

Proposed learning outcomes spaces of deep learning for sustainability

Katie Ross* (corresponding author)
Katie.Ross@uts.edu.au
+61 437 608 469
PO Box 123, Broadway NSW 2007
Australia

Prof. Cynthia Mitchell*

*Institute for Sustainable Futures, University of Technology Sydney

Introduction

Currently, our societies have extraordinary momentum towards unfathomable manifestations of unsustainability (Steffen et al. 2015, Rockström et al. 2016, Hanson et al. 2017). The root causes of unsustainability are many and complex. However, an argument has been made that unsustainability can ultimately be understood through the interactions between the societal paradigms, personal worldviews and our resulting ways of being, thinking, and relating (Sterling 1996, 2001, Ross and Mitchell under review). For example, the Cartesian-Newtonian paradigm is often criticised for its links to unsustainability (Capra 1982, Nicolescu 2002). The Cartesian-Newtonian paradigm can be characterised as viewing reality as simple (hierarchical, reductionist, monist) and fixed (mechanic, static, substance-focused) with a propensity for dualistic (mutually exclusive, binary, opposites, exclusionary) thinking. If it is this type of thinking that has caused the extraordinary momentum towards unsustainability, and if learning experiences are developed with these Cartesian-Newtonian principles operating in our subconscious, then deep learning towards sustainability will be less effective at fostering transformation towards sustainability (Sterling, 1996).

In this paper, we propose three learning outcome spaces that seek to improve the effectiveness of deep collectively learning for sustainability. By collective learning, we refer to a learning process in which a “collective engages in behaviour such as asking questions, seeking feedback, experimenting, reflecting, discussing options and errors”, as well as a “dynamic process in which learning process and the behaviour of the collective change as the collective learns” (Garavan and Carbery 2012). We intend for these proposed integrated outcome spaces to provide a heuristic that helps facilitators curate learning experiences which transcend the Cartesian-Newtonian paradigm into a more relational, complex and process-focused *ontoepistemology*. *Ontoepistemology* is the concept of ontology and epistemology as inter-intra-laced, when one holds the view of reality as primarily radically and dynamically entangled (Barad 2007).

This heuristic is designed to pass the ‘paper napkin’ test: it can be drawn from memory on the back of a paper napkin and used to make sense of or reflect on a learning experience in normal conversation (Snowden 2000). But with each engagement of the heuristic, deeper and more profound insights are possible. In other words, this heuristic seeks to provide a set of guiding principles of desired outcomes for facilitators to engage with during design.

Specifically, these outcome spaces attempt to promote attributes for: (A) understanding worldviews and the unquestioned paradigms that influence individual and societal behaviour, (B) working together with a “diversity of others” to learn and know

dialectically, built on a foundation of trust, and (C) skilfully exploring, acting and reflecting upon leverage points for change within wicked problems (Rittel and Webber 1973) or problem spaces (Armson 2011). Table 1 summarises this simple heuristic, including levels at which to recognise complexity, the implications for learner attributes, and the resulting reflection questions for the facilitators.

Table 1. Proposed learning outcomes spaces of deep learning for sustainability

Levels at which to recognise complexity and relationality in the learning experience:	Potential corresponding learning outcome spaces:	Facilitator reflection questions: <i>To what degree and in what ways does this learning experience help learners answer:</i>
Recognising individual complexity, e.g.: Incredibly complex interactions within and between worldviews and paradigms largely determine how individuals interpret and thus act in the world	Reflect deeply on, in order to transcend, our own worldviews and the unquestioned paradigms that influence individual and societal behaviour	<i>Who am I and who are you?¹</i>
Recognising group dynamics complexity: Engaging in collective problem solving requires a diversity of views. Communication and dialogue is a key process for collective learning, but it is a complex process.	Work together with a “diversity of others” to learn and know dialectically, meaning with respect and criticality, built on a foundation of trust	<i>Who are we?¹</i>
Wicked problem complexity: The systems within which we operate are integrated in complex ways. Applying simple or even complicated solutions to complex problems has the potential to exacerbate the issue.	Skilfully explore, act on and reflect upon leverage points for change within wicked problem areas or complex projects	<i>How can we collectively effect change in a complex, dynamic space?</i>

Methodology

Our methodology for this paper was primarily a literature review. We first elaborated Education for Sustainability (EfS) into its constituent parts: systems thinking, critical pedagogy, worldviews, praxis learning (active and participatory), and transdisciplinarity (collaborative co-creation of knowledge) (see Nolet 2016, 22-24, Sterling 1996, 2001, 14, Orr 2011, 254-261). Based on this elaborated definition of EfS, we undertook a

¹ Gawaian Bodkin-Andrews (Presentation by UTS Centre for Advancement of Indigenous Knowledges, 2017).

review of the intellectual lineage (Ison 2017) or genealogy of each of these particular disciplines and theories, as well as a scan of current literature.

