Collegial Conversations at a Time of COVID-19

STEVE ALSOP AND DARREN HOEG

Faculty of Education and Department of Science and Technology Studies, York University, Toronto, Canada; salsop@yorku.ca.

Faculty of Education, York University, Toronto, Canada; hoegd@yorku.ca.

Abstract. During the COVID-19 pandemic in 2020, citizens and social institutions have been called into action. Questions of the future of school and an appropriate educational response to the pandemic have been widely discussed and debated. As scholars of science education, subjects particularly relevant to educating about the virus and its transmission, we discuss the roles and responsibilities of science education during pandemic. The format of this paper is a dialogue. We discuss theoretical positions related to science education and the pandemic, inequalities and injustices, recent anti-Black racism protests, and concrete pedagogical responses. As our discussion progressed, we increasingly recognize teachers and students as crucial agents in developing community-grounded, critical place-based, educational responses, recognising and addressing injustices related to differential global and local realities experienced during the pandemic.

Keywords: Dialogue • Science Education • Black Lives Matter • Racism

Steve Alsop and Darren Hoeg are colleagues in the Faculty of Education, York University. They share academic backgrounds in science education. Steve is a longstanding faculty member at York and Darren is relatively new, having previously worked at the University of Alberta. They both live and work in Toronto, Canada. The following exchange took place over the period of the first phase of the coronavirus lockdown (in May and June 2020). The choice of format sought recognition of the importance of collegiality and discussion at a time when working remotely from home online was the only option available and affecting collegial exchanges. Our conversation was a way of getting to know each other, in addition to discussing how we might contribute to an educational response to COVID-19. Our conversation was seen as a starting place to begin to grapple with the disequilibrium and creative potentials arising from the pandemic. Our conversation, or as Paulo Freire termed it, ‘dialogue’, is a dialogical form in which knowledge is co-created by those in conversation, instead of imposed on an individual or group, as is often the case with research methods, and school curriculum. We see this format as a model, and starting point, to foster discussions among educational communities that must develop educational experiences in a time of COVID-19. It is through discussions between students and teachers and community stakeholders that relevant forms of education for COVID-19 that enable social and ecological justice might be developed.

Steve (Thursday, May 14th): Hi Darren, I hope all is well. Thank you for the suggestion of writing this article in the form of conversation. At a time of lockdown and professional isolation it seems such an appropriate approach to explore. Dialogic teaching is talked about so often in education. I hope that this dialogue might bring others into educational conversations at a stage of so much uncertainty and anxiety. Dialogue is a special, social process of re-imagining, of trying out new possibilities, sharing doubts and uncertainties, and changing ourselves with others. It has a foundational role in education reforms. I am immediately reminded of Freire’s and Shor’s “dialogues on transforming education”¹.

¹ Freire, P., & Shor, I. (1987). A pedagogy for liberation: Dialogues on transforming education. London: Macmillan Education. (p.3)
Having said this, I want to start by saying how difficult it is to think and write in the midst of pandemic, let alone start a dialogue about education that others might read. Clarity, it is often said, needs the perspectives and privileges of time. My life - all our lives - have traumatically changed with structures and rhythms shattered and makeshift replacements now taking hold. Our professional “new normal” is that the university has been closed for the past 3 months with no physical access. I have been teaching and meeting students on Zoom™, sharing my feelings and thoughts, talking about the pandemic, listening to students and their families and friends’ experiences; reassuring them that the term will not be lost, and providing flexibility to get things finalised. I have been trying to ‘make it work’ with sensitivity and compassion. It is strange how everything has changed and yet these educational pieces still somehow remain. Is this a legitimate education response to COVID-19? Like all of us, I guess, I am trying to make sense of it all. As a professor, a science teacher, I ask myself, what can I say that is helpful at this time? I am critically self-aware of the need to reach out, to actively make room for others to be heard - to listen carefully, especially to those who are being personally and professionally affected by the virus much more severely than I am.

