AFTERWORD

STS in/as education: where do we stand and what is there (still) to gain? Some outlines for a future research agenda

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Any attempt at choosing a homogeneous concept to establish connections among all entities (association for ANT ...) has a powerful but short-lived effect ... [I]n my experience, the half-life of descriptive theory is about five years! That's at least what has happened to ANT's quickly diminishing returns. (Latour, 2014, p. 265)

In his review of Eduardo Kohn's (2013) excellent book *How forests think*, Latour (2014) discusses differences and similarities between actor-network theory (ANT) and the semiotic ethnography as advanced by Kohn. In this essay, Latour – reflecting back on ANT's adoption throughout the social sciences – provocatively states that ANT has turned into being 'inoperative'. Whilst during its advent in the 1980s ANT had some powerful and generative effects, Latour argues, these effects were 'short-lived' because their generative potential shrunk very fast: scholars were saying largely similar things about different practices studied. Clearly, Latour was up to something. A similar argument was made a year before in the seminal *An inquiry into modes of existence* (2013), where he eloquently describes the first attempts of an (imaginary) anthropologist in effectuating ANT-inspired research. It is worth quoting the argument at length:

Although our anthropologist is rather proud of her discovery, her enthusiasm is tempered a bit by the fact that, while following the threads of the networks, she notices that she has lost in specificity what she has gained in freedom of movement. It is quite true that, thanks to the networks defined in this way, she really can wander around everywhere, using whatever vehicle she chooses, without regard to the domain boundaries that her informants want to impose on her in theory but which they cross in practice just as casually as she does. And yet, to her great confusion, as she studies segments from Law, Science, The Economy, or Religion she begins to feel that she is saying almost *the same thing* about all of them: namely, that they are 'composed in a heterogeneous fashion of unexpected elements revealed by the investigation'. To be sure, she is indeed moving, like her informants, from one surprise to another, but, somewhat to her surprise, this stops being surprising, in a way, as each element becomes surprising *in the same way*. (Latour, 2013, p. 35. Emphasis in original)

Latour is cautioning against the pitfall of adopting ANT as a *theoretical* vantage point that would make explicit (epistemological) assumptions about how the world is made. For instance, one could think of generic – homogeneous – theoretical arguments stating that practices are consisting of relations between actors that need to be scrutinized with a disposition of generalized symmetry; that actors associate with each other; and that one needs to trace such associations between mediating actor (-network)s in order to disentangle distributed agency. Even though Latour is only addressing specific 'ANT-as-theory adoption' in these critical lines, the argument could easily be transposed to the broader field of Science and Technology Studies (STS) in general. For instance, one could easily imagine a practice theorist finding herself lost in stating that everything boils down to nexuses of interwoven practices, a Deleuzian being puzzled by the fact that everything seems to be consisting of rhizomes and assemblages, or a scholar adopting Barad finding that all the entities she aims to analyze seem to intra-act with one another.

However, approaching STS in terms of theoretical (meta-)narratives that allow us to explain social (or sociomaterial) life away not only leads to repetitiveness ('each element becomes surprising in the same way'), it equally leads to what could be called *conceptual fatigue* (each analysis is being effectuated through making use of a similar

conceptual theoretical toolbox). Importantly, STS in general and ANT in particular are, strictly speaking, not seeking to add up or to cumulatively build a body of theoretical conceptions about how the world and its constituent sociomaterial practices need to be understood. As such, and to put it somewhat coarsely, treating ANT and STS as theory is a fallacy. Instead, one of the prime characteristics of these research strands is that they operate much more as *sensitizing devices* that allow researchers to focus on relational features of the setting(s) under investigation – in particular how various practices are ‘done’ and ‘being made’ (Fuller, 2006; Woolgar & Lezaun, 2013).

