer to indigenous knowledge but to traditional science) and because most trans-disciplinary projects are not learning from the experiences of previous projects (ibid.).

This suggests that the synthesis of knowledge implied in the inter/trans-disciplinary task does not mean conflating all knowledge systems into one discourse. It means, as Visvanathan (2010) argues, the right for different knowledge systems to exist without trying to conflate or reinterpret these systems in the language of science or a dominant logic of the way the world works, for example, the discourse of economic growth, capitalism, or even for that matter, a dominant view of democracy or the environment. This will result in knowledge systems being literally displaced and removed from the history out of which they have emerged and the place or landscape within which agents enact these knowledge systems. This displacement is equally possible if inter/trans-disciplinary research teams, whose aim is to synthesis knowledge from diverse disciplines, do so without paying attention to the history out of which different theoretical frameworks have emerged and are being used in response to a particular understanding of how the world works (one of the aims of this PhD project is to add to this understanding).

5.3 Change-oriented learning: moving from knowledge to action

In the literature on trans-disciplinary research there is a strong emphasis on the importance of learning. Learning is viewed as vital to: a) build trans-disciplinary teams so that synthetic research is possible (Roux et al., 2006); b) transformative action with multi-stakeholder groups (Cornell et al., 2013; Hirsh Hadorn et al., 2008); and c) reflexive practice and evaluation (Roux et al., 2010). Cornell et al. (2013) redefine environmental sustainability as an “an open-ended process of social learning in which a new balance is continually being sought between multiple social, economic and environmental challenges and goals” (pg 62). In this case learning is not only seen as the transformative element in research but as a process for ensuring sustainability.

Many academics identify the narrow, specialised and siloed approach to higher education as a key reason for why we can't deal with the challenges of a changing world (Shumway & Messer-Davidow, 1991; Bhaskar et al., 2010; Cornell et al., 2013; Max-Neef, 2005). Nicolescu (in Corina, 2011), a trans-disciplinary theorist, argues for an even broader role for education and learning. He embraces the idea that education is more than a process of assimilating information but rather a process of being able to synthesise knowledge as well as apply it in new, creative and adaptive ways. He argues that the issues with education the world over have to do with a system of education that is founded on the values of the previous century and the ‘disharmony that exists between the values and the realities of a planetary life in the process of change’ (Nicolescu, 1999, 4). According to Nicolescu learning is not just a mental activity nor is it only about transformative action in the real world, it is about transforming the way in which we understand the world to be and our relationship with it. It is an ontological transformation (ibid.).

For Nicolescu and others (Bhaskar, 2010; Hirsh Hadorn et al., 2008; Wals, 2007; Ison, 2007) this means relooking at how we educate within our schools, universities and the role of learning in civil society. It also means questioning the principles and purposes of education. This had lead to social learning and change-oriented learning where the purpose of learning is the transformation of social practices (Wals, 2007; Ison, 2007; Engelstrom, 2007; Lotz-Sisitka, 2013; Reed et al., 2010). This type of learning requires more than facts, it involves engagement with practice: “how people learn from each other as they participate in practices can transform the way that knowledge is thought about. This is because the focus of these theories

is on not only providing information, but also on ‘collectively transforming practice’” (Burt & Berold, 2012, p. 9).

Understanding how learning leads to transformation is a key research question for trans-disciplinary research. The role of knowledge and knowledge systems, how knowledge is generated and how knowledge enhances the ability to act and transform also become key research concerns. This research will investigate the choices of methodology, approach and tools in relation to learning in trans-disciplinarity in the earth sciences in South Africa and whether these constrain or enable emancipatory action and transformation.

6. Emancipation as a key concept in this study

Early probing of the concept of emancipation shows that it may require further conceptual work as it carries diverse meanings. The most generic understanding of emancipation is associated with being free from legal, social, or political restrictions. It is also often closely associated with notions of liberation. Freire, an educator from the critical school believed that the ultimate pedagogical aim is liberation. He understood this to be the liberation of the self, a ‘quest for human completion’ (Freire, 2000, pg. 47). For Freire, this liberation was a freedom from a false consciousness. False consciousness is the adoption of an oppressed identity. Freire’s concept of ‘false consciousness’ has been critiqued in terms of who decides what false consciousness is. Is it the person living under a false consciousness or someone else? Danermark *et al.* (2002, pg. 192-195) discuss emancipation from a critical realist perspective. They look at the emancipatory ambition of the natural sciences and social sciences. For the natural sciences, emancipation meant freedom from suspicion, illusions and mysticism as far as natural phenomenon are concerned. This can be seen in the work of Hume. In conducting this emancipatory scientific work, scientists tend to use the mechanisms of nature to explain the phenomena we experience.

In the social sciences, emancipatory objectives are directed against structures, because social structures provide the conditions for our actions and can be either enabling or constraining of social justice or the good life for all (see below). Critical realist causal analysis provides a way of conducting emancipatory social science, where the object is to uncover structures that constrain freedom or the good life. Danermark *et al.* (2002, pg. 195) say for example that “We can hardly explain racist actions without considering conceptions about races and their characteristics – and in the explanation there is a critique of these conceptions”. The same would apply, in this case, to trans-disciplinarity. However, Danermark *et al.* (2002) suggest that the critique of mechanisms is ultimately to help people in practice to “strive to replace these structures with others, which will produce the good life instead” (pg. 195). Unwanted social structures and sources of determination should be replaced by wanted structures and sources of determination, offering a reconstructive ‘phase’ to the critical social scientific enterprise. Sayer (cited in Danermark *et al.*, 2002, pg. 195) suggests that such a reconstructive phase calls for normative considerations to establish “What are wanted and unwanted structures? What are good and bad social situations?” As indicated above, trans-disciplinary research and the interest in change-oriented learning in the earth sciences appears to be based on such emancipatory assumptions, but as suggested by Sayer, these assumptions are seldom discussed in the reconstruction of critical social science. This is a core interest of this research project.

7. Research Questions

The focus of the PhD is to investigate the research practice of trans-disciplinarity as a form of research that will be applicable to the complexity of social-ecological life. Thus the main research question can be summarised as follows:

Does trans-disciplinarity enable emancipatory research and change oriented learning, and if so how does this occur in practice?

