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Stretching the boundaries of transformative sustainability learning: On the importance of decolonizing ways of knowing and relations with the more-than-human

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ABSTRACT

This paper chronicles students' experiences of transformative sustainability learning through 'epistemological stretching' – a pedagogical orientation which focuses on expanding the ways of knowing that someone respects, understands, and/or engages with. With a particular emphasis on decolonizing relations between humans and the more-than-human, epistemological stretching enables students to articulate and critically engage with the epistemologies of their academic fields, gain new(old) perspectives on relations with the more-than-human, and interact with Indigenous knowledges in more effective and ethical ways. Students in this study experienced powerful learning outcomes in the following areas: reconceptualization of relationships, acknowledgement and deconstruction of power, and worldview bridging. Some students also received validation for ways of knowing that they previously engaged in but were unsure about expressing in academic contexts.

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Introduction: epistemological and ontological stretching for transformative sustainability learning

For the field of sustainability to rest on socially robust and resilient epistemological and ontological foundations, sustainability educators must work towards critical epistemological reflexivity, acknowledgement of more diverse sources of knowledge, and more open approaches to knowledge generation (Fortuin and van Koppen 2016; Miller, Muñoz-Erickson, and Redman 2011; Miller et al. 2008; Murphy 2011). Developing capacity for interdisciplinary sustainability knowledge creation and engagement with Indigenous knowledge holders necessitates transformative and decolonizing[1] approaches to education. Such openness requires attention to ways in which 'the western knowledge narrative' (Hall 2014, 9) has made it difficult to 'hear' the many voices of the more-than-human. This research chronicles the experiences of students within a sustainability graduate program designed to evoke critical examination of their epistemological assumptions, and of the epistemology of sustainability as an inter-disciplinary and intercultural academic field. It paves the way for transformative sustainability learning that supports anti- and de-colonizing approaches to more-than-human agency and knowledge making processes. It also acknowledges the interrelated nature of epistemology and ontology.

Conventional reductionist approaches are not proving to be adequate for addressing complex environmental problems emerging within socio-ecological systems (IPBES 2011; Miller, Muñoz-Erickson,

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and Redman 2011; Shiva 2000; Wilkinson, Clark, and Burch 2007). These approaches do not engage with socio-ecological systems holistically; nor do they provide adequate acknowledgment of epistemological and ontological diversity necessary to understand and articulate sustainability problems in the first place. In order to effectively and ethically engage with Indigenous knowledge holders and address the complexity of sustainability problems in the context of socio-ecological systems, academic institutions are tasked with decolonizing approaches to knowledge creation and addressing ongoing privileging of some knowledge forms over others (Kuokkanen 2007; Marker 2004). To do so will require epistemological reflexivity, a practice which Fortuin and van Koppen (2016, 698) define as 'the ability of researchers [students and practitioners] to question the different sorts of knowledge used, to recognize the epistemological and normative aspects involved, and to reflect on their own and others' roles in these knowledge processes'. It will also require moving 'beyond a rigid knowledge structure that may fail to raise the most relevant questions and provide the most integrative solutions' (Miller et al. 2008, 4).

Many of the issues hampering effective and ethical engagement with Indigenous knowledge holders in resource co-management revolve around epistemology and ontology. For example, hunters' and Elders' stories of direct communication with animals are seldom used as data, resulting in 'epistemological cherry picking' (Nadasdy 2007, 37). Even when discrete pieces of Indigenous knowledge are seen as valuable by western scientists, the ways of knowing and cosmological orientation from which the knowledge originates is often not acknowledged (Blaser 2012; Bohensky and Maru 2011; Houde 2007; McGregor 2008; Nadasdy 1999, 2007; Wilkinson, Clark, and Burch 2007). Addressing such issues necessitates a transformative sustainability learning approach that supports a multiplicity of perspectives on knowledge, and its generation.

