Editorial: Advancing posthumanist perspectives on technology-rich learning

There is a tradition within the sciences that define the ontology of matter as being in a constant state of reconfiguration (Barad, 2003, 2007; Van Der Tuin & Dolphijn, 2012). The intrinsic vitality of matter as always in motion, productive and unpredictable, calls into question many of the assumptions that underlie academic fields that explain learning and cognition as being centered around humans. To disrupt human-centric accounts of practices like learning, scholars in the areas of quantum physics, neuroscience, psychology and adjacent fields take a material turn (Barad, 2003; Haraway, 1985), reframing moments when humans encounter non-human matter.

These thinkers (Barad, 2003; Bennet, 2010; Berlant, 2011) blur boundaries around people and matter to reveal how humans and non-humans respond to one another and mutually shape each other through intra-actions (Barad, 2003, 2007). As a result, notions of agency (ie, the ability to act) can be seen as not resting solely with humans but as becoming *through intra-actions* within unspecified, changing and entangled components (Barad, 2003; Grosz, 2010; Jackson & Mazzei, 2012). Collectively, these threads have been taken up within material culture studies (eg, Ingold, 2012; Tsing, 2015), cultural studies (eg, Behar, 2016; Shabbar, 2016) and literacy studies (Kuby, Spector, & Thiel, 2018), which have built on these perspectives to question the role of materials as drivers of processes through which people learn (eg, Hultman & Taguchi, 2010; Jackson, 2013; Jackson & Mazzei, 2013; Kuby & Rowsell, 2017; Taguchi, 2009, 2014; Taylor & Ivinson, 2013; Wargo, 2017, 2018; Wohlwend, Keune, & Peppler, 2019). Particularly within education, new materialist and posthuman perspectives investigate the oft-overlooked inequitable workings of materials for educational possibilities (eg, de Freitas & Sinclair, 2013, 2014; Ivinson & Renold, 2013; Jones *et al.*, 2016; Keune & Peppler, 2019; Kuntz & Presnall, 2012; Mazzei, 2013; Thiel, 2015; Thiel & Jones, 2017; Wohlwend, Peppler, Keune, & Thompson, 2017).

This work also recognizes more-than-human forces (eg, Kuby *et al.*, 2018) and rhythms of actions (eg, de Freitas, 2017) in the production of people, materials and learning possibilities. Across this shared work, these scholars question the mediational roles of materials that subordinate materials to people and suggest a more generative, helpful and ultimately more ethical flattening of hierarchies across people and matter. These ideas radically rupture the traditional role of materials as mediational means and sources of internalization to offer promising lenses for surfacing material-systematic dynamics for learning with technology innovations. Imagine what happens when these disruptions of human-centric explanations of foundational practices and concepts move into the domain of education. That is, when humans are not at the centre of learning and teaching, but part of a broader landscape of humans and more-than-humans insistently entangled across space and time. It is a sea change for fields like learning science and so it is that we embarked on this special section.

In this special section, we sought to advance our understandings about the implications of materialism and other posthumanist views of learning within education with new and emerging technologies that are increasingly part of the natural material world. While we are seeing posthumanist views slowly enter the educational research landscape, these *entrées* have been

predominantly within the field of literacy studies (eg, Kuby & Rowsell, 2017), and, to a lesser degree, educational technology (eg, Bayne & Jandrić, 2017), which prompted us to pull together this work. More specifically, this special section seeks to reconsider the relationship between the human and the material world, exploring methodological and theoretical implications, and the implications for how materials shape both learning and participation in ways that have been undertheorized to date in the learning sciences. To these ends, the special section brings together papers that establish a dialogue between theory and practice and focus on a variety of research contexts, such as schools and out-of-school organizations, museums, libraries, community technology centers, makerspaces, workplace settings and other contexts across everyday life.

