

Chapter 13

Confronting Self: Stories of Inciency, Disequilibrium, and Becoming Critical in Science Education



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In this chapter, we present stories related to critical scholarship stemming from our research in science and science education. We contribute this chapter together, first and foremost because each of us has strong ‘critical’ beliefs and perspectives that we want to ‘do their work’ in the social settings with which we engage, and, more generally, in society at large. What critical means may be different for each of us, and was the topic of vigorous discussion, without consensus, during planning meetings for this chapter. At their core, however, our critical views center on practices of *citizenship*. We see citizenship as, ideally, a participative, socially-constructed and dynamic subjectivity, rather than conferred status, in which individuals make decisions on, and challenge, the structures of society. We are concerned about what Henry Giroux (2008) terms a ‘hollowing out’ of civic life, and subsequent colonization of citizenship by economic, market-based rationalities and practices. Hollowing out, claims Giroux, results from the lack of citizen participation in civic/social activity, such as voting, social activism, and community-oriented decision making. This is exacerbated by the prioritization of individual rights and obligations, often directed toward self-investment and advancement at the expense of the common good. We have many questions about how school science may contribute to the hollowing out of social life in ways that are poorly aligned with democracy and community values, and we are committed to research aligned with this theme. While writing this chapter, we frequently discussed our opposition to certain common, dominant beliefs and values in science education communities, which we termed the “mainstream”. Although we are hesitant to construct boundaries, it seems difficult to argue that there is not a large, perhaps majority, community of mainstream

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science educators who prioritize what are often termed “high status” knowledge and practices in science education (Apple 2004). This high-status learning includes the acquisition of the established knowledge and facts of the discipline, and the rehearsal and performance of standard laboratory practices of science, which are advantageous to already privileged communities, but likely inaccessible to the majority of students (Hoeg and Bencze 2017). These requirements appear to be maintained by *gatekeepers* (Mueller 2011) in science education who try to conserve what counts in terms of impact in the classroom and what counts, or not, for the purposes of doing good work in science education. Gatekeepers, often associated with high status journals in science education, wield power to grant or refuse access to the field by, among other ways, rejecting research submissions. Rejection occurs particularly when scholarship submitted does not conform to high status epistemological norms that are prioritized by gatekeepers, such as the positivism central to much quantitative research. We see our values and beliefs as different than those of gatekeepers, positioning us outside the mainstream. The stories that follow describe some of the tensions each author incurred attempting to reconcile perhaps more critical perspectives with mainstream expectations.

We also write this together as individuals in various relationship to each other; we are colleagues, working in the same institution; we are science education scholars; we are friends; we are supervisor and supervisees. In these roles, we have supported each other in conducting critical scholarship when facing rejection from mainstream science education communities, which can take an emotional toll (Butler 2004). Each of our stories might be described as an experience of *becoming* a critical scholar. Philosophies of becoming have existed since ancient Greece, and generally refer to processes of change and “moving towards”, presumably some underlying or “true” reality or state, which may be difficult to perceive through human sensing of the material world. In more contemporary philosophical approaches, the notion of becoming includes the creation of ways of coming to knowing previously unknowable reality, as new perceptions of reality occur with/in the *self* (Conolly 2013). Although the concept of self can be explored from philosophical, psychological and sociological perspectives, its description as the organized, consistent set of perceptions and beliefs about oneself (Rogers 1961) aligns with our usage of the term. The self can be thought to be formed through its relation to “objects”; the constructions of the human mind that represent reality, as we come to know it, which are imbued with recognizable and definable characteristics perceivable by the human subject (Sewell 1992). The stories below represent particularly relevant and transformational personal experiences in which we come to better understand how self shapes, and is shaped by, the research that we do. Our stories revolve around experiences of self-transformation – that is, new understandings of self, due to various powerful experiences while engaged in academic scholarship or research. Although each story is unique, they hinge on events that evoke deep personal tension, reflections on self-beliefs, and adaptations of scholarship. Our stories, hopefully, provide points of reflection for others, in similar circumstances, to advance critical voices to social settings that may most benefit from them.