Many scholars have noted a strong connection between sustainability education and transformative learning (Burns 2011; O'Sullivan 1999; Sipos, Battisti, and Grimm 2008; Sterling 2010; Thomas 2009; Wals and Corcoran 2006). Drawing on both cognitive and other forms of reflexivity (Cranton and Taylor 2012), transformative learning enables the individual to come to a deeper understanding and critically reflect on their frames of reference. Because 'learning that facilitates a fundamental recognition of paradigm and enables paradigmatic reconstruction is by definition transformative' (Sterling 2010, 23), transformative learning is a particularly valuable framework for forms of sustainability learning that take decolonizing epistemologies seriously. According to Sterling (2010), transformative learning is 'normally taken to mean learning which touches our deeper levels of knowing and meaning, and, by so doing, then influences our more immediate and concrete levels of knowing, perception, and action' (22). Drawing on Bateson, Sterling suggests that students engage in three levels of learning. First order learning is 'doing "more of the same" without examining or changing the assumptions or values that inform what you are doing or thinking' (22). Second order learning requires critical examination of one's own beliefs, values and assumptions. The third order, which Sterling refers to as epistemic learning 'involves a shift of epistemology or operative way of knowing and thinking that frames people's perception of, and interaction with, the world' (23). In epistemic learning, 'ontology and epistemology cannot be separated' (Bateson 1972, 314) and are mutually-informing.

According to Morrell and O'Connor (2002, xvii), transformative learning 'involves experiencing a deep, structural shift in the basic premises of thought, feelings, and actions. It is a shift of consciousness that dramatically alters our way of being in the world'. A transformative and decolonizing pedagogical orientation, as we engage it, involves (but is not limited to) making space for epistemologies that recognize the agency and sentience of the more-than-human, and making visible power relations that work to maintain particular ways of knowing as subaltern and marginalized. As Battiste (2005) notes, decolonization is not only for Indigenous peoples, as we all embody the effects of colonization which are daily reinscribed by knowledge generation practices that frequently exclude the intuitive, embodied, oral, spiritual, and artistic (Hall 2014).

Epistemological stretching – a pedagogical focus on expanding the ways of knowing that someone respects, understands, and/or engages with – can have great value for transformative sustainability learning that simultaneously supports decolonized relations with the more-than-human and ethical engagement with Indigenous knowledge holders. Like Bateson (1972), we most often refer to this

approach by the single term 'epistemology' while fully acknowledging the tight and necessary relationship between epistemology and ontology. As one extends the range of ways of knowing that can be accepted and/or engaged with, ontologies also often shift. Materialist understandings of the world may no longer hold as epistemological stretching engages multiple domains including affective, intuitive, artistic, dreaming, animistic and somatic ways of knowing. Within the context of sustainability education, epistemological stretching constitutes a form of learning that engages Bateson's third order of learning, prompting students to question epistemic and ontological assumptions embedded in modern western culture. As we engage it, epistemological stretching welcomes explicit contemplative engagement with the more-than-human, supporting a reanimated embodied perception (Bai 2009) and what Native scientist Cajete (2000, 20) refers to as 'culturally conditioned "tuning in" of the natural world'. This opening up of perceptual awareness is an important step in decolonizing epistemologies and relations with the more-than-human.

Epistemological stretching can precipitate reconstruction of the epistemic paradigm of the learner, and as Sterling (2010, 23) describes, the result of this epistemic learning is 'seeing our worldview rather than seeing with our worldview.' As Mezirow (1997, 7) notes, 'we do not make transformative changes in the way we learn as long as what we learn fits comfortably into our existing frames of reference'. In the context of epistemological stretching, transformative learning may result in students letting go of a priori ontological and epistemological assumptions rooted in, and reinscribed through more colonized approaches to academic research and pedagogy. Our study describes students' experiences of transformative sustainability learning through epistemological stretching and the resulting epistemic paradigm reconstruction and shifts in assumptions and worldviews.