Carusi and colleagues reflect on “Doing Academia in COVID-19 Times”². Beyond medicine, epidemiology, virology, nursing and other academic pursuits with genuine frontline expertise, they explore what social sciences and humanities might offer this crisis. They are critical of the motives of hurried scholarship seeking to define and claim (academic) credit for the crisis. There is certainly an increasing abundance of COVID special issues of journals (including this one, of course) and books. In these, there are ownership moves of simultaneously defining reality and making it accountable to such definitions. Carusi and colleagues caution against quick and unnecessarily hurried judgements in framing, for example, the COVID Generation, COVID Society, COVID Capitalism or COVID Education. In place of academic labels and quick policy fixes, they conclude, “we need questions that can actually help us think, that enable us to see the novelty of the present […] so we can find our feet again” [last para.]. So, perhaps this is one starting point for these collegial conversations: what are some important science education questions about COVID-19? As academic science educators with particular expertise, what questions do ‘we’ need, and what questions might ‘we’ helpfully share with others?

Darren (Saturday, May 16th): Steve, I’m writing this response on a day Ontario has announced 390 new COVID-19 cases, from roughly half of the tests averaged over the previous 10 days. This represents a significant increase in confirmed COVID-19 infections, just as isolation restrictions have weakened, causing speculation we maybe amidst a ‘second peak’. This is an example of the uncertainty of the times, which make prescribed curriculum fixes seem ill-suited. I agree with you Steve, that in this time of instability, it seems more appropriate to start with dialogue and questions about what has and is occurring, rather than reactionary social and educational solutions. Since I’ve been thinking about connections between social oppressions with the pandemic, Freirean-esque dialogue that attempts to understand the local conditions of oppression seems to be a good method to base our conversation on. Although an urgent pragmatism fuels the call for solutions, the very nature of a solution assumes we know what the problem is and are ready to address it. Since we are not at this point, I think there needs to be school-based inquiry into what has actually occurred and how it is affecting communities, before solutions are

² Carusi, T., Paolantonio, M., Hodgson, N. & Ramaekers, S. (2020). Doing academia in “COVID-19 Times”. Retrieved from: https://drnaomihodgson.wordpress.com/2020/04/10/doing-academia-in-covid-19-times/
attempted. At the same time, the pressing need to leverage education as part of a pandemic response, now, limits the time available for necessary grass-roots inquiry.

As I write this, I realize how working from home is a privilege that many workers do not share, as their jobs have been effectively wiped away by the pandemic. Just who is able to work from home, how effectively, and what are the consequences? The corollary to this question related to school is, who is able to learn from home, and how well? These immediate questions set off a cascade of other related questions in my mind, in no particular order, such as: Who can practise social distancing? What’s the cost to stay safe? Who can access the internet? Who can access healthcare? Who has access to ventilators? Who gets emergency response benefit payments? How are lockdowns enforced, and who is subject to enforcement? Who gets blamed? How does lockdown differentially affect genders? These questions focus attention on inequities that already exist in society, which the pandemic has re-illuminated and appears to have exacerbated. For example, despite the perceived success and celebration of work-from-home practices (a measure of which may be the sudden ubiquity of the texting acronym WFH) many workers have lost their jobs as a result of the pandemic or have been forced into essential work with increased risks to personal health. Citizens who have not been able to work from home are disproportionately females and those of low socio-economic status. The ability to socially-distance is another practice closely associated with socioeconomic status and privilege. In addition, the added cost of staying safe is beyond the economic capabilities of many households, already strapped from lowered income during the pandemic. As we “zoom”-in on school, the question of who has access to the internet, and how students learn from home becomes prescient. Although we may not be able to answer these questions yet, one in ten Canadians do not have access to the internet, suggesting many students are unable to access this learning resource made essential during the pandemic. Considering the inherent justice issues bound up within considerations of (science) education during COVID-19, I suppose I start to wonder what can and should be the role of science education, in addressing these social inequities. And what are our roles, as privileged academics who may not experience the pandemic the way students and teachers have? While the responsibility to educate students about the science involved in pandemics and viruses seems fairly straightforward, the ethical and moral implications of the pandemic appear to be fertile and necessary terrain that school science may need to take stance on. What are your thoughts, Steve?