13.1 Sarah

I embarked on my PhD anticipating that I would graduate feeling ‘transformed’. I expected this transformation to occur unproblematically; that is, a smooth process in which I simply came to see the world from a different lens. Yet, I am discovering that my transformation has occurred not merely by directing my academic gaze outwards, to society, but also through reflection on my inner personal assumptions, values and beliefs. Many of these beliefs are derived from my background; I am a recent immigrant who grew up in a relatively conservative and religious family. My conservative beliefs have produced tensions with some of the ideas and perspectives that are part of the critical community each author of this chapter is engaged in. Voices that advocate for social and environmental justice have at times sounded paternalistic, “telling” me where to focus my attention, what to think, believe and feel. Was I resisting being “molded” again? Or is it that I am unwilling to leave the comfort of my own mold shaped by gender, culture and social traditions? Regardless of underlying reasons, I can’t help but feel restricted in what I can wholeheartedly advocate for and thus find it even harder to locate myself in science education scholarship. Thus, participating in a critical culture has been an ambivalent experience, empowering at times, and at others incurring a feeling of being displaced, as if I am always “in-between” spaces (Aoki 1993). This unrest is often compounded by my inconsistent relationships to different beliefs and values of self. Another way to think of this is as a *disequilibrium*. In this chapter we consider disequilibrium to be a kind of ontological and epistemological uncertainty resulting from awareness of new values and beliefs, stemming from new perceptions of the world, that may be in active opposition to prior beliefs (Connolly 2013).

My disequilibrium has been further reasserted in various academic encounters. At a NARST conference, I found myself amongst science education researchers talking enthusiastically about the topic of my presentation related to using socio-scientific issues (SSIs) to teach about the complex science and technology networks involved in our consumer-based economy. SSIs can be very broadly defined as controversial issues related to applications of science and technology, such as climate change, and development of genetically modified organisms. The general reaction to this work was, “but how is this science education?” Everyone there seemed to agree that political and economic dimensions of socio-scientific issues should be discussed in social studies classes but not the science classroom. Something in me wanted to concur. This perhaps stemmed from changing, yet still influential beliefs that science is a sanitized and pure subject. Rather than engaging with these familiar and comfortable beliefs while discussing my topic with the science educators present, I did not object. As a result, I felt a form of ‘guilt’ from my acquiescence to the more conservative beliefs about science education that came with my silence.

In a yet another salient recollection, I attended a session- during the European Science Education Research Association conference- in which some members of the audience expressed their concerns about the presenter’s choice to use gender as a fixed independent variable. A voice in me surged and sought to justify the

presenter's choice rather than to problematize it, as would be expected from critical scholars. At the end of the presentation, I found myself among the "critical" commentators that raised the question of the appropriateness of categorizing gender. While I could have presented some well formulated academic arguments to join my voice with them, my uncritical voice took over, justifying once again, this time out-loud, the presenter's findings in ways that re-inscribe normative gender behaviors. Needless to say, those critical commentators were instantly dismissive of my remarks. For them, I was perhaps seen as uncritical, or unfit of criticality. For me, it was the crux of my being in-the-middle, wondering whether my criticality will ever be encompassing, ever achieved.

13.2 Majd

My experience as a Ph.D. candidate in OISE has resulted in significant changes in my views about many things, including the notion of criticality itself. Development of my critical perspectives has been greatly advanced through work towards my doctoral thesis, in which I focus on how integrating Science, Technology, Engineering and Mathematics (STEM) education is conceptualized and practiced in some Canadian high-schools. There have been some recognizable efforts to construct STEM education to be inclusive to diverse students, and directed toward community and democratic needs. However, dominant views and practices appear to be confined by economic goals, resulting in emphasis on instrumental skills and knowledge for training purposes (Gough 2015), lack of support for ethical, active citizenship (Zeidler 2016), and employing STEM education as a means to advance transnational for-profit agendas (Hoeg & Bencze 2017). While acknowledging the valuable potential of STEM education, I embraced these critiques, navigating away from the mainstream STEM.