Research context, participants and study design

Eight former students from two separate years of a graduate level seminar course entitled *Multiple Ways of Knowing in Environmental Decision-Making* participated in the study. The interdisciplinary graduate level course is offered at the University of Saskatchewan. The program emphasizes the integrative nature of environmental challenges, the benefit of interdisciplinary understandings, and how sustainability is conceptualized and made operational. The course, as described in (Barrett and Wuetherick 2012), focuses on:

> developing an understanding that there are multiple ways of knowing, all which are valuable to environmental decision-making; understanding that some knowledge systems are given higher status than others, and this higher status has had significant (often negative) social, economic, and environmental effects. Students are also expected to become familiar with a range of explanations for transrational knowing, and appreciate the significance of multiple ways of knowing to make high quality decisions and meet the constitutional 'duty to consult' with Aboriginal peoples. The one-semester course takes a decolonizing approach, and recognizes that not only Indigenous peoples, but non-Indigenous peoples as well, have been colonized through long-term exposure to narrowly framed understandings of how one can come to know (see Bai 2009; Donald 2010; Greenwood 2009). A final course objective is for students to practice integrating multiple ways of knowing into their own personal and professional decision-making. To do so, students are challenged to move beyond what are often deeply rooted assumptions about what counts as knowledge and knowing (Meyer 2008).

Four assignments ground the course: the natural history journal; responses to readings and seminars; peer-led seminars, and synthesis assignments for both the natural history journal and reading/seminar responses. The natural history journal (Conn and Conn 2009; Fawcett, Bell, and Russell 2002; Flowers, Lipsett, and Barrett 2014) invites students into a practice of what Bai (2009) refers to as re-animated, embodied earth connection using a range of techniques such as embodied painting through Creative Nature Connection (Flowers, Lipsett, and Barrett 2014; Lipsett 2013). Students are asked to allow themselves to be drawn to a particular place, tree, river, rock etc., and spend time in that place several times a week during the semester. While there, they record both empirical and intuitive observations, using sketches, painting, prose, free-form intuitive drawing, photographs and other data. Readings and peer-led seminars provide an opportunity for students to examine possible theories and explanations for ways of knowing that transcend Western science. At the end of term, they synthesize their most significant learning from course readings, lectures, personal experience and seminar

discussions into a multi-modal representation for their final assignment for second order learning through critical examination and third order learning in shifts of ways of knowing and thinking.

Participating students either self-identified as Indigenous (n = 2), had worked with Indigenous knowledge holders before taking the course (n = 1), or had conducted research with them since taking the course (n = 5). Each participant met with the lead researcher for an in-depth, semi-structured interview lasting between one and two hours. The interviews focused on the student experience of epistemological stretching, and the implications of their engagement with multiple ways of knowing. Interviews were transcribed and returned to participants for a member check.

This research study is part of a nationally funded research project on pedagogical approaches for more ethically appropriate and effective inclusion of Indigenous knowledges into resource management processes. The lead author, Harmin, completed the intuitive inquiry cycles (Anderson 2000) as part of his master's program. He was a student in the course in the year previous to completing this research study; this shared experience as a participant in the course and previous rapport with some of the students facilitated openness and honesty during interviews. Barrett is the course designer and instructor who envisioned and taught epistemological stretching as a pedagogical approach for four years prior to this study. Hoessler, a program and curriculum development specialist, provided guidance during data analysis as outsider within this insider-outsider research team, (Thomas, Blacksmith, and Reno 2000) contributing to the richness and trustworthiness of interpretation that multiple perspectives can provide.

Methodology

Intuitive inquiry has proven to be effective in investigating transformative human experiences (Anderson 2000) and was chosen because it acknowledges both critical reflection and intuitive relating as valid ways of knowing, which both play a role in the transformative learning experience. Given that it explicitly supports using intuitive, analytical, rational and transrational ways of knowing this methodology is epistemologically congruent with the study's focus. Rosemarie Anderson developed intuitive inquiry 'in order to carve creative space or capacity within scientific inquiry for the active contributions of intuitive insights' (Anderson and Braud 2011, 69). Inquiring into the realm of epistemological stretching implicitly requires the researcher to be open to and engage with the full spectrum of capacities available to them for creating, receiving, interpreting and representing knowledge. It 'joins intuitive and compassionate ways of knowing to the intellectual rigor of human science research' (Anderson and Braud 2011, 16), and 'seeks to speculate about the possibilities implicit in the data and intimate new ways of being human in the world' (Anderson and Braud 2011, 17).

