Broadening Ontological and Epistemological Possibilities within Early Childhood Teacher Education for Sustainability

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Abstract: The dominant sustainability ethos and discourse within early childhood education pursue a normative ontological and epistemological direction aimed at empowering children's agency and thus, building certain predefined moral values, knowledge, and skills. Likewise, mainstream early childhood teacher education programmes strive to build early childhood pre-service teachers' sustainability knowledge and skills, especially to enhance their capacity to be transformative agents and motivators for change to engage children with sustainability challenges. In this conceptual article, drawing on posthuman concepts, I highlight the limits of such orthodox assumptions in early childhood education for sustainability (ECEfS) teacher education and invite broader ontological and epistemic possibilities. I interrogate the human-centric assumptions that unintentionally perpetuate the deep-rooted binary thinking that separates humans from non-humans and other species. In doing so, I offer an expanded understanding of the underlying ontological and epistemic assumptions within teacher education for ECEfS. I conclude by indicating how posthuman theories serve as an impetus for epistemological and ontological multiplicities in early childhood teacher education for sustainability.

Introduction

It is generally agreed that important sustainability attitudes and values are formed very early in life, thus emphasizing the integral and vital role of early years education in working towards sustainability. This is particularly important as today's children are reared, and educated, in a world facing unprecedented environmental, socio-cultural and economic challenges. It is now widely agreed that we have entered the so-called Anthropocene predicament. Although it is not a central focus of this conceptual article, the Anthropocene concepts provides the context in situating the problem. Anthropocene is described as an era wherein human (the west in particular) activities have widely and increasingly altered the planet's ability to self-regulate and sustain life (Crutzen & Stoermer, 2000). The era is characterized by excessive human consumption and the anthropogenic exploitation of the planet's resources (Crutzen & Stoermer, 2000). It is widely discussed that the Anthropocene is a direct result of human-centred ways of being and anthropocentric worldviews about life and the ways we engage in education. To critically engage with the damage caused by humans, we need a distinct way of thinking about ourselves, about the nonhuman and the wider planetary environment. Hence, the concept of Anthropocene poses various distinct and novel challenges for education at large and teacher education in particular. Scholars argue that the Anthropocene redefines academic disciplines that had previously focused on conventional ways of knowing and being (Horn & Bergthaller, 2020).

The dominant sustainability ethos, and the discourse within early childhood education, pursues a normative ontological direction aimed at empowering children's agency, building certain predefined moral values, knowledge, and skills. As pointed out by Ärlemalm-Hagsér, 2017, mainstream teacher education programmes in Sweden, strive toward building early childhood pre-service teachers' sustainability knowledge and skills, especially to build their capacity to be transformative agents and motivators for change, once they graduate.

In this article, I aim to challenge and expand the underlying orthodox epistemic assumptions within teacher education for ECEfS. To this end, drawing on posthumanism theories, I argue for the need to rethink teacher education for sustainability within early childhood education. In doing so, I am guided by the question: how can posthumanist thinking offers a broader possibility of educating teachers towards engaging with children who are growing in the context of anthropogenic sustainability challenges.

In addressing this question, I begin by outlining posthumanism theories and underlying assumptions. A section follows where I review some of the orthodox (human-centric/child-centric) assumptions in ECEfS teacher education and highlight what posthumanism offers for epistemic expansion within ECEfS teacher education. In the last section, I conclude by sharing directions towards opening possibilities, and the pursuit of multiple ways of knowing, for sustainability in early childhood teacher education and beyond.

Posthumanist Theories

The theoretical starting point for this article is derived from posthumanist knowledge-creating practices (Braidotti, 2013; Deleuze & Guattari, 1987). Posthumanist theories seek to de-centre the human and instead explore the intertwined relationships between the human and the non-human world (Braidotti, 2013). What humans do should not be detrimental to non-humans, and there is a need to change and reconsider many underlying constructions of what it is to be human. Therefore, posthumanism urges the human (those with anthropogenetic impact) to make an ontological adjustment from comprehending the human as an individuated entity distinct from observant of the world and its human and nonhuman inhabitants to one, inextricably related to the world and only conceivable emergent with and through it. Posthumanist theories look significantly beyond shifting educational practices and demand ontological questions, where we must rethink what it is to be human, to coexist on this planet as just one among all species. Howlett (2018) highlighted that "in the face of contemporary privileging of the human, posthumanist studies have pushed back on humancentric narratives, though not entirely antagonistically, to challenge the assumption of humanization as inherently liberatory, and the human as a stable category for grounding educational and pedagogical aims (p. 107)". I contend that such perspectives that challenge the dominant anthropocentric worldview are integral to the contemporary planetary predicament.

An important point to keep in mind is that posthuman theories are not singular but comprised of different theoretical stances, approaches, concepts, and practices, such as affect theory, assemblage, new materialist theory, multi-species thinking, and the notion of becoming and becoming-with others (Bennet, 2010; Deleuze & Guattari, 1987; Fenwick & Edwards, 2011). Although there are different posthumanist interpretations, according to Braidotti (2013), one of the crucial ideas is to challenge human exceptionalism to become mindful of and eventually circumvent anthropocentrism and species hierarchies. Posthumanism hence calls into question the essentialising binary between human and

nonhuman on which humanism depends, and challenges pervasive anthropocentric worldviews.