The initial setting for my research was intended to be a school board in Ontario, with a new STEM program. At first, they welcomed research collaboration. However, after I explained the critical lenses through which I approach STEM to the program coordinator, their enthusiasm for research collaboration disappeared, and they instead decided that they are not ready to be studied. The timing and nature of their response suggested anxiety toward the critical nature of the study. This result was distressing for me, and caused a *retreat*. Retreat was an occurrence experienced by many of my coauthors, after a particularly difficult experience that forced a reflection on our self-beliefs. Retreat came to be how we described the period of time after self-transformative experiences, in which we re-evaluated our beliefs and positions, often resulting in changes to our existing beliefs, and/or new approaches to our scholarship. Retreat resulted in my most 'critical' moments, as I re-evaluated the lenses through which I approach STEM education. However, through this contemplative search, I regained confidence in my beliefs – that dominant constitutions of STEM education tend to be narrow in focus, inaccessible, and therefore unlikely to provide claimed benefits to many students. These beliefs, I have realized, are

foundational to my commitment to forms of STEM education (and research) that are useful to the majority of students, who need skills to evaluate, be critical of, and act, on STEM knowledge and practices, for the betterment of communities and the common good.

At the same time, I could not but acknowledge the right of others, particularly research participants, to differently perceive STEM (and the world). When I could clearly define my position, I had to negotiate the dilemma of recruiting research participants while remaining sincere to my own beliefs. A colleague of mine advised me to be careful when framing the purpose of my research and my underpinning beliefs to participants. However, although I acknowledge the need for nuanced negotiation between the researcher and researched, I feel bound by ethical obligations for transparency with my research participants. I also feel anxious about the consequences of producing findings that do not align with my participants' views or are critical of their practices: other than the risk of withdrawing themselves and their data from the research, the need I feel for trust in the researcher-participant relationship drives me to think on how to sincerely present my research findings without 'offending' my participants.

If we acknowledge that the research process is a series of negotiations and interpretations of realities (Denzin and Lincoln 2000), then every stage represents a negotiation between the reality we embrace, and the perceived realities of research participants. Although all researchers may face such dilemmas, having perspectives that sharply depart from the mainstream, which is often embraced by participants, may increase and intensify this possibility. At each stage, critical perspectives may be perceived as a potential threat by participants', to their perspectives, practices and/or their ways of being, increasingly isolating the researched from the researcher. Therefore, not only recruiting participants would be challenging, but also expecting them to truly expose themselves or approve research findings could be compromised.

As a possible solution, I decided to have a section in my research representation dedicated for participants' interpretations and counter arguments. Meanwhile, there are questions I am still reflecting on as I progress as a critical scholar: How can we, as 'critical' researchers, maintain our authentic voices, establish our niches, and proceed with research while negotiating the self, others and various possibilities? Does this represent a reversal of criticality, or criticality in one of its most sincere forms?

13.3 Erin

For me, being critical means, in part, enabling research participants to engage in place-based, research-informed activism, typical of Participatory Action Research (PAR). Rather than a more traditional observation, PAR involves facilitation of participants to inquire about, create data from and propose and enact actions toward local, community-based change. My doctoral research looks at non-formal

education settings, as these are thought to have fewer curricular requirements than schools, that tend to constrain student activism (Bencze, Sperling and Carter 2012). My initial intention was to engage youth in PAR on socio-scientific or environmental issues in their community.

I was really excited about the prospect of working with youth in a PAR project at a food justice organization in an urban centre. The organization was initially supportive of this collaboration, and began discussing possible student-led actions with me, but due to limitations of time, human and physical resources, and the commitment of youth participants to the other aspects of their after-school program, it became evident that PAR was not possible. The program facilitator and other community-engagement staff explained to me that activism, while embedded in the mission of their programming, was not possible for the youth participants because of their desire for a slow and scaffolded process for community activism. For me, there was no option but to honour their request. From this experience I became aware of tensions inherent to criticality as a social justice project, potentially causing these projects to backfire on the ground, if the intended participants do not feel equipped for taking social action, or their desires are not being honoured. How can I, as researcher, help my participants further their work and their sense of agency, if they do not feel ready? I began to recognize that my initial idea for PAR research would have required a demonstration of power and privilege, and forms of agency, that the youth at the urban center likely did not have, given the short commitment time in the afterschool program, as well as realities of socio-economic and linguistic barriers.