The special section came to fruition after a Posthumanist Perspectives on Learning Workshop[1] at the International Conference on Computer-Supported Collaborative Learning (CSCL) in Lyon in 2019 (Peppler, Keune, Wohlwend, Rowsell, & Goldstone, 2019). At the time, the workshop felt like a stretch for conference attendees who tended to focus on learning theories based on cognitive and socio-cultural approaches and to step outside of a focus on epistemology and situated learning as a driving force for their theory and method. At first, attendees shared how the topic and approach felt risky and out of their comfort zones, but at the same time intriguing. These differing views forged a generative space for talking and sharing. What enriched our conversations during the event was the patchwork of approaches and orientations in the room, the openness to discuss and wrestle with posthumanism, and the varied ways of breaking apart key components. In the end, of the 30 attendees present during the day, individuals divided into groups based on what they foregrounded as the key constituents of posthumanism: material; agency; intra-actions; ethics of matter; and evidence of learning. Distilled down, as a group, we identified how much can be gained from applying posthumanist orientations to learning. There was a collective acknowledgement that there is more than one way to come into an understanding and it is important to offer more than one way to work with matter. Another group probed the ways that objects and people have particular, idiosyncratic ways of knowing and being through objects and that objects carry with them histories and cultures. These histories are entangled and in movement—constantly and insistently cutting agentially (Barad, 2007). Most of all, at the end of the day, we agreed that posthumanist theory helps researchers to pivot away from a sole focus on learning toward a broader conception of how we experience the world as humans intra-acting with matter.

The special section starts with an paper set within secondary schools in Helsinki. What is new and original about the research study is its movement away from a rush to offer epistemic explanations and instead, a move to more ontological explanations for design practices. By their own admission, **Mehto, Riikonen, Hakkarainen, Kangas and Seitamaa-Hakkarainen** argue that an over-emphasis on knowledge and epistemic orientations to design work within STEAM and the learning sciences have held scholars back from a more expansive 360-degree perspective on what happens when young people make and design. Taking a rigorous account of non-human and human entanglements during design processes, the paper elicits far more nuanced and textured accounts of not only thinking, but also feeling, being, becoming and embodying with materials across time and space. What stands out in the paper are moments of data analyses that look closely at relational moments entangled with material bricolage and assemblages as well as unscripted practices that reveal how young people experience through matter. Such fine-tuned posthuman interpretations of design work throw into relief how much more can be garnered by closely examining becoming and being with matter.

The second paper presents a stance on posthuman research by offering the field the notion of *critical* posthuman literacy. There is a crucial and often-neglected point in **Leander and Burriss'**

paper that considers hidden messages, agendas and black-boxed practices within Artificial Intelligence platforms, such as algorithms within typical searches, that disguise white hetero-normativity or that privilege particular points of view. In this way, there is a contemporizing of critical literacy which has been quite print-focused and leverages posthuman theory to interpret different cases of interrogating circulating discourses, ideologies, epistemologies, and ontologies across humans and matter. There are ways that people take up certain sets of values, assumptions and rhetoric, wittingly or unwittingly, through algorithms and searches that render so many of us what Carrington calls (2018) *algorithmic identities*. Are we the algorithms that we perpetuate? To disrupt and expose these hidden tacit practices and circulations of discourses and big data, Leander and Buriss apply posthumanist theory to give researchers mixed ontologies that locate humans and non-humans within algorithmic ecologies. Drawing on Latour and Deleuze, they present three cases of posthuman critical literacy to reimagine texts; to reframe multimodality; and to reposition identities. They are compelling enough to make us pause to seriously question how helpful representational mediational epistemologies and ontologies can be when excavating AI texts and platforms. What posthuman theory gives this paper is the depth and license to explore how profound and deeply entrenched the intra-actions are across humans, computers and data.

The third paper by **Sheridan, Lemieux, Do Nascimento and Arnseth** focuses on intra-action and agential cuts, taking a strong stance on the ways that posthumanism opens up scholarly fields to ethics, ontologies, and epistemologies in generative ways. It resonates strongly with the line, *"A good cut is an ethical cut, whereby an in-cision is also a de-cision"* (Wysocki & Sheridan, 2018, np). The paper moves across four different design/makerspace/media research studies: one featuring a group of girls in Kentucky becoming digital media producers; one in Halifax on makerspace activities with higher education students; one in Hamilton on children intra-acting with matter to think about environmental imperatives; and, one in Oslo in a science and technology museum with young people thinking about material entanglements. Some examples of interpretative work in the paper, concepts such as material-discursive entanglements are applied to young girls' production work and exploring children's thoughts about "a depressed tree" as evidence of matter and the tacit ways that people learn and become through matter. These examples are so varied contextually, and they are radical in their capacity to push back on a dominant human emphasis and narrative in educational research, giving ample room for the agency of matter. The worlds portrayed and lived in these empirical research case studies are relational, critical and most of all, ethical.