Put differently, posthumanism is about rethinking the relationships between humans and nonhumans by challenging the anthropocentric thinking that excessively elevates human beings above other species (Deleuze & Guattari, 1987). Drawing on Deleuzian theory in her methodological engagement, St. Pierre (2004) states that Deleuzian thinking provides the chance to shift the way we imagine/think about our world and our lives (2004). She sees huge capacities for Deleuzian thinking in education, acknowledging that "we are in desperate need of new concepts … in this new educational environment" (St. Pierre, 2004, p. 286). Additionally, Deleuze and Guattari (1987) demonstrate that thinking with assemblage, for instance, pushes the globe away from fixed systems consisting of discrete objects or subjects to a more linked and relational constellation of bodies, and this assemblage is concerned with what these relationships form and generate.

Recently, posthumanism has been employed as a model for thinking about sustainability in educational research, and Susanne Gannon's (2017) research study offers one example. Gannon (2017) investigated "how singular encounters with wild animals – a swamphen, a turtle and eel-became pivot points for young people's affective and creative engagement with the site and emerging issues of environmental responsibility, sustainability and urban land and water management" (p. 91). In her investigation of human/children and nonhuman/animal entanglement, Gannon (2017) describes "unplanned and unpredictable encounters that generated affective force and mobilised learning in ways that could not have been predicted" (p. 97). Gannon (2017) reports, for instance, the students' encounter with a swamphen as follows: "everything suddenly changed when a small group of students who had wandered … found a heat-distressed juvenile swamphen lying in the weeds at the edge of one of the upper pools. This encounter with this particular animal provoked a change in the students' attitude and engagement with the site" (p. 98). These encounters of a swamphen, a turtle and an eel with the children in the wetlands were affective in a posthumanist sense, with affect exemplifying a force that is present within an assemblage giving rise to strong reactions. If teachers are not trained to utilize such encounters for pedagogical purposes, children would not have the opportunity to engage with such affective encounters in their everyday life.

Therefore, posthumanist research practices in education for sustainability (EfS) demand a radical analysis of some of the basic assumptions supporting the dominant ways of doing educational research. As Gannon (2017) states "emerging posthuman paradigms are beginning to influence approaches to educational research and pedagogy" (p. 91). In her research, the three instances-swamphen, turtle and eel-indicate the potential of posthuman pedagogies for opening learning towards the future (Gannon, 2017). Furthermore, posthumanism in EfS research offers new and different stories of human/nonhuman connections/relationships. There is a unique opportunity for authentically comprehending that humans are not separate and detached from nonhumans, but interconnected with them. These stories inspire new and different ways of knowing, thinking, and doing EfS for/in/with today's planetary predicament. It also offers possibilities for rethinking initial teacher education programmes for a more sustainable future. Before highlighting possibilities, I will engage in a discussion on how posthuman theories help to highlight the shortcomings within dominant educational assumptions at large and initial teacher education for sustainability.

Critiquing Orthodox Assumptions in ECEfS Teacher Education: Insights from Posthumanist Theories

Scholars discussed that "humanism has become a "commonsense" ideological framework that underlies dominant social, political, and cultural models including education and understandings of teaching practice" (Strom & Martin,2022, p. 2). While recognizing the limits of the dominant child-centric assumption in early childhood teacher education, recent studies have highlighted that initial teacher education (ITE) for sustainability is inherently human-centric. By doing so ITE perceives the human trainee as a "stable category" for grounding its teacher training practices and hence unintentionally perpetuates the deep-rooted binary thinking which separates humans from non-humans including animals, plants, and material forces (such as elements in the atmosphere) and other species. Similarly, Bennett (2010) has pointed out that knowing for sustainability should not just be conceived of as having the knowledge, the "right" behaviour or the required ethical values, but also, and, indeed, primarily be viewed as the ability to discern non-human vitalities and be attuned to affect. Engaging with the contemporary epistemological and ontological assumptions requires teachers at all levels to challenge traditional modes of teaching and instead be creative and offer learning experiences beyond anthropocentric limitations. This demand on the teacher ultimately calls for a rethinking of underlying assumptions in teacher education practices.

More specifically, challenging the long-standing and dominant child-centric assumptions in sustainability education requires a transformation of the way we educate teachers in ITE programmes, those who ultimately nurture young children. However, this is not just about changing the way children relate to the world, but also about developing a new ecological "identity" (identity as enmeshed and entangled with the ecology and the wider world at large) and a new subjectivity that is entangled with the non-human world. Teachers play a key role which calls for new ways of engaging within ITE for sustainability. This highlights the need to educate teachers to recognize and appreciate knowledge beyond the conventional anthropocentric (human-centric) approach. Teachers within ITE programmes need to be trained in such a way that they can engage with the non-human world as a potential site for knowledge production.

However, mainstream ITE programmes are inherently anthropocentric and child-centric. Such programmes make humans (i.e., trainees in the initial teacher education programme) the benchmark and entail humans and what they do as fundamentally more valued than any nonhuman actor/agent including animals, plants, objects, or material forces. This in turn, unintentionally, creates an unnecessary hierarchy and a dichotomy that uncritically legitimatize human actions and suppresses any other alternative perspective that does not consider the excessive privilege and power granted to the human viewpoint at the expense of the nonhuman world.