Still seeing great value in the work of the site and the research I could conduct there, I 'retreated', to reconsider how to advance a research project with/in this community. My research program, and my own beliefs and values, had to shift to accommodate desires and perceived potential of the research participants. I decided to conduct an ethnography, which allows for critical perspectives on the part of the researcher, but does not necessarily engage participants in critical knowledge-production activity as explicitly as PAR does. This shifted methodology, however, presents ongoing challenges of being critical of my own position as a privileged body/researcher in the community. How can we "do" social justice research from the space of dominance or from places of privilege? Being critical in this renewed research approach of ethnography involves making visible the power structures oppressing participants, so that I may identify relevant justice-oriented social activity, slowly shifting and dismantling oppressions from within. For example, I am able to observe agency in their work toward bettering themselves and their communities, in activities such as intergenerational gardening and healthy food consumption.

This experience also demonstrates the border-crossing that had to take place for me to maintain my position as a co-facilitator and a participant-observer. I had to leave much of my academically-formed assumptions behind to engage in the research as it was reimagined, such as my assumption that research-informed activism was the best fit for my research site. I hope that at a minimum my awareness of this challenge will help me to approach deeper understanding as I report on my

research. My resilience as a researcher is ongoing, as I continue to develop entry points and moments of deconstruction of self as researcher, within the anticipated outcomes of ecojustice education. I continue to try to provoke new perspectives in science education that allow participants to feel grounded in their own knowledge building, by starting where they are ready and joining them on their journey.

13.4 Darren

Over the summer of 1998, I conducted scientific research for Agriculture Canada, to determine if honey bees were pollinating indigenous low bush blueberry. My task was to obtain and identify the pollen collected by bees from nearby fields in the Annapolis Valley of Nova Scotia. Arriving at the blueberry fields each day, I was encompassed by the resonant sound of thirty to forty thousand busy and seemingly content animals, the din reminiscent of a vibrant note from a large pipe organ in a church. Wearing a protective beekeeping suit, and thick leather gloves, I squatted near a hive entrance, inundating the hive with smoke, which acts as a mild sedative, so I could collect the bees. I gently reached for a bee, grimly discovering that the cumbersome leather gloves made it difficult to avoid maiming or destroying the insect. I grasped a second bee more gently, but still unintentionally killed it. The sound of the colony increased in pitch and intensity, becoming alarming, the low pipe organ reaching a higher octave. I was shaken as I felt sharp impacts through my suit; the irritated bees had organized an aerial assault to attack me. Over the next 10 min, hundreds of bees gave up their lives to eradicate the threat they detected in their colony, finding openings in the suit, or driving their posteriors with enough force to sting through the thick garments I wore.

I felt as an alien intruder in an uninviting world. A reversal of roles, from predator, to prey, and growing awareness of my connection to the bees as living parts of nature, allowed me to sense previously unrecognizable aspects of the life of the bees. A form of intelligence, and group consciousness, phenomenon difficult to observe through the reductive scientific sampling procedures I was using, became knowable. The experience resulted in fractures within my understanding of self, an understanding largely based on a notion of being separated from nature. Separation from nature allowed me to be an 'objective' observer of the 'other' (nature). This deeply personal experience illuminated an *incipiency* in my understanding of nature. Inciency can be thought of as a recognition of impending transformation of understanding, a sense of potentiality in epistemological boundaries, often resulting from transformative personal experiences (Connolly 2013). My experiences with the bees revealed a possibility of knowing the other (nature) in ways I couldn't perceive from objective and positivistic epistemological and ontological vectors, measuring and quantifying nature, that are important in science. As my *scientific-self* became dislocated from this experience, I felt uncertain of the 'reality' of the bees, and unsure how to understand their reality. The value I had for the bees changed, from one of scientific utility, to reverence for these powerful living organisms with their

own agency and purpose. But what exactly was the agency, what was the unknowable purpose of the bees? I spent years trying to understand this awakening of other aspects of self, which progressively became attuned to how Eurocentric scientific ways of knowing may shape how it is possible to know nature, and critical of how other ways of knowing nature, both extant or as of yet uncreated, are marginalized.

I left the field quickly that day, chased for several miles in my car by the bees. The bees have attained symbolic importance for me, representing unknown ontology of the world, perhaps knowable through emerging epistemological practices, or extant marginalized practices, such as Indigenous ways of knowing. Learning outdoors, for example, through creative epistemological approaches, such as artwork, meditation, and spiritual practices, although typically not seen as appropriate in science education by gatekeepers (Mueller 2011), may allow students to experience incipencies in understanding nature. These incipencies might lead to expansions in the scope of science, in which nature is known not as ‘other’, but as part of the same fabric as, and through a singular ontology of which, humans are a part. Changed understandings of nature resulting from such experiences are necessary, I believe, to expand the scope of science/school science in advanced capitalist societies, so we might live sustainably with/in nature.