The fourth paper by **Kumpulainen and Kajamaa** profiles another research study in Helsinki, but this time in a primary school. Drawing significantly on relational approaches to sociomateriality, the researchers create a language of description for the complex relational ways and machinations that children engage in and entangle with as they work with materials. Framed as in flux and fluid, agency becomes slippery and nimble—especially as agency shifts and cuts across humans and materials. The Fuse Studio is a learning platform that allows students to choose a challenge that appeals to them and then go about designing the particular challenge (eg, design a robotic arm), all the while accessing written materials and video tutorials. Data analyses spotlight tensions and agentive movements that ensued when students encountered difficulties and/or frustrations with materials as they designed on and off screen. There are rich, detailed data excerpts on how students work together with matter and how matter works with students. Matter comes alive and is activated in this space and student agency changes and cuts in return.

The fifth paper by **Oshima, Oshima and Saruwatari** takes on a more traditional learning sciences lens of knowledge-building toward the advancement of a methodological approach related

to social network analysis. The methodological approach makes it possible to capture and evaluate students' knowledge improvements. This paper seeks to extend canonical notions and metaphors within the learning sciences by adopting a posthumanist twist to knowledge-building discourses. The authors build on intersections of these perspectives interpreting both as approaches that help conceptualize learning as located without (rather than within) individuals. Through network analytical methodologies these emergent inter/intra-sectional epistemologies can be traced and captured toward a better understanding of student learning.

The sixth paper by **Sintonen** is exploring two materialities—digital and non-digital painting—in intra-action with a creator in order to better understand how materialities produce creation processes and meaning-making possibilities. Questioning the immateriality of digital divides and interfaces, the paper explores the relational intra-actions to identify the affordances and constraints of digital and acrylic painting through an autoethnographic process. The process included going back and forth and back again between acrylic and digital paint producing hands covered in paint and wanting "to leave these unwashed." (p. 7) as well as scalable canvases "to dive into" (p. 7) artwork. The study highlights the opportunities that materialities hold for educational design and pedagogical practice. The paper leads us to challenge the metaphorical use of existing technologies for the design of novel interfaces and to consider much more carefully the digitization efforts that we support through practice and policy within government-driven educational initiatives.

Similar to Sheridan *et al.*'s international case assemblage, the 7th paper by **Eglash, Bennett, Babbitt, Lachney, Reinhardt and Hammond-Sowah** moves across international contexts highlighting how an African, South American and North American ethno-craft and maker-centered model works across educational contexts. The paper presents a generative STEM framework for design pedagogy that is more inclusive to STEM and that respects and honors Indigenous ways of knowing; valuing the transformative histories of Indigenous technologies within educational research and instructional design. The paper provides timely insights into how posthumanist perspectives that begin with Indigenous ways of knowing opposed to quantum physics-based perspectives promise to help decolonialize technology innovation as well as educational curriculum design. This active decolonial stance reminds us that posthumanist perspectives bring together a multitude of voices regarding technology design practices and ecosystems. The paper particularly highlights Indigenous knowledge as a basis for posthumanist frames and shows how productive it is to focus on relational technologies that support "content-aware" (p. 12) educational practices.

There are a number of takeaways gained from this special section for researchers across a variety of fields, from learning sciences to educational technologies and digital humanities to STEAM and literacy studies. To begin with, there are insights about posthumanist technology design, such as Sintonen's account of material metaphors and a deep dive into unique qualities of digital materialities as well as Metho *et al.*'s account of being with matter. Add to this Leander and Buriss' critical lens on human and non-human intra-actions within immersive digital domains and the necessity to unravel and unwrap underlying agendas, biases, and ideologies. Second, there is something profound about Sheridan *et al.*'s call to acknowledge our ethical responsibilities to matter and ultimately, the ways that younger generations often seem more attuned to the uncertainties and vulnerabilities of more-than-human worlds. Eglash *et al.* point to material reverence within Indigenous traditions and how essential it is for us as educators to develop deeper respect of Indigenous ways of being with matter. Finally, all of the papers address methodological imperatives that educational researchers must face and respond to at this contemporary moment. Oshima and colleagues show how learning is not something that is solely in mind, but

rather connected across systems, and researchers need ways to identify and explore these systems. Kumpulainen and Kajamaa spotlight the depth of knowledge and wisdom children have with matter and as they work together to figure out materials and technologies as they make and become together. There is something powerful across these papers that points to how entangled people are with the matter and ultimately, the ways that these entanglements offer spaces of emergence and becoming.

Note

[1] Website for *Posthumanist Perspectives on Learning* pre-conference workshop. Retrieved from https://materialityoflearning.weebly.com.

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