For the purposes of this literature review, the constituent parts of EfS are conceived of as intra-acting in a dynamic pedagogical network, where the unique strengths of each one stretches the potential of other others, and the similarities among them strengthens their co-implementation, forming a *polyarchy of learning edges* (a term used by Lange in press, 2017). Conceiving of these constituent parts as a polyarchy allowed us to synthesise three learning outcome areas of desired change within learner praxis as a result of experiences in collective learning for sustainability:

- A. **Who am I and who are you?** (Sensitivity and intelligence in transcending worldview and social paradigms)
- B. **Who are we?** (Skills in group communication, dialogue, and trust)
- C. **How do we collectively effect change?** (Attributes in responding to complex problem spaces).

Note, each of these learning philosophies we draw upon have their own style of communication, which we try to represent in order to maintain their meaning. However, this contributes to variations in discourse styles within the document; a challenge common within transdisciplinary research.

Why is this paper a new contribution?

Existing literature conducts comprehensive reviews of specific sustainability *learning competencies* (e.g. functionally linked knowledge, skills, and attitudes that enable successful task performance and problem solving) (Wiek, Withycombe, and Redman 2011, Hollweg et al. 2011). We agree with Wiek et al. (2011) that *learning outcomes* are more abstract than *learning competencies*. However, we also agree with Lange (forthcoming) and Morin (2001), that deep learning for sustainability requires an ontoepistemological shift towards more relational, complex and process-focused ways of being. Facilitating this ontoepistemological shift might align with more abstract learning outcomes which allow for contextualized and emergent learning (Sterling 2001, 81). Thus, we propose these abstract learning outcomes as a high-level heuristic framework that complements sustainability learning competencies.

Within the brief confines of this paper, we define a more relational ontoepistemology; and then describe each of these learning outcome spaces, including why each is necessary and how a focus on this learning outcome space can move learning experiences from Cartesian-Newtonian paradigms to a more relational ontoepistemology.

What is a relational ontoepistemology and why is it important?

The insights in this paper draw from a host of thinkers from the full spectrum of the roots of EfS theory. What binds these thinkers together is that they seek to reorient or stretch the dominant Euro-Western view of reality. The pedagogical roots of EfS can be represented by John Dewey (experiential education), Paulo Freire (critical pedagogy), Frijof Capra (systems), Edgar Morin and Stuart Kauffman (complexity), Erich Jantsch

and Basarab Nicolescu (transdisciplinarity). Each of these theorists rejected the dominant Euro-Western tendency to view the world and reality in dualistic terms, and linked the wicked problems and dilemmas of today ultimately to the meaning-making systems within the dominant Euro-Western paradigm that is driving the thoughts, actions and behaviours we experience today (Ross and Mitchell under review).

Instead, these theorists offered alternative views of reality, broadly described as process-oriented, relational, complex and emergent. It is these alternative ontoepistemological views that are required to create deep shifts towards sustainability (Capra 2002, Lange in press, 2017, Sterling 2010). A process-view describes a vision of reality as constant, dynamic processes of disorder, spontaneous order, and balance (Dewey 1910, 1933/1998). In the process worldview, movement is primary; see for example, Bateson's notion of the mind (Charlton 2008) or Bergson's metaphysics of change (Osberg 2015). The relational worldview interprets reality entirely through connections. Nothing exists in isolation. The relational worldview is often linked to Buddhism (Macy, 1991; Capra, 1982); Indigenous philosophies (Sunde 2008, 355, Stuckey 2010); and quantum physics (Lange 2015, Lange in press, 2017, Barad 2007). Similarly, emergentism transcends classic physics. Emergentism is the idea that nature cannot be predicted (Kauffman 2007). Instead of determinism and reductionism, nature increases in complexity through an interplay between the path from which it is has evolved and the unlimited possibilities for future self-generation (Kauffman 2016). Broadly speaking, the universe is understood as self-organising, self-creating, and creative (Jantsch 1980, Osberg 2015). Systems within the universe (i.e. human-made, natural, or cosmic) are a "self-consistently co-constructing whole persistently evolving" of being (Kauffman 2008, 150).