The structure of an intuitive inquiry consists of five iterative cycles of interpretation as follows:

> Cycle 1: Clarification of the research topic through a creative process, leading to a precise articulation of the research topic. The focus of the research presented arose from Cycle 1.
>
> Cycle 2: The researcher reflects upon their understanding of the topic, explores the literature and research, and prepares preliminary interpretive lenses. The interpretive lenses are used to describe the researcher's understanding of the phenomena under investigation prior to data collection. Cycle 2 informs the literature review section of this paper.
>
> Cycle 3: Gathering of data takes place, and descriptive findings are conveyed, inviting interpretation by the reader. This full set of transcribed quotes is not presented in this paper due to space limitations.
>
> Cycle 4: The researcher provides a set of interpretive lenses informed by the experience of data collection, analysis, and interpretation and compares these lenses with the ones from cycle two in order to refine and articulate new understandings. Cycle 4 lenses, called interrelated areas of transformation in this paper, are presented in findings.
>
> Cycle 5: The researcher integrates the interpretive lenses with understanding from relating literature, and discusses the implications of the research. Cycle 5 occurs in the conclusion and synthesis section. (Anderson and Braud 2011, 28)

In this study, with the guidance of Barrett, Harmin refined the research topic (cycle 1), explored the literature to create preliminary lenses (cycle 2), and collected data through interviews (cycle 3). Identification of cycle 4 lenses was completed by Harmin in consultation with Hoessler while Barrett, who was the instructor of the course, stepped aside until the lenses had been discerned. For cycle 5, Harmin began connecting the lenses with literature and describing the implications. All authors were involved in the process of distilling the key facets of each area of transformation (cycle 4), and the writing of the discussion (cycle 5) for this paper.

Results: areas of transformation

Focusing on the findings from cycle 4, this section describes the four interrelated areas of transformation prompted by epistemological stretching as a pedagogical orientation discerned from student interviews. These areas are:

(1) Reconceptualization of relationships;
(2) Deconstruction of power, epistemic hegemony;
(3) Worldview bridging;
(4) Validation of previously held views.Each area is outlined and illustrated with data from student interviews.

The transformational learning through epistemological stretching did not necessarily come easily, yet it did occur. Students were taken into a liminal space that can be troublesome, as is common during transformative learning. Troublesome aspects of this learning are more fully documented in an earlier study, entitled *Shifting relations with the more-than-human: Six threshold concepts for transformative sustainability learning* (Barrett et al. 2016). At times students expressed discomfort about the validity that transrational and embodied knowing were given in the course, and the 'tensions it created between their own identities as graduate students, and engagement with a more diverse set of epistemologies' (Barrett et al. 2016, 7). Some of the liminal experiences, a messy journeying back and forth between 'new' and 'old' ways of thinking, were reflected in the words of the participants in this current study, who speak of 'hard sciences,' 'validation by science,' and 'pure scientific data,' while simultaneously referring to the more-than-human as sentient beings. The language spoken in interviews reflects the difficulty of recognizing epistemic privilege and developing a non-dichotomous understanding of epistemic power encountered by learners as they transform within these four interrelated areas.

Reconceptualization of relationships

As they expanded their epistemological toolkit, students understood their relations with the more-than-human as becoming less anthropocentric (human-centred) both conceptually and in practice. Overall, students spoke about experiencing and acknowledging greater consciousness, agency and 'aliveness,' or animacy, of the more-than-human world.