This question will be explored in three phases:

1) A meta-theoretical review of the rise of trans-disciplinarity in the earth sciences. The sub-question that will guide this phase will be as follows:

How is trans-disciplinarity conceptualised and in terms of ontology, epistemology, transformation and learning?

This will be done as an analytical literature review of the emergence of trans-disciplinarity in the earth sciences. It will focus on three major meta-theories: the global change discourse, complexity theory and critical realism as these have been identified as being particularly influential in the conceptualization of trans-disciplinarity in South African and international earth systems research. The purpose of this phase will be to gain insight into internationally emerging meta-theories on trans-disciplinarity and their applicability to the complexity of social-ecological life, and emancipatory research and learning.

2) A discourse analysis underlaid by critical realism of two project proposals as core texts representing the conceptualisation of trans-disciplinarity in South Africa. The sub-question that will guide this phase will be as follows:

How are researchers currently working with trans-disciplinarity in the earth sciences sector in South Africa and conceptualising the trans-disciplinarity/change oriented learning relationship?

The two projects that will be investigated will be:

- a) The New Paradigm water quality project funded by the Water Research Commission at Rhodes University.
- b) The Resilience in the Limpopo Basin (Olifants) (RESILIM O) project run by the NGO Association of Water and Rural Development (AWARD) and funded by USAID.

This will be done using Fairclough's approach to discourse analysis underlaid by Fairclough's latest insights drawn from critical realism (Fairclough, 2001; Fairclough, 2003; Fairclough, 2001; Price, 2007). The purpose of this phase will be to understand how South African researchers are applying the theories of trans-disciplinarity to project design and to gain insight into how meta-theories of trans-disciplinarity are being used in the South African context in the earth sciences.

3) A discourse analysis on mirror data learning opportunities of the RESILIM O project. The sub-question that will guide this phase will be as follows:

How, and if so in what way, does the practice of trans-disciplinarity reflect an engagement with democratic knowledge production, representation and cognitive justice processes?

This will be done by doing a critical discourse analysis on the quarterly reporting process which has been designed as a mirror back reflexive learning opportunity for AWARD core staff. The purpose of this phase will be to deepen understanding of the core question by gaining insight into the working of trans-disciplinarity in practice. Figure 1 below provides a diagrammatic representation of the three phases of the PhD study.

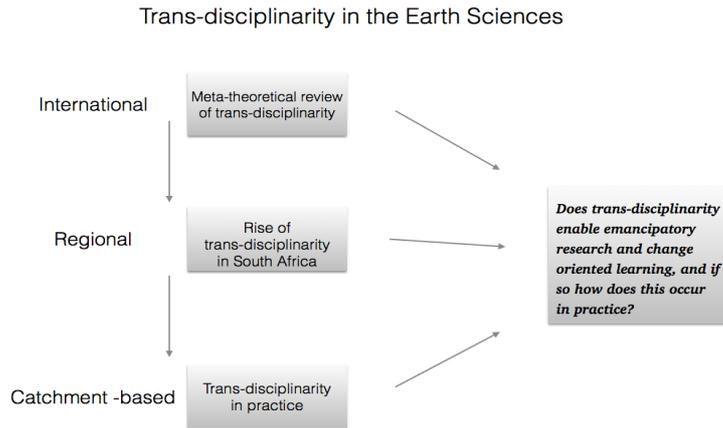


Figure 1: Three phases of the PhD study

8. Philosophical positioning: Critical Realism as an underlabourer

The practice of research is an attempt to explain phenomena (Danermark et al., 2006) and thus be able to influence and know our world. This is not always how research is viewed. The way in which research is viewed is directly influenced by the kind of ontological position that a particular research tradition takes. For example, in the tradition of empirical or analytical research reality is “‘real’, ‘concrete, material, ‘out there’ and independent of human thoughts and feelings’ and generalisations about ‘reality can be made free of context’ (Lotz-Sisitka et al., 2013, pg. 17). In previous incarnations as an academic I adopted a post-structural approach on research as transformative (Burt, 1999) but in the years following my Masters degree I have become frustrated by the relativist position of post-structural research. I wrote in a recent paper that I presented at an international critical realist conference that I struggled to find a place “for the activist in me to stand, for the environmental educator to believe in a better future” (Burt, 2012) and yet I cannot accept a view of a reality that is independent of context. It is for this reason that I have decided to underlabour this research with a critical realist ontology which states that reality is taken to exist independent of human thought, feeling and action but that how we know this reality is based on context and language and ‘interpretations of it can be controlled by human power relations’ (Lotz-Sisitka, 2010, pg. 17).

8.1 Underlabouring with Critical Realism

The task of a critical realism underlabouring then becomes first and foremost a ‘clearing out of the ideological ground.’ It is a reclaiming of reality with the intention of enabling emancipatory action and freedom (Bhaskar, 2010, xv). Critical Realism is a philosophy which critiques and, offers an alternative to current western philosophy. Roy Bhaskar highlights what he sees as a core mistake in western philosophy, a conflation between the way the world is and how we know the world (Bhaskar, 2008). Part of this confusion has led us to treat the world as a closed system. He advocates for the development of science and social science approaches and methodologies that work within an understanding of the world as an open system where reality can’t be reduced to an empirical access to causal laws (Bhaskar et al., 2010). He, like others, proposes a way of working with many disciplines by viewing reality as laminated with different disciplines addressing different ‘domains of reality’ and the mechanisms that need to be in place for a phenomena to be the way it is (Bhaskar et al., 2010).

For example, scientists may judge social science according to their way of knowing the world and so judge it as inadequate because it lacks hard empirical data. In this case they conflate their way of knowing reality as reality itself. Some of the social sciences make the same mistake by going to the other extreme. A great deal of social theory argues that the way we know is socially constructed, meaning that knowledge is constructed through language and cultural experiences and is context specific. Knowledge is not seen as neutral which makes it possible for it to be used as a powerful tool to keep some people powerful and others powerless. In other words, one person's truth becomes more meaningful and influential than another's. It also means that there is no true knowledge out there that we can discover but that knowledge is constructed and created within different social contexts and for different intentions. This is obviously a valid statement. The problem with this relativist position comes when the way we know, an epistemological position is conflated with the way reality is, an ontological position. The result is that reality is seen to be nothing more than a human construction. This is the same mistake as the empirical scientist except that for the empiricist the world can only be, and is reduced to, the way of knowing it - empirical data. Both these positions draw on the world of experience as evidence of the known world (Bhaskar, 2010).