While indicating the conventional, normative and dominant privileged position of the human in an educational context, (Howlett, 2018) stated that "we see this in many places in educational studies and practices, from the destruction of the natural world and its resources to the assertion of human rationality as the highest form of life, thus justifying innumerable projects of domination over the natural world and even other forms of human life that do not enact knowledge appropriately (p.107). In response to this, initial teacher education programmes need to challenge dominant epistemic assumptions about teaching, learning and the very notion of knowledge. As pointed out by Chiew (2016), there is a need to recognize the "fundamental inseparability of ways of knowing and ways of being" (p. 14).

Hence sustainability education in general and ECE teacher education in particular, should strive to a turn that question/challenge dominant approaches that assert human superiority and instead reconcile reality by highlighting humans as intricately entangled and

relationally muddled with the wider non-human world. This involves the need to challenge the dominant contemporary neoliberal view towards life which mainly tends to qualify, socialize, and moralize humans, including young children, so that they can simply fit into the contemporary unsustainable society.

Another dimension of the required and suggested turn within initial teacher education is the need to reconfigure the very conception of teachers' subjectivity. Drawing on the posthuman perspective, Strom and Martin (2022) indicated that: "teacher subjectivity is produced via the intra-actions between and among elements in an assemblage. The teacher is simultaneously an embodied and embedded subject with some agency, and vital and in process, and connected to multiple others (both human and nonhuman, as well as material and discursive structures) that recursively intra-act (or co-make each other) to produce teachers' subjectivities" (p. 7). Hence, initial teacher training programmes within ECE should strive towards fostering such relational subjectivities where human teacher students and non-human others are in continuous and emergent relationships.

Despite the aim of challenging anthropocentrism in this section, it should be noted that the critique in this paper is neither to deny human exceptionalism nor to be merely antagonistic to anthropocentrism, but rather to highlight the important underlying ontological and epistemological shortcomings in sustainability education at large and within initial teacher education in early childhood education.

How Posthumanism Offers Broader Epistemological and Ontological Possibilities within Teacher Education for ECEfS

Drawing on posthumanist theories, I propose knowledge contributions across the following four domains within ECEfS teacher education: rethinking the notion of sustainability and being sustainable; rethinking the notion of education and principles of teaching and learning within ECEfS; rethinking the child and the notion of agency and rethinking the features of research inquiry in ECEfS.

Rethinking the Notion of Sustainability and Being Sustainable in Early Childhood Teacher Education for Sustainability

The dominant anthropocentric approach to sustainability unintentionally reiterates the human-environment binary. However, we are now in a critical phase of the planet's history wherein we are obliged, as a matter of urgency and perhaps survival, to change the way we live (Gibson et.al., 2015). It is imperative to opt for alternative ways of conceptualizing the notion of sustainability and our ways of being and knowing for sustainability. Drawing on the concepts (sections 2 and 3) from posthumanist theorizing, we need to learn to recognize that humans are a part of nature and nature is a part of us. Failure to do this jeopardizes our existence, as well as that of other species. In this endeavour, teacher education has a central role to play in the pursuit of new and alternative ways of theorizing and conceptualizing sustainability and being sustainable.

Framing ourselves within the posthuman perspective helps us to debunk conventional understandings of sustainability as a "definite", known and pre-defined goal. As indicated by Weldemariam (2017), the current premises of sustainability education in general, mainly draw on a humanist framework (i.e., capacitating and empowering humans-including young children) to cope and deal with sustainability challenges, that is to become environmental

stewards, morally rational, and behaviourally appropriate who can take care of and sustain "nature". From a posthumanist perspective, this approach has several drawbacks.

To begin with, the literal understanding of sustainability is limited by the idea of sustaining the status quo, which implies preserving what prevails rather than changing for the better. Additionally, it is a one-sided discourse that unintentionally reiterates the human-environment binary, one where sustainability is, arguably, meant to transgress. Such an understanding of sustainability and being sustainable also has an inward-looking approach that centres on humans and tends to ignore relationality with a persistent bias towards linear and causal thinking. As a result, it lacks the complexity to capture humans' entanglement and connection to the wider world, and the current imperative to be keenly attuned to nature. Likewise, the current ethos of sustainability in teacher education pursues a normative ontological direction aimed at preparing teachers for promoting agency and building certain pre-defined moral values in children (Weldemariam 2017, 2020). Such an ethos is not aligned with the ontological, epistemological and ethical underpinnings that posthumanism frameworks introduce. In line with this, the feminist scholar Haraway (2016) argued for ethics of "response-ability" and relational ethics. This begs the question: how productive is it to use the term sustainability and to what extent does the phrase serves the purpose that it is meant for?

This conceptual ambiguity in turn brings about a philosophical and scientific challenge to the conceptualization of sustainability both in general and within ECEfS teacher education. For example, Reinertsen (2017) challenges the conventional understanding of sustainability as a "definite" situation. She reconceptualizes sustainability as "processes of thinking/feeling that are pluralistic, nourishing, and restorative, all in all, as continuing processes of change that imply authentic, positive, or healthy contemporary becomings nomadically created and recreated over time" (Reinertsen, 2017, p. 242).

In the same vein, in the experimental inquiry with the weather and bees in an early childhood setting, I adopted a non-anthropocentric stance informed by posthumanist thinking (Weldemariam, 2019, 2020). Such studies show how different modes of thinking (assemblage thinking and "becoming-with"), opens up possibilities to challenge and reconceptualise humans' place and position in the world (Weldemariam, 2019, 2020). The re-conceptualization of the human and other beings and viewing their relations as assemblages and becomings can promote rethinking about the ways we approach the non-human world and actual beings in the environment. Weldemariam (2020) also viewed sustainability as an "enactment of various assemblages of data, content, action…etc." (p. 242). This in turn calls for concomitant changes in our approach to teacher education and our very conception of sustainability as both a notion and practice.