For the sake of brevity, within this paper we will broadly refer to all of these alternative views as a relational ontoepistemological view. The following sections describe the significance of the three proposed learning outcome spaces, particularly in regards to shifting towards a relational ontoepistemological view.

Learning outcome space 1: Who am I? Who are you?

According to this subset of literature, collective learning processes that meaningful engage with the questions of "Who am I and who are you?" are a necessary learning outcome space as worldviews and paradigms offer significant explanatory power for how we interpret, act and relate in this world (Thayer-Bacon 2010, Kaplan and Harris 2016, Lange in press, 2017, de la Sienna, Smith, and Mitchell 2017). This learning outcome space deviates from the Newtonian-Cartesian tendencies to see emotions as separate from rational learning; learning principally as a matter of providing facts and information; or collective action as separate from individual growth and reflection. Instead, the complexity of internal and external systems that influence our perceptions of the world and of each other are collectively embraced and discussed in deep learning for sustainability.

Distinguishing learning outcome spaces in the way we propose requires distinguishing between worldviews and paradigms. In this paper, we define a worldview as a personal set of tendencies and beliefs for making-meaning (de la Sienna, Smith, and Mitchell 2017); where-as paradigms are a socially-shared and transmitted set of assumptions and norms for making-meaning of life, experience, the universe (Kuhn 1996, Macy 1991). Living our lives, these two theoretical concepts inter-act and co-create one

another in complex ways. For example, many individuals (i.e. society) create and carry-forwards paradigms, social paradigms influence and embed within individual worldviews, when a critical mass of worldviews shift new paradigms are generated and amplified (Morin, 2001). Therefore, developing the sensitivity and intelligence within learners to explore their own uncharted inner territory can include reflections on both the paradigms within which they sit or feel an affinity towards, and their own unique perspective and life-view.

Recognising paradigms

Living within deeply historical societies shapes our experience; experience forms our habits; our habits mediates our experience, and so on (Garrison, Neubert, and Reich 2012, x). Euro-Western paradigms have been shaped over thousands of years; others, such as Aboriginal Australian culture, over tens of thousands of years. As societies and cultures evolve over long periods, rules and norms are carried along (Dewey 1933/1998, Mezirow 1994, Darder 2015). These rules and norms become historical, social commonsense (Gramsci 1971), or a paradigm (Kuhn 1996). An individual's sub-consciousness absorbs and embodies these historical paradigms via exposure to diverse communications of cultural expectations, social norms (gender, race age perspectives), meaning, religious and spiritual beliefs (Aluli Meyer 2013, Cranton 2016, Dewey 1933/1998, 1938/1963, Freire 1974/2005). In sum, paradigms both influence and are carried forward by individuals, their consciousness and behaviours.

Social paradigms can be conceived of as external cultural conditioning of an individual's way of being, doing and knowing, and are seldom questioned (Mezirow 1992, Mezirow 2012). These historical ways of being embed within, and subsequently exert influence over, our deeper habits of mind (*meaning perspectives*), such as our aesthetic, philosophical, epistemic, socio-linguistic, psychological and moral-ethical "meaning perspectives" (Kitchenham 2008, Cranton 2016). These *meaning perspectives* or ideological beliefs sit within the realm of unexamined assumptions, or what Freire referred to as "anti-dialectical assumptions", because we are not willing to entertain the potential that their "opposite" may in fact have validity (Darder 2015, 20). In other words, we are caught in a *submerged consciousness* or *unconscious civilisation*, like a fish unaware of the water it is swimming in (O'Sullivan 2012).

These externally imposed paradigms within which we exist are powerful. Morin describes dominant doctrines and ideologies as "cultural imprinting", capable of a "normalization that eliminates anything that might dispute it" (Morin, 2001). Cartesian-Newtonian paradigms, for example, can trap us in the state of being Objects of history (i.e. being under the control of and prevented from being aware of the possibility of a different state). Becoming Subjects of history means liberation into a more fully human experience in which we can transcend existing paradigms in order to exert influence on our social organisation (Freire 1974/2005, Kolb 2015, Morin 2001).