By making the distinction between ontology and epistemology we are able to judge good science from bad science. Good science, it could be argued, is the development of theory derived from an understanding of the mechanisms that need to be present in order for a particular social phenomenon to exist and be enacted (Danermark et al., 2006). Science and science research is not judged according to our epistemological differences but rather according to how well a theory stands up to reality.

What makes Bhaskar's approach to inter-disciplinarity so useful is that the argument for interdisciplinarity is ontological (Bhaskar et al., 2010). Most other arguments for inter/trans-disciplinarity are epistemological in that they exclusively focus on how we know the world (Max-Neef, 2005). Inter-disciplinarity in terms of Bhaskar then becomes valuable for identifying the underlying mechanisms of a particular social phenomenon and understanding that these mechanisms are laminated (as in they exist at different levels and scales of society) and emergent (as in one level emerges out of another but is not reducible to it) (Bhaskar, 2010).

It is often assumed that the role of science is simply to produce objectively derived knowledge about the world through observation and contemplation (Danermark et al., 2006) and yet science is as Danermark describes "primarily a social activity" that is aimed at influencing the world of which it is a part. This goes for all scientists. Danermark goes on to argue that the connection between the real world and our knowledge is a question of 'practical relevance'. Knowledge is one instrument that helps us deal with reality in a practical way. Therefore the validity of knowledge is a question of how it functions in practice. This does not mean that knowledge is only valid if it is useful. Depending on who you are, where you live and what your activity is in the world, you will find different knowledge more or less useful to you. The usefulness of knowledge is always dependent on how well concepts capture the generative mechanisms in the objects we study (Danermark et al., 2006).

8.2 Searching for a 'depth reality'.

The emancipatory task of a critical realism study is to understand the generative mechanisms of a phenomena rather than only drawing on the world of experience as evidence and so "reduce questions about what there is (ontological questions) to questions about what we can know (epistemic questions)" (Collier,

1994, pg. 36) which Bhaskar refers to as the epistemic fallacy (Bhaskar, 2010). To do this, Bhaskar uses the idea of an ontological stratification that describes three overlapping reality domains: the real, the actual and the empirical: where the domain of the empirical are the sense experiences and constructed concepts, the actual being the events and experiences and the real being the mechanisms, events and experiences of a given phenomena (Hartwig, 2007, pg. 401). The three domains are dependent on each other with mechanisms possessing causal powers that may or may not produce events which again many or may not be

	domain of the real	domain of the actual	domain of the empirical
Mechanisms	*		
Events	*	*	
Experiences	*	*	*

experienced as a sense experience in the domain of the empirical (Plant, 2001, pg. 4) Table 1 (Bhaskar, 1978, pg. 56)

The aim of this research would be to develop a deep understanding of reality that goes beyond the evidence of sense-experience or human construction of trans-disciplinary research and practice. It will “attempt to trace the origins of experience through the level of events to the level of structures and processes - that is, to capture the stratification of the world.” (Plant, 2001, pg. 4). Plant suggests further “Thus, the success of an explanation about the nature of reality is judged not by the number of times an expected event or experience is observed but by the logic of the links established between the levels” (Plant, 2001, pg. 4). This stratified ontology was developed further into the concept of a ‘laminated system’ by Bhaskar et al. (2010, pg 4) as a way of working with the world as an open system. Bhaskar suggests that when working with an open system we need to refer to a ‘multiplicity of causes, mechanisms and theories’ to explain the phenomenon. Important to this study, is his suggestion that further clarification of this ‘multiplicity of causes’ paves the way for introducing a more robust ‘ontological case’ for inter-disciplinarily. He suggests that to explain the multiplicity of causes, it is necessary to give attention to the ontological feature of emergence, and ‘...more specifically, the emergence of levels’. This is needed to ‘understand a form of determination in reality, in which several irreducibly distinct mechanisms at different and potentially emergent levels are combining to produce a novel result’ (Bhaskar et al., 2010 pg. 5). Bhaskar does not define the number of levels that may be involved in a particular explanation or sphere of research. What is clear is that these levels are scalar and that the nature and context of the phenomenon will outline the levels that need to be explored. He uses an example of disability research undertaken by himself and Danermark (2006) which showed that in disability research it was necessary to refer to “...1) physical, 2) biological, and more specifically physiological, medical or clinical, 3) psychological, 4) psycho-social, 5) socio-economic, 6) cultural, and 7) normative kinds of mechanisms in order to achieve satisfactory explanations”. He describes this as a ‘*laminated system*’ that ontologically underpins the analysis of this research field. In this research I will make use of the concept of stratified ontology, but also its application to inter-disciplinarity via the ‘laminated system’ that has been developed within critical realism, as this will assist me to identify generative mechanisms influencing the emergence of trans-disciplinary research and practice in the earth sciences. One of the tasks would be to uncover the laminated system that ontologically underpins the research field of transdisciplinary earth system sciences, much as Bhaskar and Danermark did for the field of disability research. This will be necessary for me to generate satisfactory explanations at the ontological level (level 3 of CDA – see below).

8.3 Critical Realism and emancipation

This search for a depth reality is what Bhaskar (2010) argues can potentially lead towards emancipatory change (the concept is briefly discussed above). If we understand the mechanisms rather than simply the event or experience of a given phenomena then we are closer to understanding the way things are and have come to be; we can produce what he calls an ‘immanent critique’ of a phenomenon (in this case the emergence of trans-disciplinary research and practice and associated learning processes). This makes the possibility of acting in a way that will bring about change all the more possible. As an applied researcher this still sits a little uncomfortably. My concern lies with how we constitute the purpose of research. Is the purpose of research to critique the structural and agentive conditions of oppression or can research also be an emancipatory force of change or at least an understanding of how we emancipate via research and learning? It seems that currently critical realism tends to engage with emancipation as a philosophical problem (Hodgson, 1999). In this research I may need to probe not only the philosophical dynamics of emancipation, but also the realization of emancipation as envisaged through the change-oriented learning processes associated with trans-disciplinary research (i.e. the reconstructive dynamics of emancipatory research outlined above). For this reason in phase one of this project there will be an emphasis on understanding how different theoretical positions conceptualise emancipation and what they understand this to mean in practice, while in phase 3 I will be probing the questions in a more practice-oriented programme context.