‘Showing how’ or ‘telling that’? Using STS as a sensitizing device

In drawing this special issue to a close, it is important to again stress this crucial point, even though the argument has already been circulating within the STS field for at least two decades (see e.g. Latour, 1999). The importance of recalling this point here is at least twofold. First, as the editors of this special issue argue, educational research has been curiously slow-paced in taking up some of the insights provided by STS (see *Editorial* in this Special Issue). One might therefore wonder: Now that the uptake of STS in educational research is gaining momentum, doesn’t the educational field fall prey to the same risks as the ones outlined above? Is there a risk that STS concepts and sensibilities deployed in the field of education are quickly ‘diminishing returns’, saying the same thing about different educational practices over and over again (thereby actually conflating sensibility with theory)? Has STS already found its theoretical half-life in education, or are we conversely treating their insights as sensitizing devices? Here and there, it has been hesitantly argued that this concern indeed poses at least a potential challenge to the field of educational research. For instance, Fenwick and Landri (2012) argue for making a distinction between educational STS/ANT studies that merely *tell that* educational practices are sociomaterially composed by relational entanglements on the one hand, and studies that concretely *show how* such relational distribution and sociomaterial composition is being brought about, by meticulously tracing and disentangling the relations between actors that are necessary in order to do so, on the other hand. Thus, the proposed distinction between showing and telling points to similar concerns as Latour’s cited above: the potential danger of homogenizing concepts that were contrived during a specific study, and with a particular purpose (showing and accounting for something) in mind. *Generally* speaking then, a prime concern for educational research is not to fall prey to the risk of quickly diminishing returns when taking up STS in education, for instance by continually recycling (‘telling’) theoretical arguments and concepts (Fuller, 2006; Decuyper & Simons, 2016a).

Second, this argument is equally of *specific* importance here because I would like to take it as a springboard for concluding this Special Issue. The collection of studies gathered here all adopt various STS approaches as sensitizing devices, enabling them to become attentive to important dimensions and evolutions in contemporary educational practices. Yet, attentive to what precisely, and showing what precisely, then? And what does that say about the present state of STS in education? Thus, I want to take these concerns as generically addressed by Latour but equally present within the educational field as a starting point, and ask the question ‘Where do we stand right now in the field of ‘STS and education?’ – seeking to ‘show how’ (rather than ‘tell that’). In order to do so, and reminiscent of a latent twofold approach that

runs throughout the Special Issue, I will make a distinction between STS *in* educational research and STS *as* a form of education in and of itself. Importantly, I will consider this Special Issue holistically. That is to say, rather than ending with a linear summary of the arguments raised in each individual paper, in this piece I am going to approach the Special Issue as a collection that conveys where we presently stand as a research field. This approach, I hope, will allow me to subsequently open things up, and more particularly to identify some outlines of a future research agenda for educational scholars that (want to) make use of STS and its central sensibilities.

Where we stand: STS in/as education

STS in education: making, remaking and unmaking

There are many points to make about the present state of STS in educational research (e.g. de Freitas, Lupinacci & Pais, 2017; Edwards, Fenwick & Sawchuk, 2015). In the most general sense, one could state that educational research drawing on STS allows to trace, disentangle and subsequently show how relationality is one of the prime characteristics of each and every educational practice. Based on this very general point, one could then go on further to argue that this relational sensibility allows researchers to escape long-standing dualisms between agency and structure, micro and macro, social and material, and so forth. This is all good (and well-established, see e.g. Latour, 2005; Law, 2009), but these very broad points would not do justice to the original contributions of the articles gathered in this collection and would at once not be very helpful in showing how the field is unfolding further (for the general argument, see e.g. Fenwick & Edwards, 2010). Adopting the holistic position, I rather aim to highlight four points that seem to be running throughout the collection. This is undeniably a stringent reduction of the analytical richness present within each of the papers, but it will allow me to disentangle some of the central aspects where *educational* STS studies make an important contribution and identify how the field has been developing lately.

First, the adoption of STS in educational research has led to a profound sensibility towards the effects generated by such relational distributions (e.g. Law, 2007; Fenwick & Edwards, 2010). This moves the abovementioned point just a bit further, in the sense that it not only stresses relationality, but equally the effects that such relationality generates: relations *make* practices (and actors). Indeed, the larger part of educational studies adopting STS have focused on how educational practices (e.g. education policies; a classroom) or some specific actor(s) populating these practices (e.g. policy documents; teachers; pupils) are continuously in the making by and through the relations present within a particular practice or assemblage. This focus only works to the extent that STS studies succeed in not building a theoretical stronghold (that tries to explain the generated effects), but rather transmute the conceptual repertoire as each specific study requires. As stated, STS does not operate as cumulative theory (i.e. builds on what is ‘made already’), but rather as a list of conceptual terms that might resonate with the study at hand (or not). Most of the time, in order to be able to provide an adequate account of practices in the making, STS studies need to develop new terms that enrich the conceptual repertoire already present (Mol, 2010). Examples of such conceptual elaboration that account for the effects of relational distributions in the making can be found in **Ratner’s** paper – in this Special Issue – (coining the term ‘description devices’) and in **Sundström**