Recognising worldviews

We absorb paradigms into our own personal worldviews. But our worldviews are also influenced by our *unique biological* and *personality* traits, as well as unique combination of life experiences. Each individual is a one-of-a-kind mix of morality, needs, inhibitions, learning styles and preferences, and sense of beauty and values. According to Transformative Learning Theory, these externally and internally derived stimuli blend

deep within our meaning perspectives, which are then expressed as meaning schemes (habitual and implicit rules for interpreting experience) which combine to make our frame of reference (web of assumptions and expectations through which we see the world) (Cranton 2016, Kitchenham 2008, Mezirow 2012).

Worldviews, or meaning perspectives, are often conceived as layered and complex phenomena. de la Sienna et al. (2017) synthesise a significant volume of research, to derive the Transdisciplinary Framework of Worldviews and Behaviours (TFWB), in an attempt to articulate how a personal worldview is formed and expressed through the nervous system, the mind, its mental states and the implications for decision-making and the expression of behaviour. Macy also describes the non-seperability of, and multiple circuits between, our: internal mental and body activity; volitional formations (habits and impulses which code and construct ways that we interpret our world); cognitions; feelings and perceptions; ego-consciousness, and thus our “fabrications on the external world” (1991, 66-68, 79).

These and other interpretations of worldviews suggest our behaviour has the potential to be highly emotional and largely unconscious (de la Sienna, Smith, and Mitchell 2017, 33, Mezirow 1994, Dewey 1933/1998, Macy 1991, Garrison, Neubert, and Reich 2012). Activating our consciousness and changing behavior is not easy (Morin, 2001). Our brains are wired to bring the world around us in line with our assumptions (Macy, 1991), meaning we project our codes onto the environment so that it will conform to our expectations (Kaplan and Harris 2016). Alternatively, when we do accept a mismatch between our perceptions and our interpretive codes, this may lead to a change in the internal codes themselves (or not) (Macy 1991).

The first learning outcome space embraces complexity involved in individuals making sense of, and thus acting in, the world. Learning outcome space 1 is at the level at which sustainability-compatible worldviews are formed, or not. The first learning outcome space thus seeks to prompt the curation of processes and experiences **within learners** to develop sensitivity and intelligence in reflecting on how their own personal worldviews are created; what their own worldviews are; the paradigms within which they may be operating; and, sensitivity towards the complex worldviews within all other people involved in the collective learning experience (***Who am I and who are you?***). Both de la Sienna et al. (2017) and Morin (2001) describe processes to aid process design for this learning outcome space. Such processes relate to and are stimulated by the second learning outcome space.

Learning outcome space 2: Who are we?

The second learning outcome space recognises the primacy of communication and dialogue in collectively learning and developing contextual knowledge. Notions of learning within the Cartesian-Newtonian paradigm tend to see knowledge as universal, and unchanging, separating knowledge from the knowers who make and engage with it (Darder 2015, 14, Garrison, Neubert, and Reich 2012, 41, Sunde 2008, Kolb 2015, 85, Blackburn 1971, Capra 1982, 23, 40). A more complex and relational notion of learning and knowledge recognises the partiality of each person’s perspective, including the facilitator, and thus fosters a diversity of views, disciplines, perspectives, and develops skills within learners of co-creating knowledge via dialogue and reflections on the notions of knowledge and understanding.

Why do we need diversity of views?

Deep collective learning for sustainability requires a diversity of views. This inclusion of 'the other' (minorities, distant environments, more-than-human, future generations) is necessary to shift away from mechanistic thinking (Sterling 2001, 53). The wicked problems that we face today have been traced to the very action of not working together, what Macedo refers to as the "barbarism of hyperspecialisation" (Macedo 2006, Nicolescu 2002). Under the dominant Western paradigm, reality is viewed as something within which we can find order through reductive simplification. This means branches of knowledge and action take place within increasingly specialised and smaller realms, making an understanding of the impact on the whole impossible (Kleiber 2001). The way we structure our societies, meet its basic needs and "progress infinitely" does not recognise the complexity within which we operate, and thus has no means of linking or recognising the depth of connection between daily decisions and the negative impacts we are creating. The wicked problems we now face are greater than any single person, discipline, or expertise can solve. Therefore, a collective of diverse learners makes way for a highly competent collective for change creation (Callon 2005), if communication and dialogue and understanding are working effectively.