By adopting this philosophical position I also constitute this research project as an emancipatory endeavour that will hopefully engage with and, to some extent, further Bhaskar’s and others project of emancipation and freedom both for the self (and I include myself here) and society. This project therefore needs to be judged not only on what knowledge is produced but on whether the study contributes to emancipatory research and practice.

9. Methodological Decisions

Danermark et al. (2002) describe meta theories as theories that deal with questions about the nature of reality and how we gain knowledge about it (ontological and epistemological issues) whereas the practice of research is the theoretical and methodological development of the social sciences or science. What Danermark et al. (2006) argue is that the development of research practice is closely connected with meta-theoretical development as well as there being a need to engage in questions about the nature of reality and the practice of research. Phase one of this research investigates the meta-theoretical development of trans-disciplinary theory whereas phases 2 and 3 investigate trans-disciplinary research practice in context.

9.1 A focus on discourse

A common problem for inter/trans-disciplinary teams is developing a good enough understanding of different disciplinary concepts so that meaningful communication and learning is possible across different disciplines. At a recent social science workshop held by the Water Research Commission, South Africa, a scientist commented that social scientists can’t even agree amongst themselves about what they mean for different concepts so how are scientists meant to understand them (Munnik & Burt, 2013). Danermark et al. (2002) eloquently explains why the defining of concepts is vital for social science research. He explains that concepts are part of the social world so refining and defining them are an act of social meaning making. The concept is both the research process and the research object (Danermark, 2002). As Danermark et al. (2002) explain ‘it is necessary to understand the meaning people assign to their actions in order to understand the

actions. The actions in their turn mediate everyday social phenomena as well as deeper underlying structural relations, which are constitutive of the society under study' (ibid. pg. 36). It is for this reason that this PhD project places such a strong emphasis on understanding the historical emergence of trans-disciplinarity and the developing trans-disciplinary discourse that is emerging in the earth sciences, in South Africa. According to Fairclough "language is an irreducible part of social life, dialectically interconnected with other elements of social life, so that social analysis and research always has to take account of language" (Fairclough, 2003, pg. 2).

Working in inter-disciplinary teams has its own challenges, one being communicating across the disciplines, drawing on agreed upon conceptual frameworks and developing integrating/synthetic frameworks that can accommodate a process of meaning making and decision making by teams made up of multiple disciplines. Often this process of looking for a common language is reduced to an agreed upon set of words and terms but concepts emerge out of theoretical histories and carry with them discourses that point explicitly or implicitly to epistemological and ontological positions. Teams may adopt common words and terms but whose meaning counts in relation to these signifiers? (Shumway et al., 2012). In the contested space of meaning making, there is need to understand how meaning making is meaning negotiated between disciplines, and to establish if and how terms and words are co-opted into certain discipline domains (e.g. Fenwick has critiqued an uncritical adoption of complexity discourse from ecological sciences into social sciences). There is also need to understand how this effects, not only the common language of the trans-disciplinary team, but the underlying dominant discourse of knowledge production, transformation and learning.

Discourse is not simply that which translates struggles or systems of domination, but is the thing for which and by which there is a struggle, discourse is the power which is to be seized (Foucault cited in Fairclough, 2013, 51)

One can't consider discourse, the social theory of discourse and the role of discourse in social life without considering Michel Foucault, particularly with regards to "the relationship of discourse and power, the discursive construction of social subjects and knowledge, and the functioning of discourse in social change." (Fairclough, 1992, pg. 38). Foucault was concerned with discursive practices as constitutive of knowledge. In investigating this his focus was not on text but on the 'conditions of possibility of discourse.' (Fairclough, 1992, 38). This is done by identifying the difference between what is said, how it is said and, what allows it to be said and have effectivity which includes understanding how discourse has emerged historically (Ferreira, 2007).

Fairclough draws on Foucault and critical realism in, what he calls, a critical discourse analysis where the focus is not just on text nor is it only on 'the conditions of possibility of discourse' (Fairclough, 1992, pg. 38), it is an analysis of text within the broader context of other texts and the historical and social context within which the text is housed. For Fairclough and Foucault, language is a social practice and the context out of which language arises is vital for understanding the power and meaning of a discourse and how it constitutes social relations and social life where social relations include "not only individual actions and interactions but also the emergent properties of institutional orders and the domain of the lifeworld" (Fairclough et al., 2001, pg. 1).

As noted above, the popular and powerful discourse of trans-disciplinarity is emerging in the earth sciences. It is being fostered as a valid and necessary research response to complex social ecological challenges in the

world today. It becomes important to understand how and why these discourses are emerging and what allows these discourses ‘to be said and have effectivity’ if we are to understand whether they are or will be emancipatory and change-oriented.

9.2 Critical Discourse Analysis

Price (2007) defines the critical in critical discourse analysis (CDA) as “...making visible the interconnectedness of things” (Fairclough in Price, 2007). The “critical’ in CDA is also linked to CDA’s commitment to moving from analysis to “a sociologically informed construction of society” (Wodak in Price, 2007).

Critical discourse analysis consists of three levels of text analysis (Fairclough, 1992) (See diagram below). If this is underlaboured with critical realism, as Fairclough has done in his later work, this also includes couching the 3rd level of analysis as an explanatory critique. In this PhD study, this will be done by explaining the texts as emerging out of a stratified or laminated reality in which the generative mechanisms are located (Bhaskar et al., 2010) (See Figure 2 and Table 2 below).