Steve (Monday, May 25th): Thank you, Darren. You leave me reflecting on how we can care and look after each other if we are ignorant of the very conditions that continue to separate us. As [science] educators, how can we respond to the pandemic without fully understanding the extent and nature of its discriminatory impacts? Yes, we are all vulnerable to COVID-19, and representations such as the now infamous ‘bell curve’ and ‘R-value’ bring us together jurisdictionally and nationally. This is such an important way of understanding the virus, but this virus affects different groups in very different ways. Much recent evidence suggests that COVID-19 discriminates in terms of antecedent health and medical

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3 Lindeman, T. (2020). Why are so many people getting sick and dying in Montreal from COVID-19. The Guardian. Retrieved on May 20, 2020 from https://www.theguardian.com/world/2020/may/13/coronavirus-montreal-canada-hit-hard
4 Drimonis, T. (2020). Quebec has abandoned frontline health care workers. Retrieved May 20, 2020 from https://cultmtl.com/2020/04/quebec-has-abandoned-frontline-healthcare-workers/
5 Brown, D. (2020). Stockpiling a week's supply of food 'not an option' for many as Toronto sees increase in food bank use. Retrieved on May 20, 2020 from https://www.cbc.ca/news/canada/toronto/stockpiling-food-coronavirus-1.5481434
6 Statistics Canada (2019). Canadian Internet Use Survey. Retrieved on May 20, 2020 from: https://www150.statcan.gc.ca/n1/daily-quotidien/191029/dq191029a-eng.htm
condition (including age and genetics) and also in terms of pre-existing economic, social, cultural, material and geographic conditions and inequalities. Rebecca Solnit points out that “Coronavirus does discriminate, because that’s what humans do”\(^7\). She invites me to think of science and technology education as joining with others to take better care of each other. This necessitates simultaneously taking a step-back, recognising not only our shared humanity (our compassions, hopes, fears and vulnerabilities; our shared communities and our shared Planet), but also differences - the privileges, injustices and discriminations that continue to separate us.

As I listen to daily news reports on COVID-19, they remind me of the very public and deeply political nature of this virus. There is continued reference to “scientific expertise” and the need to follow “the” scientific advice. Scientific expertise in the form of medical and nursing practices, better epidemiological and biochemical models, tests and vaccinations are central to coming to grips with this large positively stranded RNA virus (SAR-CoV-2). I am, however, acutely cognisant of relationships between science, politics and society that are so much more complex and nuanced than government briefings want me to believe. A long time ago, I recall reading an article by Anne Fausto-Sterling\(^8\) on how best to teach embryology. Fausto-Sterling finds herself drawn to endless hybrids and networks in which biology, culture and societies come together, knot and entwine. Once you start to notice these hybrids, she reflects, they seem to be everywhere, to the extent that it is difficult to get them to disappear. Perhaps this is now an obvious point: in the case of COVID-19, the virus, politics and societies are inseparable, contiguous and co-productive. This is broadly the coproduction thesis\(^9\) that so many STS and science and technology education researchers write about.

When I watch the daily news reports, I am continually thinking about these hybrids, as well as the power accrued from the modernist move of denying them. When politicians claim that they are following “the” science, I cry out what science, when, where, how, why and with whom? And for what reasons and goals? Here I am acutely sensitive to forms of polities-without-politics, types of political decision-making that appear to be not making political decisions. This type of self-referential logic is so dangerous, because it closes down democratic participation. It makes politics seem a-political, thereby masking political discussions, choices and alternative possibilities. Seeing hybrids are teaching invitations to reflect on associated relations of sciences, power, privileges and discriminations.