Sjödin's paper (making use of the term 'folded valuations') – also in this Special Issue.

Second, one of the major contributions of this Special Issue is that it seeks to extend this focus on 'making'. If educational practices are always in the making, this at once implies that something else – something established – is being *re-* or *unmade*. The point might seem trivial, but it is of crucial importance: in giving accounts of practices in the making, educational studies often limit their focus to the processual nature of phenomena *as they are unfolding* (e.g. Sørensen, 2009). This shouldn't be surprising, since it is one of the major strengths of STS in educational research: it allows, often ethnographically, the researcher to trace how a particular practice is relationally unfolding at – and *through* – a particular moment in time. Many papers in this issue, however, explicitly aim to move beyond this 'presentism' that is often assumedly operating within educational STS studies. Instead, they show how situatedness and processuality might give way to stabilization and crystallization at a particular point in time, but never in a determined manner and never for once and for all: stabilizing something always means to destabilize something else, to unmake something established, to remake what was (already) given. Psychological learning theories such as behaviorism and social constructivism, for instance, are not *necessarily* here: they are made and continuously fabricated in and through concrete practices, thereby at once re/unmaking other competing theories – see the paper in this issue by *Saari & Harni*. The situated and contingent nature of how we think about learning, hence, can equally be *remade* and opens up different ways of thinking about what 'learning' might be or consist of when approached through an STS lens – see *Mulcahy*.

An important corollary of focusing on relational (re/un)making is that *it takes effort* to bring something into being. Whatever their precise focus, the articles in this Special Issue all show very concretely how things are never just 'out there'. Rather, they need to be produced, worked on, reinforced, stimulated, configured, etc. This insight is helpful on at least two levels: it assists in being alert to (enacted) forms of difference without having to assume that these differences are merely a representation of a singular world, and it assists in disentangling temporalities out of a concern with past, present and future.

Third, as far as this alertness to difference is concerned, this Special Issue deploys STS insights as sensitizing devices in order to refuse to draw on 'context' or other assumed-yet-unspecified markers as explanatory tools. Rather than assuming that actors are determined and shaped 'by reference to the external circumstances of their existence' (Woolgar & Lezaun, 2013, p. 323), the papers collected here adopt lenses that allow them to analyze *how* multiple educational realities or worlds come into being. These processes and operations of *enactment* should, again, not be viewed as a theoretical stance that would afford one to merely *tell* that 'everything in education is brought into being'. Rather, and with painstaking attention to detail, the papers in this volume *show* how different educational practices create particular sorts of worlds. In doing so, they approach these differently enacted worlds not as 'made already', but on the contrary as being realized, and in order for such realization to take place, educational practices make use of highly specific devices and techniques. Being a 'child at risk', for instance, is a category that is being shaped, but the same applies to being a 'teacher' who identifies children at risk. In order to shape such categories, which in their turn shape particular 'kinds of people' and specific figured worlds (Hacking, 1999), specific devices need to be constructed and made operable – see the papers by *Ratner* and *Sundström Sjödin*.

Equally, all educational technologies, be they contrived in highly ‘innovative’ Silicon Valley organizations – see *Chang* – or within the confines of national governments – see *Høvsgaard* – always *presuppose* particular sorts of users as much as they actively *configure* their users (Woolgar, 1990). Interestingly, the papers in this Special Issue show very clearly how such presupposing and configuring are, again, not unidirectional processes. Adhering to the relational sensibilities offered by STS, what these papers make abundantly clear is that such presupposition and configuration are, in their turn, always dependent on what happens in concrete practices (which are always to a certain extent recalcitrant, for instance through unruly behavior of actors or through alternative visions advanced). In that sense, practices always *reconfigure* imagined or portrayed kinds of people and figured worlds (and vice versa). In sum, STS in educational research allows to show how people, things and practices ‘show up’, that is, how their ontology is always a *regional* accomplishment or what Packer (2018) calls a cosmology: a different reality among multiple realities with its own interpretation(s) about what education, studying and teaching are or (could) consist of.