This ultimately implies a shift from the conception of sustainability as something we can do by ourselves as a human species, towards what we need to do to become with others (e.g., other species and forces), forming what Deleuze and Guattari (1987) refer to as life-affirming assemblages. Doing so will trigger a re-conceptualization of sustainability to include the formation of spontaneous and emergent life-affirming assemblages. This in turn opens up possibilities and invites us to re-examine our place in the world and our relationship with the more-than-human world and its vibrancy.

Besides, in order to engage with the vibrancy of the more-than-human world, Bennett (2010) highlights the need to work within a new ecology which refers to the political ecology of forces and things that open up possibilities for rethinking sustainability. When taking this position seriously, research on sustainability, perhaps especially in the context of teacher education, learning and capacity-building, could benefit from attending to the vibrancy of the non-human aspects of the world. Doing this opens alternative ways of knowing, such as those offered by affective and embodied ways of knowing, which may propel us forward beyond

humanist, cognitive and anthropocentric ontologies. Such an understanding offers the possibility to rethink and expand the notion of sustainability within teacher education programmes within ECE.

Framed differently, thinking through posthuman concepts makes it possible to move from sustainability as a discourse to sustainability as an emergent property of entanglement in the vibrant matter, forces, affects, encounters, and relationships, which concomitantly leads us to the question: what might "being sustainable" really mean for ECE? How can we educate current and future teachers so that they can reconceptualize environmental sustainability and enact everyday pedagogy accordingly? Rethinking our ways of living in times of acute catastrophic climate change, biodiversity loss and environmental disasters requires a creative rethinking of the concepts of sustainability and environmental issues for alternative knowledge (re)generation.

Drawing on weather-generated empirical vignettes and becoming-with the bees in a biodiversity related study, (Weldemariam, 2019, 2020), called for a different sustainability ethos; rather than viewing sustainability as a "definite" state of affairs that we can learn about as a pre-defined entity, it might be more fruitful to understand sustainability as a generative concept beyond social, human and cognitive affairs. Generative conceptualizations of sustainability may include sustainability described in various ways. For example, as forming life-affirming assemblages, becomings and response-abilities, being affected rather than something that can be mastered and controlled, entanglement, interconnection and relationship with the environment/the more-than-human world and lastly, belonging to nature or a particular environment.

Further, borrowing the term from Deleuze and Guattari, I argue for the need to deterritorialize our conceptualization of sustainability in ECE and ECEfS teacher training. Deterritorialization refers to a movement by which something escapes or departs from a given territory/context to another and produces something new/new relations (Deleuze & Guattari, 1987, p. 508). Through deterritorializing, knowing for sustainability could alternatively be viewed as an iterative process wherein humans/children become-with nature and experience themselves as nature – not separate from it. Hence, such deterritorializing processes could be understood as one component (of many) contributing to a new/alternative conceptualisation of sustainability in ECEfS.

Yet despite the potential of these generative and emergent sustainability understandings, it should be noted that there is an underlying normative aspect embedded within the notion of sustainability per se. This is the assumption that it is worthwhile that we humans survive on this planet in a good way, which makes us feel responsible and accountable towards other species and future generations. Thus, we are obliged to attend to and deal with the problems rather than passing on a damaged world to future generations. Although our ability and intelligence do not allow us to know everything, we are ethically and morally responsible for playing a critical role. The posthumanist stance that I adopt here is not intended to deny human agency, but to challenge the excessive emphasis human agency currently receives, and to offer the possibility of learning alongside other agents and forces. Akin to this post-anthropocentric perspective, Cielemecka and Daigle (2019) argue that we need to embrace "an inclusive posthuman approach to sustainability that decentres the human, re-positions it in its ecosystem and, while remaining attentive to difference, fosters the thriving of all instances of life" (p. 6). I assert that teacher education within ECEfS would significantly benefit by embracing such an expanded notion of sustainability.

Rethinking Education and Associated Principles of Teaching and Learning Within Early Childhood Teacher Education for Sustainability

Parallel to reconceptualizing the notion of sustainability and being sustainable, posthumanist theories are also useful in the development of alternative ways of perceiving education by embracing long-absent perspectives within sustainability discussions. This entails examining the ontology, epistemology and axiology of educational thought underpinning sustainability education and teacher education. Posthumanist thinking urges us to revisit the principles of teaching and learning, perspectives on the teaching content and assumptions about the role of education in society. As indicated in previous studies, sustainability education, and ECEfS in particular, mostly focus on building cognition, skills, attitudes, moral values and empowerment of children (Caiman & Lundegård, 2014; Engdahl & Rabusicova, 2010; Hadzigeourgious et al., 2011). Such an approach is confined to conventional ways of knowing and being, which unintentionally overlooks alternative ways of knowing/being, including affective, relational and embodied ways.

This calls for education and perhaps for ECEfS in particular, to enrich and broaden its context by recognizing that human beings are multiple and already enmeshed, embodied and affective, with other species and other non-human forces within an assemblage. Yet in conventional ECEfS discourse, we often talk about learning to be and learning to care (Weldemariam, 2017). Becoming-with and learning to be affected are notions that are being expanded within ECEfS. However, to learn is also to "become-with", to "learn with" and to "learn to be affected by" others (Weldemariam, 2020). Viewed in this way, sustainability education and learning/knowing for sustainability is not simply a cognitive process to know, control and master the world, but embraces how one can deterritorialize (Deleuze & Guattari, 1987) and become-with non-human others.