I am concerned that science teaching about SAR-CoV-2 will follow engrained traditions and stubbornly focus on the ‘technical’ nature of this virus and miss all these political, economic, material, societal, and ethical pieces. I really do not want COVID-19 science education to resemble government briefings. Indeed, I want the opposite, for it to offer openings to challenge these briefings, and thereby allow people to become more politically and ethically informed and engaged. This type of critical analysis and dissent are essential for democracy, and active democratic participation.

Your comments also invite me to also think about how this pandemic is altering conditions of education (as well as the reverse: how is education implicated in conditions of the pandemic). Your point is that the seemingly convenient and self-evidently desirable decision to move education on-line (as a response to COVID-19) needs much more careful and critical attention. Certainly, in my experiences, online learning is offered as “a solution”, but the solution to what, where and for whom, is under-

\(^7\) Solnit, R. (2010). Coronavirus does discriminate, because that’s what humans do. The Guardian, Friday 17th April, 07.00 BST. Available online: https://www.theguardian.com/commentisfree/2020/apr/17/coronavirus-discriminate-humans-racism-sexism-inequality

\(^8\) Fausto-Sterling, A. (2003). Science matters, culture matters. Perspectives in Biology and Medicine, 46(1), 109-124.

\(^9\) Jasnos, S. (2004). States of knowledge: The co-production of science and social order. Routledge Taylor & Francis Group.
discussed. It is an answer without questions. Perhaps some basic questions are: why is online learning so seemingly desirable? How ought it be judged? What can it offer at this moment? Don’t get me wrong, I can obviously see many medical and educational advantages. But I also want to understand what it cannot offer, how it empowers and disempowers. As educators, for example, I think we need to keep a very close eye on powerful and high influential tech-companies with particular visions of the future combined with economic market dominance. I want to know how much of the recent government education bailout end up in these already excessively wealthy corporations, as well as the increasing influences that these organisations have in shaping public education. I encourage critical reflections on ways that online learning is potentially furthering and exacerbating social inequalities. Without these types of critical discussions, there is an ever-present danger of reaching the virus without the social conditions of the virus. It is another modernist move of separating science, technology and progress from societies and politics. This coronavirus allows us to see injustices in educational practices, which have overtime become faded and silenced. We can reach out and join with others for change. It provides bases for potentially transformative online educations. However, if we overlook these injustices and contradictions (seeing ‘the’ solution and ‘the’ future as online learning) we are ill-positioned to appropriately respond. So, concluding with the spirit of asking questions, I wonder: where, how and in what ways is this pandemic educational? What inequalities in our educational practices are the virus rendering more visible? How might we join with others, recognising these inequalities, and act to shape more healthy, equitable and environmentally sustainable futures?

Darren (Thursday, May 28th): Thanks Steve for your thoughtful response, and, like you, I’m wondering more and more what I can and indeed should do, as a science education scholar. We’ve asked a lot of questions; to advance our discussion, I’m going to move from the ideological (what might be) into the realm of the material (what can be/what is), in terms of my thoughts on science education’s response to COVID-19.

The mixed messages surrounding the use of masks to prevent the spread of COVID-19 must be one of the most concerning examples in Canada of the hybrids of science and politics you mention. As background to this issue, initially, Canada’s Prime Minister, Justin Trudeau, on the advice of the Public Health Agency of Canada (PHAC), declared that there was little scientific evidence that surgical masks prevented the spread of COVID-19. This advice contradicted that given in other countries, such as those in East Asia, where the use of such masks is more widespread. Over the following weeks, the political-scientific discourse in Canada surrounding masks slowly changed, acknowledging masks may have the benefit of containing infection to the wearer of a mask. The most recent suggestions from the PHAC is that everyone should wear a mask in public if possible and that even cloth masks, such as a scarf, may have some beneficial effects. These changes in public discourse correlate with increased supplies of masks in Canada, causing some to speculate whether initial denials of the efficacy of masks was based on economic realities, rather than scientific ones. If this is true, these changing beliefs are based on certain ontological assumptions – that the population represents ‘a problem’, that the perceptions and practices of the population need to be controlled, and that this control might be achieved through forms of communication, texts, and/or discourse. The use of science and official knowledge to support particular political discourses meant to shape public perception and practice appears to be a form of what Foucault