Fourth, it is argued here that this focus on how regional ontologies and cosmologies come (performatively) into being cannot do without an explicit dealing with how *temporalities* are enacted. This focus on temporalities is another major strength of this collection, since this has largely been sidestepped, both in STS literature in general (Serres, 2017) and in critical educational studies in particular (Decuyper & Simons, 2016a; Lingard & Thompson, 2017). One might suspect that this could be due to the prevailing STS concern of analyzing practices in the making (cf. *supra*). Yet, taking the focus on (re/un)making seriously equally implies that what takes shape (or is being given shape) now, necessarily impacts future relationalities and assemblages (how precisely then, is of course a matter to be analyzed and discussed). Indeed, a focus on enactment in a certain sense always necessarily implies a focus on the (portrayed) sorts of future that are being constructed. Some papers do explicitly take this insight into account, by stressing and highlighting how the enactment of multiple worlds *in the present* will have ramifications in/for the future. For instance, these papers argue that the future of education is largely being envisioned by present-day governing mechanisms and operations that seek to reduce uncertainty and limit the range of possible futures (see *Filho & Kamp; Chang; Høvsgaard; and Ratner*). This unavoidably broadens the scope of the ‘presentism’ characteristic of so many forceful educational STS studies: if teachers, pupils and more broadly educational realities are always brought into being, this collection shows that we should equally reflect on how these educational actors *will* be brought into being. In that respect, educational STS might fruitfully adopt broader discussions in the educational literature that focus on the making or fabricating of (future) education and that, for instance, point to the fact that education is always prone to processes of *taming* and *containing*, as well as being (re)made by projecting what is deemed to be worthwhile onto the future generation (e.g. Masschelein & Simons, 2013; Popkewitz, 2007).

In sum, this focus on making, unmaking and remaking runs as a common thread throughout this whole collection. To be clear: the point here is not so much that existing educational STS studies are overly concerned with the present. Rather, the point is that this Special Issue showcases the *consequences* of showing how educational practices are constantly in the (re/un)making. This opens up important insights for a productive future of STS studies *in* education (last part of this article). Yet, STS can equally be considered *as* a form of education in and on itself. It is to this last point that I turn now.

STS as education: educating through researching

Besides giving a state of the art overview of where we stand in researching education *through* STS, this Special Issue equally highlights how STS can be deployed within educational activities themselves. There is a strange tension to be noticed here: whereas the general STS-field has recognized the educational capacity of its insights raised throughout the years, educational researchers themselves have largely abstained from exploring and developing this capacity. As far as the former is concerned, STS scholars have broadly explored the educational potential of teaching students and pupils how to *map* and subsequently *analyze* controversies (e.g. Venturini, 2010; 2012). Drawing on STS's insights in the making of scientific facts, several educational initiatives have been developed that aim to teach students how science is a practice of fabrication *and* objectivity; how this fabrication doesn't engender relativity but precisely seeks to do justice to the activities of scientists; how facts rarely take up an isolated role but are rather heavily entangled with other societal actors and values; how scientific controversies amplify all of this to such an extent that it is no longer evident to take a singular course of action; etc.

As such, and as far as the latter is concerned, the insights developed by STS are not simply something that can be taught in class or in the lecture hall (which would be a form of research-based education – Simons & Elen, 2007); they equally have the potential to be developed in particular pedagogical approaches (Latour, 2010). At this point, it might maybe more apt to speak of a *paradox* rather than (merely) of a tension: the development of STS-inspired pedagogical approaches has largely been ignored by educational STS scholars themselves. STS *as* education, hence, is an issue that is currently underexplored in educational circles. In this Special Issue however, we are introduced to much-welcomed experimentations in the classroom inspired by the techniques of controversy mapping (see paper by *Elam, Mäkitalo, & Solli*). Drawing on the arguments as outlined above, of particular significance here is how it is being concretely shown that controversy mapping, when introduced in the classroom, is prone to specific operations and processes of (re)configuring teachers and students, and that *remaking* the classroom by infusing it with a novel pedagogical approach results in particular (wanted and unwanted) effects. Crucially, if we seek to educate pupils and students *through* researching controversies, that is, to conceive of STS *as* education, it seems as if there still is some major work to be done – which brings me seamlessly to the final part of this article.