Likewise, to teach for sustainability is not just to transfer predefined knowledge but is rather a continuous search for generative ways of becoming. Teachers are not just hegemonic knowing agents who focus on children but rather they become-with and learn with the children and the more-than-human world. This perspective and principle need further developement in contemporary teacher education programmes around ECEfS, apart from a few scholars (Somerville and Powell, 2019; Malone, 2018; Taylor, 2020). Despite the variation across institutions and traditions, initial preschool teacher-training programmes sometimes tend to focus on providing the knowledge and functional skills that teachers need to perform everyday routines in preschool settings.

Hence, ECE and its teacher education programmes should not solely focus on the children, but rather explore what the shift, from the individual child to assemblage and from being to becoming, might contribute to ECEfS pedagogies. From this vantage point, ECE is an emergent process that invites the child to unfold and draws out relationality by offering ways of being and becoming that lead to more sustainable ways of living as a continuous search. This entails the need to explore emerging notions of relational pedagogies (Ceder, 2015; Murris, 2017) for sustainability education, and hence, future preschool teachers should be trained in how to enact relevant pedagogies.

An important dimension of enacting relational pedagogies in ECEfS teacher education is to adopt a more open view of subjectivity. Rethinking subjectivity, rather than aiming to teach any specific knowledge and skills deemed necessary for engaging with sustainability challenges, calls for repositioning the child and generating the knowledge and skills required to understand the expanded relational self. The human subject, including children, are multiple, and pedagogies must be viewed as such. Thus, there is not just one idealized learning human subject, but a range of subjects (humans and non-humans) and other agents in entangled relationships of emergent learning.

A subsequent question is whether any existing curriculum currently allows for subjectivity to emerge in everyday learning spaces. Non-human agents are manifested in a non-linear and unprecedented manner requiring an emergent, living curriculum instead of a structured and predefined one. Teachers need to remain attuned to the emergent and non-intentional characteristics of sustainability activities and potential events (Reinertsen, 2017). For instance, as observed by Somerville and Green (2015), who refer to place as an agentic entity, there is a demand for a curriculum of place and space that challenges boundaries between the human (the learning subject) and non-humans (object to be learnt). Such a reconfiguration would, of course, first require deconstruction and reconfiguration of existing curriculum frameworks and pedagogical practices. This would challenge established ways of being and invites the early childhood curriculum and associated teacher education programmes to new and generative possibilities.

Parallel to repositioning curricula, a pedagogical reorientation appears necessary. Moving towards a more relational pedagogy-or pedagogy of entanglement-implies recognizing and embracing the agentic characteristics of non-humans as well as our inevitable embeddedness in a web of connections and continuously evolving relationships. While borrowing the term pedagogy of entanglement from Gannon (2016) and Letts and Sandlin (2017), I highlight its relevance and potential for rethinking sustainability pedagogy in ECE and related teacher education programmes. Enacting a pedagogy of entanglement calls for a rethinking of our understandings of time and space in sustainability pedagogy. From this perspective, sustainability cannot always be considered as something that can be predetermined, predefined and "taught", but rather as an emergent phenomenon of becoming-with and fundamental to the continuity of life in all its richness.

Recognizing and enacting the agency of non-humans requires teachers to be in a key role in altering pedagogical conditions, and competence to undertake this must be further strengthened within teacher training. It is critical how teachers think about children, themselves, and sustainability per se, and what conditions they can create or can find in the everyday pedagogical environment. If teachers are not in tune with the agentic qualities of the non-human world (e.g., materialities, other forces, animals, places), they might unintentionally "delearn" and "denature" children or keep assemblages and entanglements from being recognized. If teachers can disrupt existing ontological and epistemological assumptions, new possibilities emerge for rethinking children with the natural world and sowing the seeds of entanglement before they become ingrained with the anthropocentric worldviews they will likely encounter after early childhood education. Thus, the way we train our teachers, shape curricula and pedagogy, and the kinds of knowledge teachers recognize as pertinent, play an integral role.

Assemblage thinking highlights children's relational entanglements and is an important pedagogical orientation to open and recognize possibilities for rethinking children's mundane and seemingly trivial everyday encounters with the non-human world in and around early childhood settings. By acknowledging these entanglements and expanding children's opportunities to be entangled with all that is around us, early childhood educators can provide a more connected way of being in the world. Implementation of assemblage thinking requires teacher training to prepare teachers to rethink and reorganize their teaching and learning activities as emergent and relational, so that all actors (humans and non-humans) come into play within an assemblage, without being constrained by predefined subject areas and prescribed goals. By acknowledging and foregrounding non-human agency, early childhood educators might be able to turn the pedagogical gaze toward relationality, reciprocity and entanglements of humans (children) and non-humans.

Traditionally, the pedagogy within ECEfS has espoused: nurturing love and care for nature and the need to preserve it; building agency; focusing on science and action-oriented

practices (Weldemariam, 2017). This, I argue, has emanated from the inherent anthropocentrism of teacher training. Teachers now need to be trained so that they reflect on and ask important questions, such as what kinds of knowledge have the power to influence us (e.g., researchers and educators) and hence, the children that we are educating?