13.5 Larry

Being a science educator and researcher has, for me, largely felt like swimming against the current. Many of my most prized perspectives and practices seem antithetical to those promoted around me by colleagues, government and school district officials, textbook publishers, teachers, school administrators, students and others. Although it is difficult to pinpoint when such discontinuities began, prominent in my mind is frustration I felt early in my career towards opposition to my promotion of student-led primary research – including relatively uncommon correlational studies – leading to conclusions determined by students and possibly contradicting mainstream science education. After some initial puzzlement to explain resistance to such activities that I believe to be very agentic, it became apparent to me – particularly through reading books like “The Cancer Stage of Capitalism” (McMurtry 1999) – that such opposition may be due, at least in part, to influences of globalizing neoliberal networks. Neoliberalism is an ideology that, while a widely-accepted definition is lacking, appears to involve rallying of vast arrays of resources and contributors (e.g., transnational trade agreements, transnational organizations [e.g., Organisation for Economic Co-operation and Development], banks, think tanks [e.g., Atlas Network], financiers, universities, etc.) into a ‘team’ apparently promoting (e.g., via de-regulation, tax reductions, etc.) private sector interests (Springer, Birch and MacLeavy 2016). As discussed elsewhere (Bencze et al. 2018), these networks appear to me to be like *The Borg* (from the Star Trek™ programmes) – a menacing cyborg-like cooperative threatening to assimilate everything and everyone and, like a cancer, wreaking personal, social and environmental havoc along its

path. Such oppression and damage deeply concerns me and motivates me to act for a better world. Accordingly, my prime educational goals have including efforts to encourage and enable citizens to develop and implement informed and negotiated socio-political actions to try to rectify relevant harms perceived by them. In part, this goal has been reinforced by Albert Einstein's (Calaprice 2000) advice:

The aim (of education) must be the training of independently acting and thinking individuals who, however, can see in the service to the community their highest life achievement.

Although I have reported some successes in achieving these goals (e.g., Bencze 2017), ever-adaptable neoliberalism seems to have installed 'speed bumps', such as STEM, inhibiting progress in this regard. STEM appears to prioritize selection and training of a relatively small fractions of student populations that may become for-profit knowledge (and, more particularly, commodity) producers (or marketers, etc.) working as STEM professionals, while simultaneously indoctrinating most students to serve capitalists as knowledge *consumers* as, for example, enthusiastic, repeating and unquestioning purchasers of often non-essential commodities (e.g., Pierce 2013). Given such serious reservations about STEM education projects, it has been disheartening to me that most of my immediate science education colleagues have embraced this movement – particularly in pursuing institutional collaborations with engineers, focusing on development of innovations, apparently often without significant concerns about associated personal, social and environmental harms. While I largely attribute colleagues' orientation towards engineering-focused STEM education to hegemony of global for-profit systems, it seems that this may also be linked to some science educators' isolationist perspectives about fields of science and technology. It was startling to me, for instance, to hear colleagues' claim that scientists and engineers largely operate strictly in terms of logic and evidence, immune from political and/or economic pressures. Such a claim seems contradicted by case studies indicating numerous compromises to integrity of work of scientists and engineers contracted by government-sanctioned financiers (Mirowski 2011). Perhaps protection of images of integrity of STEM fields blinds attention to adverse outside influences.

While it has been relatively lonely working in a milieu apparently engulfed in neoliberalism-informed perspectives and practices, I am very grateful to work with supportive graduate students and, especially, to have a virtual community of like-minded scholars (many having chapters in this book) located in different parts of the world. It seems that perspectives and practices like ours are a 'mile wide and an inch deep.' Ironically, perhaps, we have found each other and maintained our community through capitalist infrastructure. In the context of our collaborative protests regarding an 'international' conference held in an exclusive gated resort, for instance, some of us formed a scholarly activist collective, using various Internet-based resources to sustain our project between conferences. Accordingly, it seems we have, likely in complex ways and for complex reasons, largely avoided assimilation into the neoliberal Borg, persisting in struggles for social and environmental justice.