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[Xu, X. (2020). Cultures clash over wearing masks amid virus. The Globe and Mail. Retrieved May 25, 2020 from https://www.theglobeandmail.com/canada/british-columbia/articlecultures-clash-over-wearing-masks-amid-virus/](https://www.theglobeandmail.com/canada/british-columbia/articlecultures-clash-over-wearing-masks-amid-virus/)
has termed biopolitics\textsuperscript{11}. What biopolitics generally means in Foucault’s\textsuperscript{12} work is a type of politics that “deals...with the population as political problem, as a problem that is at once scientific and political, as a biological problem, as power’s problem” (245). Larry Bencze and I have written about biopolitics in science education elsewhere, making the case for the need to examine biopolitical assumptions underlying STSE issues, in order to address these in school science. The controversy of masks would be excellent content through which to learn about nature of science, socio-scientific issues, and viral epidemiology, as well as student-activism related to this issue. Many ideas, from sanitary practices to treatment options, have been dismissed during the pandemic by the statement “There is currently no scientific data to support this” (i.e. Ibuprofen makes symptoms of COVID-19 infection worse), which reproduces the misconception that ‘solutions’ are always preceded by basic science. These would make excellent case studies to discuss with students’ notions such as validity of science knowledge, co-production of knowledge, and other ways of knowing. Today, in any public space in Toronto, you still see many people without masks, which causes me to wonder who has access to these devices, how, and why? These are important topics communities of learners might inquire about.

This brings me in a round-about fashion to the topic of online learning. Like you, Steve, our colleagues, and millions of workers around the globe, I have had the privilege of working from home, through various online platforms. You and I have discussed this, how, although we are working, we feel displaced from work, and the mental and emotional adaptations required to work effectively from home during the pandemic take a toll, while acknowledging we are among the fortunate. On the one hand, I feel we must celebrate our technological capacity to allow work and school to continue while social institutions have closed their doors, yet I fear in the mad rush to accommodate people staying home, there needs to be more critical attention to the discourses online work advances, and what might be lost. I have attended (virtually) several workshops that demonstrate how communities of learners and social interaction might be enabled through online instruction, yet I have difficulty seeing how affective and socio-political orientations, which have been shown to be important for commitment to activism, might be fostered\textsuperscript{13}. Perhaps I was born in the ‘wrong’ era, and therefore somehow see the online experience as artificial, despite being told by workshop moderators that ‘digital natives’ who make up the majority of our students, perceive online environments differently. I tell myself to delay judgment until after I have more experience and expertise teaching online, yet I wonder how my preconceptions might already work to make the online classroom the inferior counterpart to face-to-face classrooms. I think the theme of access and equity that can be seen threading throughout our discussion is nowhere more relevant than in the case of online learning. Access to technology is the most apparent consideration, but as Karen Strassler\textsuperscript{14} writes, the environments of online VS physical classrooms themselves have inherently different characteristics important to equity. At least the classroom is an environment where students have equal space to work, where they meet as apparent equals, they sit in the same chairs. In my online experiences during the pandemic, I spend an inordinate amount of time observing and evaluating the work-from-home environments of those I’ve interacted with. Who has office space? Is there a window? What can be seen through the window? What other people or things are in the background? The loss of assumptions of equity are quickly lost in such encounters. While this may do the important work of making inequity visible,

\textsuperscript{11}Hardt, M., & Negri, A. (2000). Empire. Cambridge, MA: Harvard University Press.
\textsuperscript{12}Foucault, M. (2003) Society must be defended: Lectures at the College de France 1975–1976 (D. Macey, Trans.). New York: Picador.
\textsuperscript{13}Watts, R., Williams, N. C., & Jagers, R. (2003). Sociopolitical development. \textit{American Journal of Community Psychology}, 31, 185–194. doi:10.1023/A:1023091024140.
\textsuperscript{14}Strasler, K. (2020). What we lose when we go from the classroom to Zoom. \textit{The New York Times}. Retrieved on May 25, 2020 from https://www.nytimes.com/2020/05/04/sunday-review/zoom-college-classroom.html