Transformative teacher training is called for, leading to a critical pedagogy that directly invites teachers to elicit and reflect on the premises and assumptions underlying their pedagogical activities. A key point here is to possibly challenge the idea of viewing children as sole individual agents and autonomous learners or what Taylor (2017) refers to as environmental stewards. Instead, it is important to recognize ontological multiplicities and pedagogical possibilities, that is, the different ways of being and relating with others - to invite children to think and learn with the non-human world, a world that they are inherently entangled with and one they constantly encounter in their everyday lives.

This question/reflection is important in early childhood teacher education where socio-cultural and developmental pedagogies have remained dominant (Weldemariam & Wals, 2021). Arguably, children are more open and able to see themselves as integral to this world and are therefore better positioned to develop a symbiotic relationship of "becoming-with" the world. Manning and Massumi (2014) have even argued that young children already know affect. Ironically, most adults seem to have lost this affective and relational capacity, to a large degree because of their education and training. Perhaps adults could learn from how children relate to the natural environment. Early childhood education is a uniquely positioned field as it allows us to see curriculum and learning in a holistic way rather than as different domains and subjects; this can lay the foundation for a lifelong relational curriculum. Teacher training is a very good arena to develop these pertinent competencies.

Rethinking the Child: The Unfolding Relational and Affective Child

Dominant discourses within teacher education for ECEfS mainly draw on a humanist framework that continually promotes the developmental child and children's agency (Weldemariam, 2017). Drawing on posthuman concepts such as assemblage, distributed agency and becoming-with, I challenge the idea of producing a rational, ethical and agentic child, and explores possibilities for the unfolding relational and affective child, with implications for sustainability. From a post-anthropocentric perspective, the child is not a fixed autonomous and self-privileged subject but rather situated within an agentic and assemblage world in which he/she becomes-with and is affected by multiple actors, forces, and entities. Pedagogically, this opens possibilities and moves ECEfS from the agentic child to diverse ways of coming to know such as affective learning, embodied learning, and learning with and becoming-with others. The agentic relational child emerges from entanglement, interaction and intra-actions.

Challenging the orthodoxies of children's agency and embracing the broader notion of distributed agency directs us towards shared agencies with non-human actors and other species and fundamentally rethinking children's relationships with the world. This entails the liberation of ECEfS from the confinement to and celebration of the tenet of the agentic child, towards an entangled, relational, and affective subject who is constantly co-constituted together with non-human agentic forces. discuss this shift, I borrow from Braidotti's (2016) posthumanist understandings of the relational human subject, which suggests a non-anthropocentric subject position. As she highlights: "Human subjectivity in this complex field of forces has to be re-defined as an expanded relational self, engendered by the cumulative effect of social, planetary and technological factors. The relational capacity of the post-anthropocentric subject is not confined within our species, but it includes non-

anthropomorphic elements: the nonhuman, vital force of life" (Braidotti, 2016, p. 22). Specifically, Braidotti's (2016) idea of human subjectivity as an expanded relational self urges us to rethink how subjectivity has been enacted within environmental education and particularly ECEfS. Adapting a posthumanist concept of subjectivity transcends a focus on the individual by moving towards the notion of a collective and connected affective assemblage of humans as well as other species, bodies and materialities.

Thus, rather than starting with the notion of a predefined agentic child subject, assemblage thinking provokes our recognition of the ontological multiplicity that challenges anthropocentric subjectivity. As previously explored, subjectivity is co-constituted with the human children, the teachers, the researcher and the non-human actors (e.g., the force of weather and the bees) (Weldemariam 2020). Likewise, agency is shared among these co-existing subjects (children, adults/teachers, researchers, weather, and bees) within an assemblage. This implies a movement beyond the learning child to a conceptualization of the affective child alongside teachers and other agents who are also learning, interacting and becoming-with. Thus, teachers need to pay attention to and engage with the children and their own affective relationships with the natural world, as these might allow something to surface that would be otherwise overlooked. For teachers to engage with more-than-human relationships, teacher-training programmes should strive to embrace such possibilities.

In parallel with agency, ethics is another aspect that requires rethinking. Post-anthropocentric thinking challenges the idea of educating the rational and ethical child as an individual who engages with ethical principles and makes rational ethical choices. Instead, post-anthropocentric thinking calls for entangled and relational ethical practices where vulnerability and suffering are shared collectively. Such ethics call for an entangled subjectivity that "opens up possibilities for a shared pain and mortality and learning what that living and thinking teaches" (Haraway, 2008, p. 83). In the previously described "theatre", I illustrated how ethics can take shape as the children were urged to share the pain of the bees through theatre performance and their responses offered a new lens on relational ethics with performative dimensions (Weldemariam, 2020). The children performed the bees in their play, artwork and outdoor activities. In doing so, relational ethics were articulated through the children's touch (of the dead bee), hands-on activities (arts and crafts) and bodily movement (dance, music, theatre).

Relational ethics cultivate sensitivity towards the other and generate what Haraway (2008) refers to as "response-ability" (p. 71). Such ethics challenge the notion of care at a distance and instead argue for imagination to be articulated and experienced. Relational ethics also urge us to be open and receptive to the suffering of others (e.g., the bees). Thus, building on the already existing scholarship on relational ethics, I argue that ECE and teacher training should avoid educating children about abstract ethical principles, but instead open opportunities for response-abilities, cultivating the capacity of children to respond beyond simply loving and caring from a distance. ECEfS, as a discipline, needs to challenge the dominant and long-standing orthodox narratives of the autonomous, moral and relational child and introduce the affective child, a child not yet widely discussed in ECEfS research or pedagogy.