> I was lying under 'my tree', a towering blue spruce on the front lawn of a place where I was staying. I tried really hard to see things from the tree's perspective – an animist point of view. I lay there for a while, studying all the individual characteristics of the tree: the needles, the texture, the colours and shadows … then, I felt like my perception switched, like I could almost see myself lying under the tree, and that each of the needles had eyes, that they were looking down at me, just watching placidly, with no emotion. (participant 8)

> It's what we are talking right, not just scientific, it's about traditional knowledge, it's about the sky knowledge, it's about what the living beings convey, it's about every kind of knowledge in this world that is interconnected with our Earth. (participant 7)

This shift in relations with the more-than-human was disruptive to most students' understanding of humanity as somehow apart from and superior to the ecological systems in which we are embedded:

> ... it's not a symbolic relationship, it's a relationship of equals. (Participant 3)

> some of the readings that we did really made me think about how we are so used to being the observers, and so used to being the perceivers, that we forget that we are also being perceived. Which I thought … That was a huge, something really important to recognize. That even when you're standing in a cluster of trees, you're not just looking at them, and they're not just static objects, they are aware of you as well. (participant 5)

This relationality produced both a sense of groundedness, and creative inspiration for many of the students, who expressed a capacity for drawing on their relationship with the more-than-human for new things. Also, in relating to nature in new ways, some students came to understand that interacting with the more-than-human in and of itself provides a wide range of capacities for coming to know:

> my body is interacting with those natural things on a subconscious plane. By allowing my body to actually have time to do this, where my mind isn't distracted writing my thesis … I'm actually allowed to have a fuller interaction. I am in turn allowed to pull the knowledge that the body has gained through these interactions, I think this is a source for a lot of inspiration that I might receive. (participant 6)

> it's about what the living beings convey, it's about every kind of knowledge in this world that is interconnected with our Earth. So now, I can understand, it's not just the knowledge of humans, it's the knowledge of nature as well. That's what I understand now. (participant 7)

> I think I am a lot more aware of the potential that comes from nature, in terms of grounding me, in terms of offering insight and guidance from … I think I am also a lot more aware of how much more I could be in touch with nature, and how I can actually get in touch with it, and how rarely I do that. I think also when I am outside and having experiences in nature I now interpret those experiences a little bit differently. (participant 3)

For students who tried out, but did not continue engaging with the earth as animate, the experience of epistemological stretching was viewed as valuable for understanding the perspectives and experiences of others.

> I can better understand what people mean when they talk about the trees and other living or non-living beings as having spirits and thoughts of their own…..not everyone processes their surroundings the same way ... some people truly feel that nature speaks to them, rather than being inanimate objects in the environment. (participant 8)

> I'm more willing to believe that knowledge is being shared [in the way] the people who receive the knowledge say it's being shared. (participant 1)

Students consistently expressed a changed awareness of the more-than-human world and an expanded capacity to engage with and conceptualize the more-than-human as animate. However, it is yet unclear whether epistemological stretching led to these new understandings, or the new understandings precipitated epistemological stretching. In any case, the ability to know nature with affective capacities was concomitant with recognizing the land as sentient and potentially communicative. Even an ambiguous expression of change in terms of relating to nature, proclivity for the affective, or understanding the natural world to possess different properties, is significant as an articulation of a transformative sustainability learning that acknowledges the more-than-human as having agency.

Deconstruction of power, epistemic hegemony

Epistemological stretching both requires and enables an acknowledgement and deconstruction of power. As they 'stretched' epistemologically, students were able to recognize epistemic power dynamics both internally held and outwardly imposed. Much of the students' dialogue reflected tensions with Western science and resulting understandings of the power dynamic within academic and professional fields of practice. They also represent the ways in which those tensions and dynamics influence how Indigenous and other subalterned knowledge is understood and taken up. All students commented on the ways in which knowledge forms exist in a hierarchy, with Western science at the top, holding the power to validate knowledge claims:

> I just think it's going be a long time until our society doesn't need that validation by science. (participant 3)

> I never felt like science was the answer to everything, and I didn't feel like we could figure out all the world's problems by looking at them in a very rational sort of way. I've had a lot of experiences in my life which I don't think fit, and can't be rationalized. I think that was part of the draw to the class. (participant 5)

> I think it's just the way our society is built right now. Our worldview depends on science, and the results of science, so to ask people to ignore science, and only look at certain facts, I just can't see that happening. (participant 3)

This awareness had important implications for students in terms of the ways they expressed, or stayed silent about their own ways of knowing, in order to negotiate a position for themselves within normative practices in their field.