\textit{Journal for Activist Science & Technology Education}, Volume 11, Issue 2 (2020) [jps.library.utoronto.ca/index.php/jaste]
it seems to do so without the consent of students, so it potentially both reveals and magnifies inequity. I believe, therefore, before we celebrate online learning as a new norm, critical inquiry into the discourses reproduced and associated equity issues must be undertaken.

Steve (Tuesday, June 2nd): Thank you, Darren. In terms of the “realm of the material”, I am reminded of the increasing number of creative COVID-19 science education resources that are widely and freely available. The San Francisco Exploratorium, for example, has a COVID-19 Science Learning Toolbox, with “science snacks” that include templates for making model viruses out of paper, string and cotton wool (illustrating the identical proteins that make up the capsid); a soap film model demonstrating how virus membranes behave and can be disrupted through soap; and a string and pony-bead necklace to illustrate the genetic sequence of coronavirus RNA (rather than DNA) with an accompanying Codon table. These ‘hands-on’ activities are really good at teaching about virology, focusing on the nature of virus. They warrant extending to include discussions of ethics and politics, including the biopolitics that you highlight.

As an example, you highlight facemasks and get me thinking about possible teaching approaches. What are some different ways of better understanding what has now become one of the world’s most desirable commodities? There are a number of online templates in which students build face masks. There is, of course, a proliferation of research into the efficacy of facemasks (with respect to transmission characteristics and different materials). I like the idea of thinking about the mask as a “source of controversy”. I think that studies of science in the media are so important. Students might follow the mask as a controversy in newspapers and social media discussing not only what makes the mask a useful response to the pandemic, but also when and how is its controversial nature resolved and unresolved? A study to unmask the masks, if you like. Perhaps this could usefully connect with broader discussions of controversies and the politics of doubt. I used to read Oreskes and Conway’s “ Merchants of Doubt” with my education students, which picks up this point.

Scientific research on COVID-19 is ongoing and emerging, and it is quite likely that some (perhaps most) will turn out to be wrong. Researchers are being propelled to sort things out with desires of/ for policy answers, but the speed of research and policy are often very different. I’m sure that scientific research can be frustratingly glacial. This is part of the nature of science that you mention. As science educators, this places us with responsibilities to represent science as emerging, as tentative, as slow, as political, but in a way that doesn’t undermine its expertise and credibility. I recognise that this is not always an easy balance.

I teach a graduate class on science, technology and society, which includes an assignment based on Joseph Dumit’s provocation of “writing the implosion” by “teaching the world one thing at a time”. The students seem to really enjoy picking and unpacking an object (a technology) and exploring what it means to different groups and how it is situated in the world and the world is situated in it. They start with common everyday understandings and then through research and discussion, they slowly awaken to other stories and accounts. What is at first a comfortable, invisible, throwaway thing, becomes an increasingly complex and problematic hybridised entity. Then, perhaps most importantly, following Dumit’s 4-twist method, the students slowly turn the implosion in on themselves, questioning their assumptions.

15 Exploratorium (2020). Learning Toolbox: COVID-19 Science. Available at: https://www.exploratorium.edu/learn
16 Dumit, J. (2014). WRITING THE IMPLSION: Teaching the World One Thing at a Time, Cultural Anthropology, 29(2), 344-362. Available online: https://journal.culanth.org/index.php/ca/article/view/ca29.2.09
knowledge, and ways of making sense of the world. This critical consciousness-raising exercise enables students and professors to recognize ways they, and powerful others, are implicated in reproducing worlds. They can now explore whether this needs changing and ways that they might bring about changes, joining us in coalitions acting for better, more just and environmentally sustainable possibilities.