The three phases of CDA are described in Price (2007, pg. 103) as:

- Box 1 – description – a detailed description of the text (the choice of words and phrases, their juxtapositioning, their sequencing, their layout)
- Box 2 – interpretation – the way that the characteristics of the text structure human and non-human relations through processes of interaction (writing, speaking, designing, reading, listening, viewing)
- Box 3 – explanation – the way that socio-historical and /or social-ecological conditions and /or generative mechanisms (in a stratified or laminated reality) have provided the preconditions for these processes of interaction (See Figure 2)

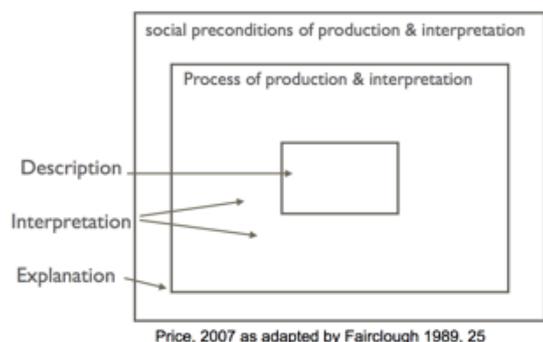


Figure 2: Critical discourse analysis: Description, Interpretation and Explanation framework

A more detailed step-by-step approach to the way I will conduct the analysis is outlined in Table 2 below:

Table 2: The process of CDA will follow the six steps as outlined by Price and Sathiagnanan (2005):

Steps of CDA	Description of step
Collect examples of text	Collect typical examples of text that represent the discipline and discourse that you are investigating.

Choose the texts you will work with	The first step is to choose one or two texts. You may draw on more to deepen the analysis if necessary.
Describe the text	Describing the characteristics of the text for example, absences of relevant information, concealment of the 'agent' (the person, people, or even non-human thing which was responsible for something), nominalisation – representing a process as a noun. It is important just to describe and not analyse at this stage
Interpret the text	This is done in two phases: a) reading with the text where you interpret what the writer wants you to understand. The reason this is done is to generate empathy for the writer so as to understand their motivations and constrains. b) reading against the text. This means reading offering an alternative reading which begins to unearth issues of power and positioning in the text. “we are asking how the text performs in society to reproduce/transform the status quo” (Janks, 1997:329 in Price, 2005).
Explain the text	Here we explain the characteristics of society that explain the way in which language is used in the text. For example, disaggregating the environment into resources for humans can only happen because most of us accept the description of our world in economic terms. This will be done using a lamination of reality.
Verification and expansion of initial findings	Here you look for evidence in other texts and in other theories that may support or contradict your initial explanation of the text. This may include looking at how texts have changed over time and in response to certain events.

To underlabour this approach to discourse analysis with critical realism means further broadening the context of the socio-historical by embedding discourse in the “practical engagement of embodied and socially organised persons with the material world.” (Fairclough et al., 2001, 6). This acknowledges that although semiosis does constitute social life it is not only semiosis that does so, there are also structures and mechanisms at play (as discussed above).

...texts are both socially-structuring and socially-structured, we must examine not only how texts generate meaning and thereby help to generate social structure but also how the production of meaning is itself constrained by emergent, non-semiotic features of social structure. (Fairclough et al., pg. 6)

Fairclough et al. (2001) argues that semiosis is far more than discourse in context. Meaning making can happen without any discursive influence (ibid). Semiosis is also dependent on unconscious or subconscious motivations and habits that cannot be unearthed in the text but are 'made' within the socio-material world and emergent from the history of an individual or social practice. The missing layer to Fairclough's original model for CDA is to extend this into an explanatory critique of possible generative mechanisms by developing transfactual theories based on all domains of reality - the empirical (what is experienced?), the actual (what has happened?) and the real (what mechanisms could be in place that explains what is experienced and what has happened?). I will do this by looking beyond the text to other powerful mechanisms within which the text is embedded by using a stratified lamination of reality which is loosely based on a scalar reality (this provides further refinement to the stratified ontology outlined above) (Bhaskar and Danermark, 2006). Such a typology helps us 'to develop a way of dividing up the world for research purposes that is able to include that which is not easily or directly measurable. Questions of, for example, the economic or the social are dealt with in each level rather than separated out into different categories'

(Price, 2014, pg. 65). Each level of scale emerges from the previous one but is not reducible to it. It is also important to understand the relationships between levels.

Different theorists are building on Bhaskar's interdisciplinary frame of a stratified, laminated reality. Price (2014) describes seven layers that she uses to reflect and deepen an understanding of violence against women. Sarah Cornell investigates the use of lamination to explain social ecological phenomena. She simplifies the levels down to three significant layers: human and social systems; ecological systems and physical systems (COE, 2014). In the case of this PhD, the texts being analysed would help in understanding the meaning people assign to their actions in the social world. These would then be explained (Fairclough's 3rd level of analysis) in terms of how they influence and emerge from ecological and physical systems.

10. How the three phases of research will be conducted

Phase 1: An analytical literature review of the rise of trans-disciplinarity in the earth sciences.

There is an ontological justification for inter/trans-disciplinary research and practice which argues for research to be responsive to real-world problems (Hirsh Hadorn et al., 2008). This section of the thesis will critically review (from a meta-theoretical perspective) selected academic texts that provide evidence of the movement of 'inter/trans-disciplinarity' as a response to the social-ecological in research and practice. Particular attention will be paid to the theoretical approaches that are prominent internationally, and which have influenced the two case studies being, the global change discourse, complexity theory and critical realism. To manage scope here, I will select between 6-10 key texts that represent these three discourses of trans-disciplinarity, and where necessary supplement the analysis with other literature. For example, the ICSU has a Future Earth Science Plan which draws on complexity theory discourse, while the Planet Under Pressure Conference document reflects a global change discourse, and Bhaskar's (2010) book on climate change has key texts that draw on critical realism to discuss and frame trans-disciplinarity.

The focus of this meta-theoretical review will be to identify the ontological and epistemological positions of different approaches to trans-disciplinarity and investigate how these could potentially enable emancipatory research and change-oriented learning. This means that this review will investigate how each approach articulates the concepts of emancipation, transformation. The reason for this kind of investigation is to try to understand what would enable or constrain the emancipatory intent of a particular approach to inter/trans-disciplinary research. Phase one will therefore provide the historical and theoretical landscape that informs the trans-disciplinary studies that will be investigated in Phase 2 and 3.