How to enable diversity?

Enabling diversity within a collective learning experience can be strengthened through a commitment to pluralism. John Dewey, one of the fore-thinkers of experiential education with a radical commitment to pluralism in collective learning, argued that in our multi-cultural world and multi-perspective world, the collective learning process should not privilege any one perspective over others (Garrison, Neubert, and Reich 2012, 114). In order to stand against uniformity, Dewey suggests that facilitators should reflect on "How numerous and varied are the interests which are consciously shared?", for example in any given collective learning experience (Garrison, et al., 2012: 146).

Once diverse views have been gathered in the collective, other educational philosophers speak of the need to not only value the diversity of the group, but also stress the unity. This requires a dialectical approach of seeing and valuing these seemingly contradictory views. Paulo Freire and Edgar Morin suggest prompting discussions about how both unity and diversity exist concurrently (Morrow 2013, 84, Morin 2001). For example, all humans, with our similarly biological, mental, psychological, emotional, intellectual processes, are on a common adventure (Morin, 2001). Yet diversity exists in everything human. Specifically in relation to a collective learning process for change, diversity exists in the ideals and viewpoints on a) what should be, b) what is, c) what could be and d) what can be (Brown and Lambert 2013, 17). The diversity of interests should be recognised and celebrated through the entire collective learning process (Brown and Lambert, 2013), while also developing the concept of "unity in diversity and diversity from unity" within learners (Nicolescu 2010).

Communication: its philosophical and ontological importance

A valuable tool to help us overcome the notion of otherness is meaningful dialogue. Taking a historical and philosophical view, communication is a fundamental skill for humanity. The atomic bombs released after WW2 prompted a deep reflection about our beliefs of the role of humanity and its relationships. The atrocities and devastation for WW2 were attributed to "the shocking failure of communication among men" (Charlton

2008, 21). And ironically, even though today's world has opened up technologies and scales of communication previously never imagined, these communication technologies have increasingly led to new exclusions of people (Callon, 2005) and our distorted communication still remains our society's pathology (Fleming 2015). Thus, while a process as old as time, the role of communication and dialogue as a means to develop shared understanding is still heralded as a skill for the 21st century (Morin, 2001).

A century earlier, John Dewey also recognised the critical role of communication in collectively learning. Dewey uses religious metaphors to accentuate the sacredness, power and necessity of communication: communication is the "*miracle* of giving body and definiteness to experience...of all affairs, communication is the most wonderful...that the fruit of communication should be participation, sharing, is a wonder by the side of which *transubstantiation* pales" (LW 1: 132, Garrison, et al. 2012: 26); and "*its name should not be taken in vain* by terming communication that which produces no community of thought and purpose" between a group of collective learners (Dewey 1933/1998, 292).

Systems and complexity perspectives also position communication capacity at the core. Communication, in its broadest terms, is a central notion in systems dynamics (Montuori 2011), soft-systems thinking (Checkland and Poulter 2010) and a process-oriented (as opposed to substance-oriented) view of reality (Jantsch 1980). Communication is the medium through which parts and wholes interact (Alhadeff-Jones 2008). It mediates and controls system behaviour and systems change (Meadows 1999), or in other words, is a central process in how our perception of reality creatively evolves and co-creates itself.

Communication can help shift our ontoepistemological stance

By engaging with and being open to diverse viewpoints, we can explore and criticise the ideas that possess us, so that we are less influenced by our subconscious worldviews (Morin, 2001). That is, communication and dialogue have the capacity to strengthen individuals' thinking. While rationality can often be thought of as a state, or a characteristic to have, an alternative view is that rationality is actually a movement or process, a dynamic state of perpetually becoming. In this conceptualisation of rationality, it is dialogue and communication that mediates this process of becoming 'rational'. Rather than rationality being a property of a system of ideas for which we must convince others of, rationality is strengthened through the debate of ideas (Morin, 2001). It allows for the "constructive and critical integration of isolated bits of information into a more coherent and systematic grasp of social realities" (Garrison, et al: 2012). Thus to create deep learning, it is precisely through these collective, critical dialogues that the transformation of consciousness can begin (Freire 1970/1996).