13.6 Resolving Incipencies, Gaining Equilibrium, and Continued Inquiry About Self

As our stories demonstrate, we have moved towards criticality along different, often complex paths. Yet, similar tensions were palpable components of each of our stories, and influential in our decisions as critical scholars. These tensions are deeply personal, and hint at transformations of self, evident in incipencies and disequilibrium in our perceptions and beliefs about reality. Although we suggest no particular relationship or progression of these transformative events, an impending sense of changing perceptions of reality, or incipency, was often an initial part of self-transformation. For example, Darren's experience with the bees revealed to him impending changes to his understanding of 'reality' (nature). Erin's story suggests an incipency related to her understanding of the limitations of agency and power of low SES youth as she attempted to engage them in a PAR project at a local urban center. Many of the stories also suggest feelings of disequilibrium, an event related to incipency, in that they both appear to be processes involved in transformations of self. For example, Sarah admitted to ongoing tensions in her existing beliefs about including socio-scientific issues in school science, a disequilibrium that manifested as a sense of in-between-ness. The frustration Larry felt early in his career towards the opposition of colleagues to many of his most prized perspectives and practices appears to be evidence of a disequilibrium that, upon reflection, caused him to seek communities in which he could achieve equilibrium in beliefs and perceptions of self and society. Majd and Erin express experiences of disequilibrium of self, related to research ethics; in each case, tensions in research settings invoked ethical and compassionate perceptions and beliefs, resulting in new awareness of self and participants, which allowed them to accommodate these new social realities.

Our stories appear particularly similar, in that, at initial stages of scholarship there was a degree of naïve expectation that our views should be unproblematically accepted. This might be explained by the very local-ness of the critical space we share at our institution, which isolates us to a degree from the scrutiny of others who may not share our critical perspectives. Perhaps propelled by confidence in our self-beliefs and perceptions, each of us enthusiastically entered into research engaging in practices representative of specific beliefs, such as Erin's initial beliefs related to equality of participants' ability to engage in activism, or Darren's somewhat positivistic epistemological beliefs that nature is knowable through objective description and classification, before interacting with honey bees. In each of our stories, initial rejection of our views by the subject of the investigation forced a temporary retreat, to understand our changing beliefs, transformations of self, and re-evaluate on how scholarship might then proceed. Retreat and reflection is clear in the questions Sarah asks about how to locate herself in research, considering her concurrent alignment to seemingly oppositional self-beliefs. Adjustments Majd made in her approach to recruiting participants, the shift in intent and methodology, from PAR to ethnography in Erin's study, and Darren's decision to leave science after his transformational experience with the bees, also occurred after a retreat. Retreat

appeared to be a necessary period of time in which new ideas, beliefs and values about the world developed, and creative ways to utilize emerging beliefs and values to understand the world were imagined.

Far from being infrequently experienced and isolated events of our stories, early stages of planning this chapter also resulted in feelings of incipency and disequilibrium, which emerged from reflecting on and questioning what critical scholarship is. The terms critical and scholar, for example, were seen by us to be somehow in conflict; critical suggested a resistance to certain dominant and/or privileged discourses of Academia, while advocating for oppressed ‘voices’. Scholar implies to us a position granted to certain individuals, that is generally recognized by conformity to certain discourses that are dominant and privileged of a field of study. A perceived incommensurability between these selves resulted in more questions about how to be critical scholars than answers, such as: What should the outcome of critical scholarship be? What practices represent criticality, and just why are these critical? To what extent can one be critical and remain a scholar? Careful reflection on these questions challenged many of our fundamental beliefs about what it means to be critical, and required reflection of self, and retreat, for each of us to understand how to proceed in writing this chapter. These very questions are perhaps instances of the critical enterprise, not only posing a problem – what is this critique that we supposedly do or, indeed, aspire to do? – but enacts a certain mode of self-inquiry that we believe is central to the activity of critique itself. Far from answering these questions, instead, is recognition that this period of retreat, of being “critical about criticality”, may be essential to understand how to negotiate self with other, learn from disequilibrium and incipency, and enact critical scholarship.

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