What there is (still) to gain: some outlines for a future research agenda

In all, this Special Issue clearly shows the richness of adopting STS insights as sensitizing devices that enable researchers to approach educational practices as relational entanglements which are always in the (re/un)making. Equally important, it shows the potential of adopting STS *as* education, for instance by educating through researching scientific controversies. At the same time, several issues seem to be latently present in this collection, but not fully explored yet. I can only briefly outline four of these issues here. However, taken together, I hope they might inform a future agenda for STS in/as education.

- *From tracing to dealing with uncertainty.* Both STS in and as education have already largely dealt with tracing complexity and uncertainty, and showing concretely how such complexities and uncertainties continuously unfold. Yet, what is at present not fully explored is how educational STS studies might help students and teachers to *learn to deal with* such matters of public concern. It is one thing to show the heterogeneity and entanglements of contemporary educational practices, but it is arguable a very different thing to proceed from such showing to learning to cope and deal with our increasingly complex life (something that the very *act* of mapping controversies does not allow to do, as **Elam, Mäkitalo & Solli** clearly show). This would amount to a searching for, and developing of, educational practices that are able to enhance students' and teachers' *response-ability*, i.e. the required capacities and distributed agencies that need to be deployed in order to be able to respond to our ever complex world (Haraway, 2016). Rather than taming complexity, this would imply to learn to deal with presents and potential futures that are necessarily complex and difficult to anticipate. Additionally, this would require that educational STS researchers explore much more extensively what this process of 'learning' is, does, comprises and entails. There are traces of such explorations present in this Special Issue (**Mulcahy; Elam, Mäkitalo & Solli**), associating learning with ruptures, shocks, hesitations and, more broadly, things forcing us to think (cf. Stengers, 2016). A more profound elaboration of learning might equally be substantiated by inserting classical and forceful pedagogical notions such as emancipation and (hidden) curricula (back) into contemporary STS discussions.
- *From method adoption to method construction.* STS approaches are somewhat notorious for lacking explicit engagement with research methods, and the same thing holds true for educational versions of STS (Fenwick & Edwards, 2010). A few exceptions notwithstanding (e.g. Law, 2004), research methodology continues to elude STS – an observation that seems to apply to this specific collection of papers as well. It has been argued that this affords the STS researcher the (pragmatic) possibility to cherry-pick methods as deemed appropriate for the purposes of a specific study (Fuller, 2006). On the one hand, this methodological evasiveness indeed allows for a pragmatic attitude towards research methods, analogous to picking up the right tool required for the specific job at hand. On the other hand, however, such picking-and-mixing might convey the impression that STS is flabby when it comes down to research methods. The associated danger here, of course, is that STS studies might convey the impression that one finds whatever the conceptual repository of STS allows one to find (reminiscent of Latour's quotes above). An important future task to undertake then, is at once being more precise and elaborate when reporting about the methods deployed as well as seeking to develop and substantiate new methods that operate and function as sensitizing devices themselves, or to phrase this otherwise, that spark our curiosity, direct our attention, and give us the tools to see how educational practices and actors come about precisely. This task has recently been central to the work of many STS scholars (e.g. controversy mapping, visual network analysis, digital methods), but is currently somewhat underdeveloped in the educational field. If we don't develop and construe our own research methods, we risk having no other option *but to* appropriate and adopt methods from other disciplinary fields. Why would we need our own methods? A rather forceful answer to that question might be: because the educational field itself is characterized by specificity and uniqueness that can perhaps not be fully captured with the methodological

toolbox present in the larger STS movement, which necessitates having tailored educational methodological tools at our disposal as well (e.g. de Freitas, 2012).