Illustrations of how to enable dialogue and communication

Meaningful dialogue is essential to collective learning (Brown and Lambert, 2013: 26). The dialogue and communication required in each experience is highly contextual, but we collate several principles below for enabling effective communication in collective learning experiences. In order to provide the conditions for meaningful dialogue and communication, it is imperative to maintain a welcoming space for open-ended dialogue through the collective learning experience (Brown and Lambert, 2013: 26). Meaningful dialogue requires significant time (Orr 2011, 254), without which, the learning experience could be considered time wasted (Freire 1974/2005, 79). It is helpful to discuss within

the collective learning the Achilles heel of knowledge, that is how all communication is vulnerable to error and illusion (Morin, 2001). Acknowledge that each individual involved has their own practices of communication, born out of their culture, experiences, training, discipline, etc, and thus develop skills in various forms of integrative communication (see for example Jahn, Bergman, and Keil 2012, Bammer 2017). Within the group, use tensions and misunderstandings as an opportunity for reflective learning, such as through tools like Critical Systems Heuristics (Ulrich and Reynolds 2010). Collectively explore the sources, modalities, and effects of misunderstandings as they arise in the group (Morin, 2001). Over-time this can develop into a meta-thought structure for the collective group: *“understanding across different thought structures requires the ability to pass through a meta-thought structure that can understand the causes of incomprehension from one to another, and overcome it”* (Morin, 2001).

It is common, in collective learning for knowledge cultures, or perspectives to reject the others' form of knowledge: *“Individual knowledge is called only an anecdote, community knowledge just a story, expert knowledge fragmented jargon, organizational knowledge self-serving and holistic knowledge too airy-fairy”* (Brown and Lambert, 2013: 42). Reconciling the barriers to knowledge integration and co-understanding can also be highly contextual, however several strategies for reconciliation can be employed. For example, groups can reflect on their various learning styles and knowledge types (Kolb, 2015). Facilitators can help learners explore different epistemological views of knowledge, e.g.: knowledge as universal and unchanging, versus knowledge as pragmatic valuable only in its successful use in the real world (Dewey 1933/1998), versus knowledge as hegemonic, historical, cultural and ideological (Darder 2015, 37, Freire 1985, 48), versus knowledge as emotional, moral, intuitional, embodied, imaginal and spiritual (Lange 2012, Barrett et al. 2016, Dirx 2012); or approximate, provisional, relational (Sterling 2001, 61). Discussions about the nature of knowledge help develop rational humility, or the “principle of rational uncertainty”, which is the notion that true rationality is actually only theoretical in nature but is achieved through a process of self-critical reflection aided through dialogue and reflection with diverse viewpoints (Morin, 2001).

Developing trust

Necessary in these challenging conversations is trusting one another to share one's views openly. One example of fostering trust in the processes of collective learning is Freire's notion of *radical love* (Freire 1974/2005, 47-50, 1970/1996, Darder 2015). Radical love can enable an experience in which participants recognise their differences, yet value and trust one another and thus allow the collective group to engage with the totality of their worldviews (Freire, 1974/2005). An important enabler in enacting this radical love, is the notion of 'unfinishedness'. Freire attempted to embody this notion, recognising that his ideas and ways of being in the world were not perfect, nor never will be, so he remained open to learning and conflict, in order to grow from interactions and dialogues (Darder, 2015: 39-44).

Learning outcome space 3: How can we collectively effect change?

The first learning outcome space recognises the need for and complexity of learners understanding themselves. The second learning outcome recognises the need for and challenges of developing trust and truth together. The third learning outcome recognises the complexities of collective change creation. Several key skills are discussed below.

Dancing with systems and leveraging their change

Taking a more complex and relational view of reality drives a different orientation to problem solving beyond the simple mechanistic paradigm (Sterling 2001, 53, Snowden and Boone 2007), in which the beat of the system is probed before you dance with it, so to speak (Meadows 2002). This resonates with a holographic approach, in which the problem situation is explored by learners from multiple dimensions: personal, cultural, institutional, psychological, historical, mythical, planetary (Montuori 2013). Exploring the messy situation or problem space holographically helps to re-orient collective learning around “deep” leverage points for change (Meadows 1999, Abson et al. 2017). From a systems perspective, this can mean systematically exploring perspectives in order to develop accommodations that are desirable and culturally feasible (Checkland and Poulter 2010, Ison 2017).