Phase 2: A Critical Discourse Analysis of how South African researchers are engaging with trans-disciplinary frameworks

Both Phase 2 and Phase 3 will draw on the methodology of critical discourse analysis to investigate the rise of trans-disciplinarity in the earth sciences in South Africa. The results of phase one will be used to contextualise phase two within the broader landscape of trans-disciplinary theory. The main texts that will be chosen to be analysed will be the project proposals of: the New Paradigms project on water quality and, the RESILIM O funding proposal as mentioned above.

Secondary texts will include proposals from research projects that led up to the New Paradigms project being the project proposal for the SANPAD research project on water security and, the GCSSRP proposal on water security and, and selected reports from all three projects.

For the RESILIM O project, secondary texts will include: powerpoint presentations given by senior staff at: a) reference group meetings for 2013 -2015; and b) team leaders meetings for 2013 and 2015; and c) USAID documentation which outlines the funding environment.

This analysis may highlight contradictions and alignments between the meta theoretical positions in the literature and how these are expressed in the research proposals.

Phase 3: A discourse analysis on mirror data learning opportunities of the RESILIM O project.

This will be done by doing a critical discourse analysis on mirror data learning opportunities in the RESILIM O project.

I am contracted to the RESILIM project as part of the monitoring, evaluation and learning (MEL) team. My role is to develop narrations of learning (otherwise known as process narration). The development of process narrations draw on Wenger's method of value creation narrative where narratives of learning are developed based on different levels of value in a social learning process (Wenger et al., 2011). Every quarter RESILIM O staff go through a reflexive mirror back process using the 'most significant change narrative' approach (Davis and Dart, 2005). Staff members deliberate on which narratives best describe the change they are trying to bring about through the project, providing potentially useful data on the emancipatory intent of transdisciplinary research as practiced in the RESILIM O project. It is this deliberation process and the chosen narratives that will form the core texts for the phase three critical discourse analysis.

What is mirror data?

Mirror data is a process that comes out of the cultural historical activity theory (CHAT) literature (Engelstrom, 2000). Mirror data is research evidence that is shared with those who are engaged in the practice under investigation. The research evidence usually points to contradictions in the activity system. These contradictions are unearthed using the CHAT methodology which investigates the activities according to different aspects of the activity such as the object, subject and tools which make the activity possible (Engelstrom, 2007). It also investigates the context within which the activity takes place by investigating the division of labour and community within which the activity emerges. These contradictions are mirrored back to people engaged in the practice as potential learning opportunities and opportunities for change. In this study, the text being analysed will be generated from these mirror data learning opportunities. NOTE: The study is not using CHAT, hence this is not a focus here, rather I will be analyzing texts using CDA that emerge from workplace learning practices that make use of CHAT.

11. Ethics and Validity

In this research, I thus consider validity to be a function, not of measurement, but of the adequacy of 'explanation' or 'corroboration' (Sayer, 1999, pg. 21). Therefore, I assess the success of my attempts to construct adequate knowledge by the degree to which my work 'explains' the textual features (Price, 2007, 97).

Issues of validity and ethics are closely linked in a study of the socio-ecological world. Questions of ethics refer to the way in which the study is conducted but it could equally apply to the kind of study one chooses to do and to what end. Issues of validity refer to whether the process of the research and the conclusions drawn from this process can be valued as true and, I would add, relevant in the world today. Trans-disciplinarity argues that research needs to be valid in the 'life-world' in other words it needs to have meaning for people engaged in addressing complex socio-ecological problems. This not only includes

fellow researchers but also other stakeholders who are linked to the projects that this PhD engages with and civil society at large. The philosophical positioning of this study claims to be an emancipatory position. Explanations, therefore, need to be aimed at forwarding an emancipatory position, as outlined above.

Since validation in critical realism research is a function of explanation, I will need to justify why my theory adds to or is better than other competing theories by comprehensively showing evidence of having considered competing theories. Danermark et al. (2002) suggest that an important part of this process is to evaluate the explanatory power of the mechanisms that are identified in and through descriptions of the object of investigation (i.e. the quality of the level 3 CDA analysis). The validity of my research also rests on how well I am able to explain my position or theory, based on my improved or new theory/ies (Bhaskar, 2013).

Discourse analysis is a revealing methodology. In order to deal with this sensitivity, I will not do a critical discourse analysis on any text without informing all participants that I will be doing so. Senior staff of the two projects being investigated will also be given the opportunity to read through the analysis and comment on my explanations before it is shared more broadly; this will be an important member checking process. I will also share the analysis with the whole team as a reflexive process and as an opportunity for staff to give further comment for further member checking and reflexivity. Both the projects that I have chosen as cases have, as central objective of their research practice, reflexivity and learning. Research managers and leaders are all aware of the research and what it aims to achieve and have formally agreed that I shall conduct it. To further ensure what this will entail, I will not only share the purpose of the research with the projects, but also the methodology of critical discourse analysis and the way in which this methodology works in practice, as well as sharing insight into what this methodology can reveal. This has already been done in the RESILIM O project, in the form of a think tank, by one of my supervisors, Dr Leigh Price, but I will continue to ensure that the methodological processes and premises of the study are well understood throughout the research as I proceed with it. As this is a critical realist study, the aim is not to critique the experiences of people or events, it is to uncover the mechanisms that enable these events and experiences to occur, and to probe the emancipatory intent of the new practices of trans-disciplinary research. For this reason the focus on explanation will not be at the level of what has been said but what mechanisms need to be in place for it to be said (Bhaskar, 2010). This will remove some of the possible personalising of critique. There will also be a focus not only on discourse that reveals power relations and contradictions but also on what is transformative and enabling in the discourse.

In critical realism, data transparency is necessary amongst other things to enable the participants in the research and the reader to agree or disagree with the analysis. Since it is assumed that what interviewees say is not always the best version of the truth, and that they may be mistaken, I will have to carefully justify my own position on a subject, especially if that position differs from that of the interviewees.

There may be some concern that I am involved and contracted by one of the projects I have chosen to investigate: the RESILIM O project. I am part of the monitoring, evaluation and learning team. This process has been designed so that all staff and, in the future, stakeholders are part of monitoring and evaluation and that this process is a reflexive learning opportunity and not an external evaluation process. This research has been integrated into this process, as mentioned above (AWARD, 2014).

