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Troubling the Social: Entanglement, Agency and the Body in Science Education

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1. What is the social that we trouble?

This introduction to the “social” in science education that is troubled in the following texts will be based on our own experiences of adopting various socio-material theories in research. These experiences have brought us to recognize the challenges that emerge and which we wish to address in this in-between chapter.

First, what is *the social* that we trouble? To start off, we might choose to translate “social” into “human”, thus understanding it as involving all endeavors where humans are. To us, however, troubling the social in science education means to accommodate its interconnectedness with all “the rest”. Consequently, the social needs to be understood not as an entity of “human”, but in combination with its entire social, cultural, and material embeddedness. We call this a socio-material standpoint (Serder, 2015, Løken, in review), which, in this sense, leans toward post-humanist material feminist theorizations, and learns from Science and Technology Studies (STS) and Actor Network Theory (Latour, 1999, Law, 1994). The purpose is to assert the principle that entities take shape through interaction or, as perhaps more precisely termed by Barad (1998) as “intra-action” with other entities. In our view, one of the most important benefits of this research approach is the troubling of the question of agency in general, and more specifically, “the possibility of non-human forms of agency” (Barad, 1998, p. 112).

To be human is to have ongoing relations with everything non-human, or, to paraphrase Bruno Latour in his *Reassembling the Social* (2005, p. 2), “It is no longer clear whether there are relations that are specific enough to be called ‘social’ and that could be grouped together in making up a special domain that could function as ‘a society’”. In the

following three texts, we claim that the relations between humans and non-humans, and indeed between humans themselves, are the core focus of interest. Hopefully the reader will find that such an understanding of “the social” allows the researcher to raise questions about learning and knowing.

2. A socio-material approach

We have employed a socio-material approach in this in-between chapter by engaging with the following three texts as empirical research material with which we are intertwined. This has entailed a method of going back and forth in dialogue with each other and the texts themselves—the materials with which we entangle. This has given us an insight into the method of *diffractive reading* (Barad, 2007), which is used in one of the texts by Auli Arvola Orlander and Marie Ståhl, by actually performing the method ourselves during three days together. Just as with Arvola Orlander and Ståhl (ibid), we believe to have experienced *becoming-with the data* (Hultman & Lenz Taguchi, 2010).

When we started to engage in socio-material theories, one of the most difficult ideas was how can we consider non-human matter in terms of agency. In two of the texts, the non-human takes the form of a human with non-human extensions, by using Donna Haraway’s figuration of the *cyborg* (Haraway, 1991). The cyborg, as with other figurations, allows us to think differently about how things are put together (Haraway, 1991). We conceive of figurations as a way to approach the possible agency of artefacts, molecules, technologies, and even rituals and practices. Furthermore, we understand agency as an effect of intra-actions between the human and non-human. According to Karen Barad, agency is not something humans or non-humans have, but what occurs in the actual engagement, or intra-action (Barad, 2003). Therefore, another word for intra-action is co-constitution.

A socio-material approach seeks to avoid representational views of knowledge, and replace them with other ways of thinking about objectivity and truth (Serder, 2015). This will be evident to the readers of the three texts that constitute our empirical material. The reader will also become aware of the three authors’ struggle to be fair to the social and material aspects in the analysis of their data. We have also experienced this ourselves. The question is: How can these appealing theories operate with the empirical material in order to serve them well? We are using this opportunity to stress what is in it for us, that is, to articulate some of the contributions of the socio-material stance through examples of how the authors have engaged with this task.

3. The material body in science education and research

The three texts do not unanimously adopt an explicit socio-material approach; however, two have an explicit post-human stance, namely the chapter by Arvola Orlander and Ståhl, and the chapter by Ståhl. Kathrin Otrell-Cass actually defines her research as socio-cultural with references to John Dewey and Lev Vygotskij. However, in all of the texts, we can read an interest in becoming-with the embodied, material world. Otrell-Cass addresses the sensory aspects of science education learning, and the interplay between the senses and the material world. The inseparability of the mind from the body is likewise recalled in her text, as she refers to Dewey's term "body-mind" in order to bring the two concepts closer together. The body-mind is present in all of the texts, and makes room for new relations and interpretations in science education research. Otrell-Cass writes about "seeing" with her ears, and Arvola Orlander and Ståhl are reading "with" their bodies. The latter two authors claim that they have experienced learning in a bodily affective way. Knowing thus emerges "in-between", something that occurs for the authors during their diffractive reading inspired by approaches often labeled as "material feminism" (see, for instance, Alaimo and Heckman, 2008).