To be clear, this article is not abandoning the idea of the rational and ethical child but rather challenges these notions by highlighting the limitations and calling for enrichment by embracing and connecting with other actors and forces. In doing so, relational ethics opens possibilities for reflexive thinking, which invite us to recognize, mirror and confront our relationships with other species and forces. Thus, preparing ECEfS teachers to engage with non-human vitalities and their pedagogical affordances offers a broader scope to embrace the affective child and not just the social child which persists as a dominant discourse. This expanded perspective of the child is particularly important for ECE teachers given this is the

field where the developmental human/child is continually deployed, hence reaffirming the nature-culture binary.

Rethinking Inquiry Approaches in ECEfS and Teacher Education

The fourth contribution of the article involves the very process and practice of research (i.e., nature of inquiry) within ECEfS and teacher-training programmes. Sustainability challenges are complex and wicked; hence, they require a rethinking of our epistemological assumptions and a search for a more complex and rigorous methodological engagement. Most research orientations within ECEfS and teacher training focus on researching teachers' competence and researching on, for and with children (Lillvist et al., 2014). Drawing on the ongoing trajectory of posthuman thoughts, I will highlight a few studies that elucidated the possibilities of researching with the more-than human world.

Drawing on examples from children's mud play, Somerville and Powell (2018) indicated possibilities to rethink human relationships with the world. Taylor et al. (2012) also nudged researchers to engage with more-than-human conversations by highlighting the need to pay attention to children's relationships with the more-than-human world as a means to challenge anthropocentrism and realize the ecological interdependence between humans and non-humans. Rautio and Jokinen (2015) argued how children's relationships with the more-than-humans (e.g., snow piles) offer possibilities to see children beyond the conventional age-related developmental and moralizing approach toward learning. Such research approaches with the more-than-human world within ECEfS are indicators that research can become more complex and richer when it is not confined to the humanist framework, but instead recognizes and utilizes non-humans as knowledge-creating actors/entities. Such redefining of research inquiry can also promote engagement with the vibrancy of the non-human aspects of the world and allow us to both think within and be affected by the world beyond the human.

Attuning to and engaging with the vibrancy of the more-than-human world requires experimentation and methodological freedom. ECEfS researchers could utilize various thinking territories (species, subjects, actors, agents, forces) around them, and experimental approaches like post-qualitative inquiry. Doing so requires a rethinking and deterritorialization (Deleuze & Guattari, 1987) of the research processes and reconsideration of the researcher, and orientation of the researcher as an affective being entangled with the world they explore. Although some of these studies embraced more-than-human actors in their research, most did not engage with a post-qualitative research inquiry approach due to the lack of earlier exemplary empirical studies. Hence, there is a potential for more research to explore how post-qualitative inquiry could serve as an alternative approach for methodological creativity and hence a possible way to embrace sustainability. An empirical investigation of post-anthropocentric approaches can bring about challenges, which may include institutional structures, research cultures and scientific stances.

Yet, the implications of a post-qualitative inquiry approach for the conceptualization and research of sustainability (which at its core seeks to sustain and preserve) and sustainable development (which is to sustain continuous change) are in their infancy and need to be further explored. Likewise, it should be noted that post-qualitative inquiry and its accompanying ontological turn are not yet well established in ECEfS research or teacher education. Our role and position as researchers, including what to research and the ontological and epistemological positions explored above, do call for a thorough examination with calls for further empirical studies. This again indicates the potential for more research

that demonstrates the potential of this approach for researching and rethinking teacher education traditions.

The Pursuit of Multiple Ways of Knowing for Sustainability in ECE Teacher Education

In this section, I would like to provoke a meta-level conversation and make suggestions to propose multiple ways of knowing for sustainability when preparing teachers for ECEfS. I begin by interrogating the broader notion of science and research practices within ECEfS. At the heart of hegemonic scholarship practices within ECEfS lie inherent separations. For example, the adult researcher separated from the researched child; the living from the non-living; theory from practice; and the human (children and adults) world from the non-human world. Within this tradition, both research and practice in ECEfS appear stuck in a paradigm where binary thinking is perpetuated. By contrast, in posthuman thinking, the human world is inevitably entangled with the non-human world. As stated by Powell and Somerville (2018, p. 2), we are living in a world with "ever-changing becoming" where humans and non-humans are intricately intermingled.

The adoption of a relational ontology, which refutes dualisms, has been identified as a mechanism to become and remain attuned and engaged with matter and the non-human world (Bozalek & Zemblyas, 2016). Such an ontology leads to a more relational way of looking at humans and the environment, on the one hand, and at theory and practice in sustainability research and within ECEfS, on the other. Such a relational ontology paves the way for seeing our interconnectedness without falling into the trap of binary thinking. Enacting such an ontology requires creative thinking which invites us to challenge paradigms that perpetuate binaries. Affective, embodied, and intuitive ways of knowing could help overcome binaries and offer a path to relational and sustainable ways of being (Weldemariam, 2019, 2020).