Issues of validity do not only mean a careful consideration of theory, conceptual framing, research methodology and method but also how the research process allows for the engagement of people who are not researchers or academics. This is a sub-question of the PhD study itself, 'how does trans-disciplinary research and practice ensure cognitive justice and the democratic representivity of knowledge?. I will need to engage in this question with regards to my own study as well as exploring how other research projects address this question. This means considering the socio-cultural and historical context out of which knowing emerges and not reinterpreting words or text from outside of this context. To do this requires both understanding the context of knowing and being personally reflexive in terms of how I interpret what is known from my own socio-cultural perspective. Member checking, journaling and mirroring back data will be used to mitigate against decontextualised meaning making.

For discourse analysis texts I will also follow more traditional forms of member-checking (as mentioned above) where analysis will be shared with the authors of the proposals, senior staff at AWARD, all core RESILIM O staff, supervisors and critical friends (Costa and Kallick, 1993). This will particularly be the case with the RESILIM O project where my research will be reviewed and monitored by the project reference group, which is an independent group of international researchers that review the entire RESILIM O project.

As mentioned above I will adopt an approach to discourse analysis that sees text as generating and being generated from a broader socio-cultural and historical context. Other text and data will be used to verify the analysis of discourse. As described by Price, (2007) I will triangulate by looking at other related texts to 'confirm that my explanation is able to explain even quite small features of them' (pg. 109).

12. References

- AWARD. (2014). Monitoring, evaluation and learning framework. AWARD: Hoedspruit.
- Berkes, F., and Folke, C. eds. 1998. *Linking Social and Ecological Systems: Management Practices and Social Mechanisms for Building Resilience*. Cambridge University Press.
- Bhaskar, R. (2010). *Reclaiming reality: A critical introduction to contemporary philosophy*. Taylor & Francis.
- Bhaskar, R., Frank, C., Hoyer, K. G., Næss, P., & Parker, J. (2010). *Interdisciplinarity and climate change*. Routledge.
- Bhaskar, R. (2008). *Dialectic: The pulse of freedom*. Routledge.
- Bhaskar, R., & Danermark, B. (2006). Metatheory, interdisciplinarity and disability research: a critical realist perspective. *Scandinavian Journal of Disability Research*, 8(4), 278-297.
- Burt, J.C. & Berold, R. (2012). *Investigating knowledge flow to communities*. Water Research Commission.
- Burt, J.C. (1999). *Dramatic Learning: environmental education and theatre for development*. Masters thesis, Rhodes University.
- Burt, J.C. (2012). Looking for the Heartfelt Intellectual: Exploring a Theoretical Framework of Possibility and Hope. Presented at the International Critical Realism Conference: Grahamstown
- Canter, M., & Brumar, C. I. (2011). Transdisciplinary niches fostering Lifelong Learning. *Procedia-Social and Behavioral Sciences*, 28, 636-639.
- Costa, A. L., & Kallick, B. (1993). Through the lens of a critical friend. *Educational leadership*, 51, 49-49.
- Council of Occupational Education. (2014) A resilience approach to social-ecological systems: Central concepts and concerns. Interim report.

- Collier, A. (1994). *Critical realism: an introduction to Roy Bhaskar's philosophy*. Verso.
- Cornell, S., Berkhout, F., Tuinstra, W., Tàbara, J. D., Jäger, J., Chabay, I., ... & van Kerkhoff, L. (2013). Opening up knowledge systems for better responses to global environmental change. *Environmental Science & Policy*, 28, 60-70.
- Carr, W., & Kemmis, S. (1983). *Becoming critical: Knowing through action research*. Deakin University.
- Corina, M. (2011). Education and Transdisciplinarity. *Euromentor Journal-Studies about education*, (1), 64-70.
- Cornell, S., Berkhout, F., Tuinstra, W., Tàbara, J. D., Jäger, J., Chabay, I., ... & van Kerkhoff, L. (2013). Opening up knowledge systems for better responses to global environmental change. *Environmental Science & Policy*, 28, 60-70.
- Cundill, G., & Rodela, R. (2012). A review of assertions about the processes and outcomes of social learning in natural resource management. *Journal of environmental management*, 113, 7-14.
- Cundill, G. N., Fabricius, C., & Marti, N. (2005). Foghorns to the future: using knowledge and transdisciplinarity to navigate complex systems. *Ecology and Society*, 10(2), 8.
- Danermark, B.; Ekstrom, M.; Jakobsen, L.; Karlsson, J.C. (2002). *Explaining Society: Critical Realism and the social sciences*. Routledge.
- Davis, R. & Dart, J. (2005). *The Most Significant Change Technique: A Guide to it's use*. Care International & Oxfam.
- Department of Water Affairs. (1956) *The National Water Act no 54 of 1956*. Government Gazette: Pretoria.
- Duraiappah, A.K. , Scherkenbach, C., Munoz, P., Bai, X., Fragkias, M., Gutscher, H., & Neskakis, L. (2012). RIO + 20 POLICY BRIEF Human well-being for a planet under pressure. Planet Under Pressure: New Knowledge Towards Solutions (www.planetunderpressure2012.net).
- du Toit, D., Pollard, S., & Burt, J. & von Balkom, M. (2013). *The Shared River Initiative Phase II: Part 1: Collective Action for improved water resource management*. Water Research Comission: Pretoria
- Engeström, Y. (2007). Enriching the theory of expansive learning: Lessons from journeys toward coconfiguration. *Mind, Culture, and Activity*, 14(1-2), 23-39.
- Engestrom, Y. (2000). Activity theory as a framework for analyzing and redesigning work. *Ergonomics*, 43(7), 960-974.
- Fairclough, N. (2003). *Analysing discourse: Textual analysis for social research*. Psychology Press.
- Fairclough, N. (2001). *Language and power*. Pearson Education.
- Fairclough, N. Jessop, B & Sayer, A. (2001). Critical Realism and Semiosis. Paper presented to International Association for Critical Realism Annual Conference, Roskilde, Denmark, 17-19th August 2001
- Fairclough, N. (1992). Discourse and text: Linguistic and intertextual analysis within discourse analysis. *Discourse & Society*, 3(2), 193-217.
- Ferreira, J. 2007. An unorthodox account of failure and success in environmental education. Phd dissertation. Deakin University.
- Hirsh Hadorn, G. H., Hoffmann-Riem, H., Biber-Klemm, S., Grossenbacher-Mansuy, W., Joye, D., Pohl, C., Wiesmann, U., & Zemp, E. (Eds.). (2008). *Handbook of transdisciplinary research*. Springer.
- Folke, C. (2006). Resilience: The emergence of a perspective for social–ecological systems analyses. *Global environmental change*, 16(3), 253-267.
- Freire, P. (2000). *Pedagogy of the oppressed*. Bloomsbury Publishing.
- Hartwig, M. (2007). *Dictionary of critical realism*. Routledge.