- *From internal to connecting repertoire.* This article started with the argument that STS has never been about faithfully adhering to theoretical maxims. Instead, STS studies can be conceived as ‘a tradition in which each new study slightly shifts the repertoire that has been shaped by those preceding it’ (Mol, 2010, p. 262). Yet, STS studies never exist in a vacuum: not only do they shift perspectives and repertoires, thereby operating as sensitizing devices for future readers of these studies, they could equally make use of other repertoires themselves. For instance, latently present within nearly all contributions to this volume, is the notion of *form* and related described acts as transforming (changing forms), shaping (molding forms) and distributing (actors and relations across forms). Likewise, STS studies often talk about *formation* (receiving a particular form), *isomorphism* (having the same form) and *performativity* (which is the act of giving something a designated form). However, what forms are and do, how they are operational and transmute over time(s) and space(s), is often not (yet) explicit object of analytical concern. The emerging discipline of sociotopology and broader related educational, philosophical and anthropological discussions on forms, time, space and topological enactments might significantly enhance our understanding of these phenomena, by operating as sensitizing devices themselves (e.g. Colebrook, 2017; Decuyper & Simons, 2016a; Kohn, 2013; Serres, 2017).
- *From showing how to interfering in.* Lastly, future research in educational STS might try to move a step further by trying to move beyond ‘showing how’. The focus on enactment – empirically showing how actors and worlds are constantly being given a particular (regional) form, are never completely realized and always in flux, and are thence always in the process of being composed – offers STS researchers the possibility to show that *it could be otherwise*. Whereas this entire Special Issue applies this core STS slogan to a variety of educational practices, I would like to end with the suggestion of Woolgar and Lezaun (2013) that the recent turn to ontology in STS allows to apply this slogan to the level of *interfering* in the world or, at least, within commonly held assumptions about various educational realities. If, as I argued above, educational STS could be more specific in substantiating forms, the field will probably be able to identify *typical* educational forms. One could think of typical classroom forms, typical forms of community building, typical forms of teaching, and so forth. Crucial in this respect is to apprehend that this would not imply a recurring to some sort of essentializing epistemology. Rather, current dealings with the ontological turn and ontological pluralism (Woolgar & Lezaun, 2013; Latour, 2014) would allow to exacerbate first, what typical forms (plural) of education might *be* like in order to, second, *interfere* within assumptions, practices and ways of being that seek to infiltrate or even colonize these educational forms (Decuyper & Simons, 2016b). If practices perform various worlds and their constituent actors, it can indeed be argued that educational STS research could – and perhaps should – bring about different accounts that provide or propose different figurations of these worlds. Put more strongly, if different practices perform different sorts of worlds and crystallize different forms of educational realities, it is one of our central tasks, as educational researchers, to not simply account for such *cosmopolitical* acts (Stengers, 2016). Rather, instead of contenting ourselves with showing such cosmopolitics in action, we might deliberately choose to interfere in the enactment of different educational forms. The collection of studies gathered within this Special Issue does challenge the self-

evidence of presently accomplished forms. However, the starker act of interfering in such cosmopolitical educational formations (which would necessarily imply adopting a normative position) is not common practice yet. It might be hoped and expected that future educational STS studies generate particular kinds of interfering effects by actively engaging in educational world-building. But which effects and how to bring them about, which spokespersons should be present, who is advocating for which sort of forms, and which sorts of figured worlds could and should be associated herewith, are questions that this sketchy outline for a future agenda of STS in/as education can at present only raise.