> I think that even the hard sciences, particularly field biologists, people that do field work, gather plants, and do wildlife surveys and things like that, I think that this is an innate part of how they come up with their ideas that they want to look at, it's just they don't talk about it, because they know that it won't be accepted. We all engage with this, whether we're aware or not, and some people engage more than others based on their awareness, and their acceptance of it. I wouldn't go and tell a bunch of biologists that I do this, that I… try to open my body to listening to the land, or that sort of thing. Because I don't think that they would respect me for that. They would say, oh, that's weird, but after they would think, oh, I kind of do that too. (participant 6)

> [the course] created a really safe space for [the exploration for marginalized ways of knowing] that, and it also gave some sort of validity to these ideas of intuition, or knowing through your body, or communicating with plants and animals. (participant 5)

This recognition of epistemic power dynamics was most frequently represented in students' reframing of their understandings of Indigenous knowledges (IK) and the ways in which IK is understood in the context of environmental management and decision-making:

> Even if we as a consultant wanted to frame our reporting in a way that puts other ways of knowing and those knowledge holders information at the same level as pure scientific field data, we would have the report returned to us, and be asked to redo it, because it's not accepted at a regulatory level. They want to see the hard western science, and oh but people are important so let's have a paragraph at the very end of the assessment talking about what people are upset about. So that's kind of how it's shaped right now. (participant 1)

> That's the power. It's just a problem of the people that they don't have the ability to see or feel the spiritual world, but it exists, it's everywhere. It's only a person's problem because it's not developed enough … In the science there is a big unwillingness to accept the spirituality. (participant 2)

Epistemological stretching gives the students an understanding that there are more stories about what knowledge is than the one(s) that they currently embody or have been supported to engage with. An important way the students develop this understanding of epistemic hegemony is by acknowledging, critically analyzing, and in some cases deconstructing power dynamics embedded in what is considered legitimate knowledge and how, and where, different forms of knowledge get represented. Another key theme of this section focuses on the power dynamic between Indigenous and non-Indigenous knowledges. This will be addressed more fully in the next section.

Worldview bridging: effective and ethical engagement with Indigenous knowledge holders

Linked to the other two areas, 'worldview bridging' represents the ways in which the non-Indigenous students interviewed began to interact with Indigenous knowledge holders in more conscientious and effective ways. It also represents the beginnings of more reflexive and sophisticated understandings of the implications of worldview on how they see the world, and approach sustainability problems. Coming into the course, all but one of the non-Indigenous participants in this study had limited exposure to Indigenous knowledge.

Each non-Indigenous participant expressed a greater respect and appreciation for knowledge system diversity:

> ... even though the knowledge may come from different sources through different processes, it can offer valuable additional information and perspectives on problems. (participant 6)

> For ecosystem management to be successful, or environmental management to be successful, [engaging with TK] it's kind of a requirement … Otherwise it's just going to continue to be the same that it's always been, something that is just steeped in one tradition. (participant 4)

> if I am going to fully help and understand the people that I am working with then I need to know exactly where they're coming from and why they feel their insight and the knowledge they hold is important and non-negotiable. (participant 1)

For students coming to the course with minimal exposure to multiple ways of knowing, epistemological stretching shifted their understanding of the diverse peoples of the world towards a constellation of worldviews, rather than a collection of cultures. As one student noted, I 'didn't really get the whole concept that people literally *SEE* and *FEEL* the world differently' (participant 8; emphasis in original). This understanding is a key entry point for students to more effectively engage between worldviews in professional and academic contexts.

> Including multiple ways of knowing in education would make a huge difference, but multiple ways of knowing, and the way we learned about it, where you see it as a different worldview and not just an issue of cultural respect, or racism or whatever. Because I think what happens now is a lot of researchers do try to be trained in those things, and they come in, and they don't want to be racist, but they're still not getting that it's a fundamentally different worldview. So I think education about multiple ways of knowing, in that respect, would help.(participant 3)

Nuanced understanding of power in knowledge imposition and appropriation issues

All non-Indigenous students also expressed a more nuanced understanding of problematic ethical aspects of knowledge legitimization, validation, imposition, and appropriation. This ability results from both a clearer conception of one's own epistemological standpoint and worldview, and a deepened respect for ineffable and sacred Indigenous viewpoints. As one student noted:

> I was very conscious of the impact of my western worldview on any traditional knowledge. So the main thing was that I wanted to make sure I was receiving … I didn't want to collect knowledge and then filter it through my perceptions, and I didn't want to pick out what was valuable from that knowledge. Because I feel that translating knowledge is problematic. (participant 3)

Constant in all the interviews is that there seems to be no proper verb that feels ethically appropriate with regard to bringing knowledges together. Incorporation, integration, synthesis, on down the line, all those words begin to sound and feel like assimilation because of the power dynamics students acknowledge exists in most contexts where the bringing of knowledges together would occur:

> Yeah, the course made me realize, incorporating that knowledge, is it possible? Is it beneficial to do so? Because incorporating is a word that kind of makes traditional knowledge subordinate to…. (participant 4)

> If you take the approach that environmental problems are perceived to be environmental problems because they're problems to humans, then your worldview determines what the environmental problems are. (participant 4).

The ability to interact with individuals who embodied worldviews other than the ones they grew up with became particularly relevant for the study participants as all of them were involved in some way in natural resource management and environmental consultation. Epistemological stretching proved to be particularly useful for those who were learning to enter into the spaces between distinct epistemologies and ontologies. All non-Indigenous students reported feeling better prepared to engage worldview bridging in a manner that did not subordinate Indigenous knowledge or the worldview from which it originates.

Validation of previously held views

The final area for discussion relates to those students for whom aspects of the course validated previously held perspectives. For a student engaged in issues of wildlife management, the presentation of sustainability questions from non-western, non-anthropocentric, and Indigenous perspectives was a welcome divergence from previous educational experiences. By providing a space in which multiple ways of knowing could be applied to sustainability issues, the inclinations this student held previous to entering the class could be explored openly. This validation was central to this student's positive experience in the course:

> I think that's the number one thing the course did for me. It created a really safe space for that, and it also gave some sort of validity to these ideas of intuition, or knowing through your body, or communicating with plants and animals. (participant 5)

For a student who came to the course with the experience of considerable personal development in their own understandings of relating to nature, much of which occurred doing socio-ecological field work, the environment in and content of the course was conducive to the further development of an embodied knowing practice and an intuitive nature connection:

> I was exposed to a lot of the ideas prior to, in this other class that I had taken, but this class reinforced those ideas, and I was seeing it from another person's, another professor's perspective. I wasn't familiar with the authors she had on her reading list, so I was getting to see those kinds of ideas that I had been exposed to prior, from the perspective of more authors. I guess the class had further validated some of those feelings, as well as reinforced those things within me, and to be cognizant of them as they arise. (participant 6)

For another student, who self-identifies as Indigenous, the natural history journal project, and the associated imperative of attempting to communicate with a natural being, referenced their roots, but also expanded on the implications:

> Writing the journal, talking with my living being, which in this case was a tree. You know, it's something that I used in my country, or in my city with my grandma and my mom. Talks with plants, it's usual. But not in the sense that you go in depth, and try to understand, or try to listen to what the tree is telling you. Maybe not in that way. But I think that experience, to write in the journal, was a good one. (participant 7)

Epistemological stretching creates space that accepts and values Indigenous knowledges, and does not marginalize students' Indigenous identities. The course was a heartening experience for the two Indigenous participants in this study, demonstrating to them that there are pedagogical approaches, which can bring students from a western background to a place of greater understanding of some properties of Indigenous ways of knowing.