Accordingly, teachers need to enact curricula for children that supports both knowing and acting in relation with non-human others, that is, other species and non-human forces. Knowing for sustainability should not just be conceived of as simply 'having the knowledge' or enacting the 'right' behaviour or the required ethical values, but also viewed as the ability to discern non-human vitalities (Bennett, 2010) and attunement to affect. These abilities need to be addressed in teacher training so that teachers have the skills to be creative and grapple with the idea of teaching and learning as emergent and relational. One possible approach is to create or employ life-affirming stories and narratives (e.g., Weldemariam, 2019 on engagement with the bee theatre) for pedagogical purposes. As indicated in the empirical examples from my previous discussion, thinking from a posthuman perspective provokes adults to think with children and their assemblages with the non-human world, serving as a bridge to other ways of knowing.

Additionally, there is also a need to interrogate the overemphasized notion of agency in ECEfS. Pointing out the limits of human agency, Cielemecka and Daigle (2019) highlight that "we have been powerless since there have been so many more agents than the mere human agent and since the agentic capacities of other beings have often surpassed our own very limited powers and thereby have impacted us in ways we have not suspected" (p. 2). Alaimo (2016) also states that the Anthropocene is urging us to "rethink agency in terms of interconnected entanglements rather than as a unilateral 'authoring' of actions" (p. 156). Existing knowledge within ECEfS teacher training and pedagogy largely focuses on what children as agentic humans can do without embracing the agentic characteristics of the non-human (Weldemariam & Wals, 2020). Both in research and practice within ECEfS, the agentic power mainly rests within the human (the child and the adult), essentially inhibiting

our engagement with and attunement to humans' entanglement and connectedness with other species and non-human forces.

The dominant human-centric understanding of agency has in turn led the absurdity of human thinking and belief that they alone can solve, represent, control, and master the material world, which unintentionally obscures our enmeshed connectedness with it. Despite being inadequate, and at times even inaccurate, human representations (often linguistic) simply heighten the separation. Hence, there is a need to shift the gaze from the capitalist/colonialist human, who is believed to have the ability to master and control nature, toward a conceptualization of the human that is entangled and attuned with nature. This brings about the question of creating alternative learning spaces-spaces where children can *learn-with* and be *affected by* non-human agents.

Moreover, complex environmental problems such as climate change and loss of biodiversity are presently and urgently demanding a re-orientation that recognizes multiple other ways of knowing that can help us recognize our relations and connections with nature and the wider world. Within this vein, environmental sustainability and, more specifically, ECEfS, can be conceived as a continuous quest for finding ways to live *in tune* with the non-human world and other species. This quest implies the need to combine different ways of being and ways of knowing with a plurality of scientific practices by questioning and challenging the dominant and deep-rooted binaries across all spheres of research and practice within ECE teacher education.

An endeavour to go beyond empirical analytical science brings about the need to recognize ontological and epistemological multiplicities that invite creative and generative engagement with the problems. To this end, teacher education for ECEfS may benefit from a complement of childhood studies and a posthuman lens. Given the possibility it offers to see the world beyond human-centredness, posthumanism has the potential to generate alternative and creative ways of knowing for sustainability.

Thus, I argue for a rethinking of practice within teacher education for ECEfS. Often, such practice emanates from human representation that invites and cultivates binary thinking (Scantlebury & Milne, 2020). An approach to challenge binary thinking and herald possibilities for a more relational ontology can happen when solutions are not solely human centric. Additionally, drawing on St. Pierre's (2018) refusal on the demand of application, I argue that ECEfS research and practice should not necessarily be guided by a model to be applied. Rather it needs to embrace the emergent nature of data as a happening or event that can be created and performed with children. To this end, post-anthropocentric concepts such as assemblage and becoming-with serve as tools to broaden underlying ontological and epistemological assumptions within ECE teacher education for sustainability.

Concluding Remarks

As solutions to contemporary planetary predicaments are complex, asking and teaching children to find solutions seems problematic. Rather, there needs to be a mechanism to engage young children and ourselves to remain curious about the problems the world faces, such as climate crises and mass extinction, without seeking definite solutions. Haraway's (2008) notion of "staying with the trouble" reminds us of the level of destruction that we inherit and hold in our hands and the need to stay attuned to our contact zone of more-than-human relations.

However, prescribed answers and methods on how children are to deal with ecological challenges do not exist. As an alternative pedagogical approach, ECEfS educators could work on engendering relationality and life-giving processes to encourage children to

stay curious about their questions without necessarily moving on to solutions. This aligns with Haraway's (2016) notion of the art of staying with the trouble, which urges humans to be mindful of our entangled relations with "nature" that is, other species and non-human forces.

Finally, I emphasize that ontological and epistemological rethinking has the potential to make non-human agents intelligible. Such rethinking opens spaces of attunement making it obvious how human lives, including children's, are intricately connected with other species and non-human forces. When conceived as such, ECEfS offers alternative ways of knowing for sustainability.

However, in this article, I not only indicate the limits of mainstream ways of conceptualizing sustainability but also supplement ideas and offer different possibilities of conceptualizing sustainability within early childhood teacher education. Thus, the posthuman/post-anthropocentric approach is not presented as a panacea for solving the current ecological problems; rather, it strives to decentre the human and authentically see relationality and entanglement with non-human others. Yet, although posthuman theories help identify and challenge our human-centric characteristics, they fall short in addressing the highly resilient power inequalities and dominant structures that hinders transitioning towards a more relational and emancipatory conceptualization of sustainability within teacher education. This certainly implies the need for more studies, not just of ECEfS pedagogy and teacher training, but also on ECEfS governance and policy.

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