With this approach, I like to imagine that I could teach a whole course on the face mask exploring various dimensions with students, including - drawing from Dumit again - the masks: “labour dimensions” (Where and who was involved in its production?); “professional dimensions” (What types of professionals are involved? What types of knowledge are involved in its development?); “material dimensions” (What is it made of and where do these materials come from?); “technological dimensions” (What types of machines were involved in its production?); “context dimensions” (What kinds of activities and ways of life can it support and not?); “economic dimensions” (How is it marketed and branded? What are associated profits and how are these distributed?). You bring my attention to “political dimensions” and the ways in which objects (such as face masks) can [deviously] shift our consent to dominate orders. I like to add environmental dimensions (what environmental impact does the mask have from construction to disposal). These are very pressing questions now and in the future.

Just to pick up on the labour dimensions. Even a cursory internet search reveals ways in which masks are deeply implicated in promulgating world injustices and precarious labour practices. Prison labour is being used to make face masks in the US and Hong Kong. Many masks are produced in sweatshop conditions in which workers are paid sub-minimal wages on short time precarious contracts, with restricted working conditions that are more vulnerable to the coronavirus. For example, Sam Dean, staff writer for The San Diego Union-Tribune, writes about Santiago, a worker in a downtown factory in LA who was scared to give his full name, and had just got paid for the first week of making masks: “$230, in cash, for 50 hours of work. That’s $4.60 an hour, for essential work”17. We need to ask: why and how can this be happening? Who is allowing it to take place? How can it be stopped?

This is just one example. The general point is that a science education response to COVID-19 should offer opportunities for students to understand ways in which the virus (and surrounding technologies) are embedded in world injustices, including patriarchal, colonial, class and capitalist systems of oppression. Perhaps in this manner, turning to Dumit once more; “we confront the histories and the intolerable not just in objects but in ourselves, in our identities as partial, in our senses, our worries, and our common sense”. Perhaps this will awaken activists, those who join with others and mobilise for change. Making the seemingly mundane (or banal) intolerable is a really good way to raise critical consciousness.

I am also mindful of mindsets that reduce everything to the corruptions of systems of oppression and thereby perpetually rehearses worlds in death grips of prejudice, greed and market forces. It is equally important to remember that face masks can be conceived as acts of altruism - wearing them is to protect others (in addition to protecting ourselves). This pandemic is full of acts in which people have sacrificed personal health and financial security (choosing well-being over money) even before government policies. Face masks have been distributed freely to communities which are unable to afford them, and face masks are being produced and distributed by volunteers. Knowing and understanding this is equally important. This pandemic is about caring with each other, and to miss this point is a mistake. Yes, as a privileged White, cis-gendered male, science educator, I need to continue to confront the intolerable in my

17 Dean, S. (2020). The sweetshops are still open. Now they make masks. The San Diego Union-Tribune. April 21, 2020, 7:15am.
perspectives and actions, but in so doing I should not abandon my capacities for helpful acts of generosity and kindness and playing a role in change.

I am continuously inspired by care-givers, parents, elder siblings, science teachers and students now all working in unfamiliar and unforgiving online contexts and putting in all those extra hours and efforts in response to extraordinary times, which I am sure can seem intolerable. The general point is that this pandemic has many stories to tell about science education in the “realm of the material” – stories about who we are, what is, and what can/might be possible in the future. What we need to let go of? What do we need to cling to more tightly? Being an educator is deciding which stories to focus on and how to develop these to release the scientific imagination.

Darren (Friday, June 5th): I love your idea, Steve, of face masks as the theme to explore various aspects of the pandemic, from the biological, to the socio-scientific. This aligns with the suggestions of many science educators as to how Science, Technology, Society and Environments (STSE) might be taught in school science18. Like you, I have found it heartwarming to see acts based on kindness, generosity, and altruism as life has been altered to ‘flatten the curve’. At times, I’ve felt a sense of community I seldom experience, as I am instead critically aware of the radical individualism that seems to permeate all levels of society. We have heard stories of some corporations re-tooling production lines to produce and supply much needed medical supplies and PPE (personal protection equipment) - another acronym that has become part of the public discourse due to the pandemic – muddying the critical view of capitalism and ‘the corporation’ as inexorable evils, akin to a form of social cancer, or a virus. From my pedestal as a university professor with a secure job and salary, safe place to live, and ability to work from home, it is easy to have a rosy view, as the pandemic has brought out acts of social responsibility and community engagement.