Epistemological stretching and transformative sustainability learning

Based on analysis of student responses we have observed that epistemological stretching within a graduate program can foster a reconceptualization of relationships, deconstruction of power, and an increased capacity for effective and ethical engagement with Indigenous knowledge holders. It also validated ways of knowing and being that some students were already familiar with, but hesitant to talk about openly, within their academic programs. Epistemological stretching offered students the tools and permission to explore new ways of relating to the more-than-human world and enabled them to enter and inhabit a more liberated epistemological and ontological space, thus offering an understanding that there are more stories about what knowledge is, than the one(s) that they might currently embody, or have been supported to engage with. Furthermore, it facilitated significant epistemological and ontological reflexivity whereby students became skilled at recognizing existing epistemic paradigm(s), the power embedded within them, and possible new ones in their fields of practice. Their learning also included experiences of more intimately relating to the more-than-human, and for some students, acknowledging the more-than-human as a source of knowledge, insight and inspiration. These are all significant outcomes of the transformative sustainability learning experience facilitated by epistemological stretching and a decolonizing agenda. This learning shaped students' engagement with the field of sustainability as well as their ways of seeing and being in the world, thus raising important questions about what identities (subjectivities) they felt comfortable performing as graduate students – for as Bai (2015, 136) notes, to confuse the binary categories of what is sentient and what is not, 'would be considered strange, if not *crazy*'.

Expanding the ways of knowing that students respect, understand and/or engage with can help them to 'reconceptualize not just sustainability but the processes used to produce sustainability knowledge' (Miller, Muñoz-Erickson, and Redman 2011, 189; see also Fortuin and van Koppen 2016). It can also provide an important step towards educating sustainability professionals who engage in 'knowledge co-production,' a collaborative process of bringing diverse forms and sources of knowledge together in order to 'address a defined problem and build an integrated or systems-oriented understanding

of that problem' (Armitage et al. 2011, 996). This expansion also has significant implications for the ways in which learners can begin to engage with Indigenous knowledges, Indigenous knowledge holders, and the agency of the more-than-human (Smith 1999; Watts 2013). Furthermore, it can work towards 'extending the epistemological and ontological bases through which socio-ecological problems are approached' (Barrett 2012, 190) in ways that may lead towards problem definitions that are more inclusive of a plurality of epistemologies and ontologies.

Final reflections

If the concept of epistemological pluralism utilized by interdisciplinary and sustainability fields of practice is only welcoming to epistemologies that comfortably mesh with normalized academic modes of knowing and being then it is pluralistic only superficially. If this epistemological pluralism does not fully acknowledge the privilege of the University, its processes of education, and any hegemonic knowledge practices it reproduces, then the concept and pursuit would 'itself [be] part of the dynamics of the system that it seeks to change' (Miller, Muñoz-Erickson, and Redman 2011, 178). Student responses suggest that epistemological stretching has great value for preparing students in many fields to engage in research and practice with diverse communities. Learners who acknowledge worldview plurality in a more ethical and effective manner can better utilize diverse research methodologies, which may more closely reflect the epistemological values of host communities. Integrating epistemological stretching into coursework will also go a long way towards acknowledging and making space for Indigenous ways of knowing, and mirrors worldviews many Indigenous students bring to the classroom. These findings spark possibilities for future research including exploring the liminal space encountered by students in troublesome learning, the challenges such learning brings to instructors' and students' identities, implications for Indigenous students who have and have not grown up with access to traditional Indigenous teachings, and the longitudinal implications of these educational experiences for more socially and ecologically just outcomes.

Epistemological and ontological stretching makes a pedagogical contribution by putting sustainability professionals in a stronger position to acknowledge, respect and engage with different ways of knowing, including those conventionally defined as 'scientific', as well as more subjugated knowledge forms. Whether students referred to ways of knowing they encountered as embodied, intuitive, spiritual or just 'different', the awareness that they exist is important to students' expanded understandings of what constitutes valuable and legitimate forms of knowledge. Student reflections contained in this study also point to the importance of (re)considering the ontology of the more-than-human and the relational and epistemological possibilities that such reconsideration entails. This decolonizing process has profound implications not only for knowledge generation, but also for developing intercultural competency and reorienting relations with the more-than-human.

Note

1. In our use of the term 'decolonize' we acknowledge the recent arguments regarding the use of decolonization as a metaphor (Tuck and Yang 2012) Yet we also recognize that decolonization is required not only for Indigenous peoples but for non-Indigenous peoples as well. In the context of this project, the revisioning (for some) and remembering (for others) relational ways of being with the more-than-human, is the focus of our decolonizing efforts.

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