- Hodgson, G. M. (1999). Marching to the promised land? Some doubts on the policy affinities of critical realism. *Alethia*, 2(2), 2-10.
- Ison, R., Röling, N., & Watson, D. (2007). Challenges to science and society in the sustainable management and use of water: investigating the role of social learning. *Environmental Science & Policy*, 10(6), 499-511.
- ICSU (2010). Earth System Science for Global Sustainability: The Grand Challenges. International Council for Science: Paris.
- Kemmis, S., McTaggart, R., & Retallick, J. (2004). *The action research planner*. Springer.
- Lather, P. (2013). Methodology-21: What do we do in the afterward? In the *International Journal of Qualitative Studies in Education*, 2013, Vol. 26, No. 6, 634–645
- Lawrence, R. J., & Després, C. (2004). Futures of Transdisciplinarity. *Futures*, 36(4), 397–405.
- Lotz-Sisitka, H.B. (2009). Insights from an environmental education research programme in southern Africa. In Cooper, L. & Walters, S. (Eds). *Learning / Work. Turning work and lifelong learning inside out*. Cape Town: HSRC Press.
- Lotz-Sisitka, H.B. (2013) (in press). Change-oriented learning and sustainability practices. A synthesis. Paper prepared for a book on Change-oriented learning and sustainability practices for the South African Qualifications Authority / RU research partnership programme.
- Lotz-Sisitka, H.B., Fein, J. & Ketlhoilwe, M. (2013). Traditions and new niches: An overview of environmental education and curriculum research. In Dillon, J., Brody, M., & Stevenson, R. (Eds.). *International handbook of research on environmental education*. Routledge.
- Luks, F., & Siebenhüner, B. (2007). Transdisciplinarity for social learning? The contribution of the German socio-ecological research initiative to sustainability governance. *Ecological Economics*, 63(2), 418-426.
- Max-Neef, M. A. (2005). Foundations of transdisciplinarity. *Ecological economics*, 53(1), 5-16.
- Munnik, V. & Burt, J. (2013). *Towards developing a social science research agenda for the South African water sector*. Water Research Commission: Pretoria
- Nicolescu, B. (1999, April). The transdisciplinary evolution of learning. In Symposium on Overcoming the Underdevelopment of Learning at the Annual Meeting of the American Educational Research Association, Montreal, Canada.
- Novy, A. (2012). “Unequal diversity” as a knowledge alliance: An encounter of Paulo Freire's dialogical approach and transdisciplinarity. *Multicultural education & technology journal*, 6(3), 137-148.
- Orr, D. W. (2004). *Earth in mind: On education, environment, and the human prospect*. Island Press.
- Planet under Pressure. (2012). A major international conference focusing on solutions to the global sustainability challenge. Retrieved 25 March 2014 from, <http://www.planetunderpressure2012.net/>.
- Plant, M. (2001, August). Critical realism: A common sense philosophy for environmental education. In Proceedings of the conference of the Association for Teacher Education in Europe, Stockholm, August.
- Price, L. (2014). Critical Realist versus Mainstream Interdisciplinarity. *Journal of critical realism*, 13(1), 52-76.
- Price, L. (2007). A transdisciplinary explanatory critique of environmental education. Doctoral dissertation, Rhodes University.
- Price, L. & Sathiagnanan, J. *Writing Style: Political implications*. iied: Netherlands
- Popkewitz, T. S. (2008). *Cosmopolitism and the Age of School Reform: Science, Education and the Making of the Child*. Routledge.
- Reed, M., Evely, A. C., Cundill, G., Fazey, I. R. A., Glass, J., Laing, A., ... & Stringer, L. (2010). What is social learning?. *Ecology and Society*.

- Roux, D. J., Rogers, K. H., Biggs, H., Ashton, P. J., & Sergeant, A. (2006). Bridging the science-management divide: Moving from unidirectional knowledge transfer to knowledge interfacing and sharing. *Ecology and Society Vol 11(1):4*
- Sayer, A. (2000). *Realism and social science*. Sage.
- Scrambler, G. (2012, 9 November). Basic Critical Realism, 'Interdisciplinarity' and Health. Retrieved from <http://www.grahamscambler.com/basic-critical-realism-interdisciplinarity-and-health/>
- Shumway, D. R., & Messer-Davidow, E. (1991). Disciplinarity: an introduction. *Poetics Today*, 201-225.
- Virkkunen J. & Schaupp, M. (2008). From change to development: Expanding the concept of intervention. Paper Presented at the ISCAR Conference in San Diego, September 2008.
- Visvanathan, S. (2005) "Knowledge, Justice and Democracy" in *Science and Citizens: Globalization and the Challenge of Engagement*, Melissa Leach, Ian Scoones and Brian Wynne (eds), Zed Books.
- Wals, A. E. (Ed.). (2007). *Social learning towards a sustainable world: Principles, perspectives, and praxis*. Wageningen Academic Pub.
- Wenger, E., Trayner, B. & de Laat, M. (2011). *Promoting and assessing value creation in communities and networks: a conceptual framework*. Rud de Moor Centrum. Open Universiteit.
- Zalasiewicz, J., Williams, M., Will Steffen, W., and Paul Crutzen, P., 2010. The New World of the Anthropocene. *Environmental Science & Technology* 201044 (7), 2228-2231