References

- Colebrook, C. (2017). What is this thing called education? *Qualitative Inquiry*, 23(9), 649–655.
- de Freitas, E. (2012). The classroom as rhizome: New strategies for diagramming knotted interactions. *Qualitative Inquiry*, 18(7), 557–570.
- de Freitas, E., Lupinacci, J., & Pais, A. (2017). Science and Technology Studies × Educational Studies: Critical and creative perspectives on the future of STEM education. *Educational Research*, 53(6), 551–559.
- Decuyper, M., & Simons, M. (2016a). Relational thinking in education: Topology, sociomaterial studies, and figures. *Pedagogy, Culture & Society*, 24(3), 371–386.
- Decuyper, M., & Simons, M. (2016b). Continuing attachments in academic work in neoliberal times: On the academic mode of existence. *Critical Studies in Education*. 1–19.
<https://www.tandfonline.com/doi/full/10.1080/17508487.2016.1240095>
- Edwards, R., Fenwick, T., & Sawchuk, P. (2015). *Emerging approaches to educational research: Tracing the socio-material*. London: Routledge.
- Fenwick, T., & Edwards, R. (2010). *Actor-network theory in education*. London: Routledge.
- Fenwick, T., & Landri, P. (2012). Materialities, textures and pedagogies: Socio-material assemblages in education. *Pedagogy, Culture & Society*, 20, 1–7. doi:10.1080/14681366.2012.649421
- Fuller, S. (2006). *The philosophy of science and technology studies*. New York/London: Routledge.
- Hacking, I. (1999). *The social construction of what?* Cambridge, MA and London, UK: Harvard University Press.
- Haraway, D. J. (2016). *Staying with the trouble: Making kin in the Chthulucene*. Duke University Press.
- Kohn, E. (2013). *How forests think: Toward an anthropology beyond the human*. Berkeley/LA: University of California Press.
- Latour, B. (1999). On recalling ANT. In J. Law, & J. Hassard (Eds.), *Actor network theory and after* (pp. 15–25). Oxford, UK and Malden, MA: Blackwell Publishing.
- Latour, B. (2005). *Reassembling the social. An introduction to actor network theory*. Oxford, UK: Oxford University Press.
- Latour, B. (2010). *Cogitamus. Six lettres sur les humanités scientifiques*. [Cogitamus. Six letters on the scientific humanities.] Paris: La Découverte.
- Latour, B. (2013). *An inquiry into modes of existence*. Harvard University Press.
- Latour, B. (2014). On selves, forms, and forces. *HAU: Journal of Ethnographic Theory*, 4(2), 261–266.
- Law, J. (2004). *After method: Mess in social science research*. London: Routledge.
- Law, J. (2007). Pinboards and books: Juxtaposing, learning and materiality. In D. W. Kritt, & L. T. Winegar (pp. 125–149). Plymouth: Lexington Books.

- Law, J. (2009). Actor network theory and material semiotics. In B. S. Turner (Ed.), *The new Blackwell companion to social theory* (pp. 141–158). Malden, MA and Oxford, UK: Blackwell Publishers.
- Lingard, B., & Thompson, G. (2017). Doing time in the sociology of education. *British Journal of Sociology of Education*, 38(1), 1–12.
- Masschelein, J., & Simons, M. (2013). *In defense of the school*. Leuven, Belgium: E-ducation, Culture & Society Publishers.
- Mol, A. (2010). Actor-network theory: Sensitive terms and enduring tensions. *Kölner Zeitschrift für Soziologie und Sozialpsychologie*, 50(1), 253–269.
- Packer, M. (2018). *The science of qualitative research* (2nd edn). Cambridge University Press
- Popkewitz, T. (2007). *Cosmopolitanism and the age of school reform: Science, education and making society by making the child*. New York: Routledge.
- Serres, M. (2017). *Geometry: The third book of foundations*. Bloomsbury Publishing.
- Simons, M., & Elen, J. (2007). The ‘research–teaching nexus’ and ‘education through research’: An exploration of ambivalences. *Studies in Higher Education*, 32(5), 617–631.
- Sørensen, E. (2009). *The materiality of learning: Technology and knowledge in educational practice*. Cambridge, MA: Cambridge University Press.
- Stengers, I. (2016). *In catastrophic times: Resisting the coming barbarism*. Open Humanities Press.
- Venturini, T. (2010). Diving in magma: How to explore controversies with actor-network theory. *Public Understanding of Science*, 19, 258–273. doi:10.1177/0963662509102694
- Venturini, T. (2012). Building on faults: How to represent controversies with digital methods. *Public Understanding of Science*, 21, 796–812. doi:10.1177/0963662510387558
- Woolgar, S. (1990). Configuring the user: The case of usability trials. *The Sociological Review*, 38(S1), 58–99.
- Woolgar, S., & Lezaun, J. (2013). The wrong bin bag: A turn to ontology in science and technology studies? *Social Studies of Science*, 43(3), 321–340.