According to Stacy Alaimo and Susan Heckman, "material feminists want to know how we can define *the real* in science and how we can describe non-human agency in a scientific context" (2008, p. 7). In Andrew Pickering's work (1995), the human and the non-human in scientific practice are in constant and mutual accommodation and resistance, in a "dance of agency" (1995, p. 102), a movement for which he uses *the mangle* as a metaphor. The mangle pulls material agency into the terrain of human agency and mixes everything up, such as Arvola Orlander and Ståhl interestingly try to do in their work on diffractive reading.

Using the concept of the "mangle" to explore practice and science education issues can be particularly useful, as it allows the researcher to understand the array of causal factors involved in the event (see, for instance, Serder & Ideland, 2016). Ståhl uses "mangling" as an analytical tool in her reflection of how the intra-actions between a chemistry test and the students taking it produce different subject positions. With inspiration from Haraway's concept of "the apparatus of bodily production" (Haraway, 1991), Ståhl wants to emulate the test as an apparatus – a world in the making (Haraway, 2004, p. 330) – allowing for different figurations to emerge from the mangling. It appears to us that, also in Otrell-Cass' text, we could use the concept of apparatus for the sensory pedagogy she is advocating, using such examples from students' experiences as hot/warm water, glasses, and plastic wine corks. Nevertheless, the material is more than a tool or an artefact. The apparatus as a feminist figuration is a relation: an intra-action.

Feminist figurations, used analytically in the texts of two of the authors, speak to thought, feelings, and body (Lykke, 2009). Why involve the material body as sensoriality and affections in research? The answer could simply be: Why not? Feminists have critiqued the scientific rationalist discourse and the nature/culture dichotomy for decades. However, in an anti-essentialist mode, the objectification of bodies has continued to trouble feminist thought. Haraway's concept of the "God trick" relates to the problematic idea that nature and bodies are passive resources for culture and mind (Haraway, 1991), to which Arvola Orlander and Ståhl respond: "The body has to be involved because the body is always a complex, contradictory, structuring and structured body whose parts are impossible to separate." (Arvola Orlander and Ståhl, referring to Haraway, 1988, p. 589). The authors continue by concluding that the only position from which objectivity cannot be practiced is from the "standpoint of the master", illustrated by Haraway's metaphor of the God trick.

4. Disclosure of the social from a post-humanist stance

The commonality of these three texts is the troubling of reductionist analysis, or rather some of the ideas that are often attributed to a positivistic scientific stance: the goal of science as rational, logical, disembodied, objective, and value-free knowledge. They also have in common a more or less explicit critique of dichotomies, whether it is the body/mind, nature/culture, or human/non-human. Our experience is that although post-modernism as a whole has given us important insights, it is also the case that some post-modern thinkers do the opposite of what post-modernism claims to accomplish, that is, to deconstruct dichotomies. The challenge that confronts post-modern and post-humanist thinkers, including ourselves and the authors of the three chapters, is to define a theoretical position that does not privilege either the human or non-human, but instead explores their intimate co-constructions (Løken, submitted).

In this book, the cultural, the social, and the political have been separated into three different perspectives. Our "socio-material reflex" suggests integration to dissolve categories such as these. How otherwise can we deal with the hybrids and tricksters (Haraway, 1991)? At this point, we have arrived at one of the ever-present risks of reproducing the same dichotomies and pedagogies of difference that the material feminist or post-humanist-inspired researcher is actually seeking to escape: While problematizing *some* categories, their opposites are simultaneously construed. We believe it also illustrates how constrained we are as researchers operating within our human discursive limits.

This in-between chapter has examined how a socio-material approach refuses to take for granted the distinction between the social and cultural, and the human and non-human, and moves beyond the zones of human-centered research at large. Our objective has been to contribute to a new understanding of how reading the three texts with a socio-material approach draws the material back in. Learning from the work of Haraway, Barad, and other post-humanists about the complexity of our world and becoming-with, we can work from here to develop reflections that speak across differing forms of becoming-with in science education research.

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