Critical historical reading of the world

Part of “getting the beat of the system” means developing a critical understanding of history, and specifically, how history impacts on the dominant relations, institutions, knowledge and ideologies (Brookfield 2005). This component of collective learning for change is sometimes forgotten. For example, as mentioned above, Brown and Lambert (2013: 17) pose four key questions for collective learning for transformation: *What should be; what is; what can be; what could be?* However, they do not provide strong guidance on the need for conducting a critical historical reading of the system of interest. Yet, this historical reading is one of critical pedagogy’s central message around collective learning (Freire, 2005: ix) and the first step in engaging with systems (Meadows 2002).

A critical historical reading of the world attempts to strengthen and refine critical reflection on the nature of causality and reality, as a means to collectively transform it (Freire, 1974/2005). A critical historical reading develops processes that challenge ideologies, contest hegemony, unmask power, overcome alienation, learn liberation, reclaim reason, and practice democracy (Brookfield 2005). Critical pedagogy asks questions such as:

- What are the prevailing ideologies, hegemonic assumptions, and epistemologies that inform the structure of communal life and thus human actions (Darder, 2015: 84; Gramsci, 1971; Kreber, 2012)?
- How does the “*spirit of capitalism, and technical and bureaucratic rationality enter into and distort everyday relationships*” (Kreber 2012)?
- How do people learn this dominant ideology and how does it constrain life choices and prevent the possibility of transformation (Brookfield 2012)?

Cycles of action and reflection

Conceiving of learning, knowing, thinking as a cycle of action and reflection is a more complex and relational onto-epistemological viewpoint. In this view, learning is seen as more of a process than a product (Kolb, 2015: 30). Links are made between abstract and concrete thinking (Dewey, 1933/1998: 220-226). In fact, many notions that have been radically separated in the Cartesian-Newtonian paradigm are re-united and viewed as complementary in this pedagogical approach: student/teacher, teaching/learning,

action/reflection, theory/practice, scholar/practitioner (Winchell and Kress 2013, 153, Kolb 2015, 41-42, Orr 2011, 257).

Cycles of observing, thinking, acting and reflection are key attributes for deep learning for sustainability. These cycles of action and reflection are the central process for humans collectively creating change and adapting to the social and physical environment (Kolb, 2015: 43). It is through their application that knowledge and skills become an instrument of understanding (Dewey, 1933/1998: 44). Transformative Learning Theory uses this basic cycle of action and reflection to theorise how learners develop deeper, more integrative habits of mind, which lead to changes in the way they think, act and be in the world. Problem-posing and learning from error are crucial foundations of collective learning" (Morrow, 2013: 85).

In formal education settings, it is rare for sustainability courses to curate the opportunity for learners to implement their change as part of their experience in sustainability learning (Brundiers and Wiek 2013). Brundiers and Wiek (2013) identify several solutions to ensure that cycles of action and reflection can be integrated. An additional case study is the Bachelor of Creative Intelligence and Innovation at University of Technology Sydney. In this four-year transdisciplinary course, students are introduced to complexity and systems ways of viewing reality. These groups of collective learners have time and are encouraged to explore problems through 'safe to fail' experiments, where the students can "probe, sense, respond" (Snowden 2000) (i.e. trial, experiment), then reflect and adjust their interventions, throughout the course (Edwards 2017). In addition, in their fourth year, the students have an extended period to experiment with change and interventions in a complex system.

Conclusion

The curators of learning experiences for sustainability have much to juggle and be aware of: the paradigms, worldviews influencing the way individuals interpret and act; the dynamics and dialogue of groups; as well as systems, complexity and praxis skills to explore meaningful leverage points for change in society. This paper recognises the complexity of curating these learning experiences and proposes three learning outcome spaces. These questions are proposed as a simple heuristic for designing and reflecting on learning experiences for more successful advances towards deep sustainability. The simple but profound nature of this 'paper napkin' tool, can potentially not only deepen the curation of learning experiences, but also structure and thus improve the sharing and cross-fertilisation of ideas among practitioners.

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