As I sit here writing this in my high-rise condo, in downtown Toronto, I realize this image is an apt metaphor of privilege, which allows me to be separate from the ugliness of ‘real’ life below on the streets. I’m reminded that our privileged experience of life during COVID-19 is not shared by everyone, or perhaps even the majority, and there has been a darker and more sinister reality to the way many people have experienced the pandemic. In fact, there is a protest happening today on the street below, 18 floors down. I hear cowbells and shouts and chants of “I can’t breathe”, referring to the words of George Floyd, captured on video, as his life was stamped out of him as he was asphyxiated by the foot of a Minneapolis Police officer. This incident, and the resulting worldwide re-ignition of ‘Black Lives Matter’ protests, have been packaged by the media as a new commodity, aside from the pandemic, but they are in fact inseparable, as they both reveal the systemic racism in society that sours our celebration of community goodwill and communion. It is a fact that COVID-19 has impacted people of colour and other marginalized communities more seriously than advantaged communities, as they make up the bulk of ‘essential service workers’ and may not have the financial capacity to isolate and physically distance19. It is not a matter of coincidence that those most likely to participate in “Black Lives Matter” protests, the close confines of which exposes them to high risk of contracting COVID-19, are part of marginalized communities that are also more at risk for acquiring COVID-19 infection in their daily lives.

18 Pedretti, E. & Nazir, J. (2011). Currents in STSE education: Mapping a complex field, 40 years on. Science Education, 601-626.
19 Winsa, P. (2020). Which workers are being hit hardest by the COVID-19 lockdown? These 6 graphics paint a stark picture of Canadian inequality. The Star. Retrieve on June 5, 2020 from https://www.thestar.com/news/canada/2020/05/28/which-workers-are-being-hit-hardest-by-the-covid-19-lockdown-these-6-graphics-paint-a-stark-picture-of-canadian-inequality.html
I’ve thought awhile about how to respond to the horrific Black racism and murder that has occurred in the US and Canada recently. As a citizen, I try to understand. As a science educator, I want to do something. I want to educate my students, future teachers, about racism in schools. School is one of the social institutions that perpetuates racism and privilege. The curriculum in Canadian schools has been identified through research as Eurocentric (White), privileging already advantaged students, and marginalizing those the curriculum ‘does not have in mind’ in its design. As educators, we need to be aware of the hidden biases in school curriculum, our own privilege and ‘blind spots’, and the way we may reproduce privilege and oppression in our practice. We can’t accept narrow reproductions of curriculum that perpetuate racism in society so that some students can attain their ‘allotted’ status in society when other students fall by the wayside, and whose very livelihoods and lives might be at stake. Common rationalizations such as the need to prepare students (which students) for exams and university seem weak considering the social cost of this education to groups of students that are not represented in or by dominant curriculum teaching and learning. We must find ways to confront the racial biases in school and find ways to teach and evaluate students based on broader conceptions of education that care for and nurture human life and potential, rather than a narrow set of skills and knowledge that perpetuate racism.

So, how do we do this? How do we make racism a topic in school science? Once again, ‘the pandemic’, despite its terrible cost, seems to present an opportunity. As I write this, I imagine students’ stories of the pandemic, science and oppression informing science lessons. What do students know about the pandemic? Is science knowledge related to COVID-19 racialized? There exists in society assumptions that, because knowledge is available freely on the internet and television, everyone has equal access to it. In fact, we know this is not the case, and access to knowledge is dependant on a number of identity markers, and a function of privilege. Who are the students in the privileged position to know the science of viral transmission, and who are not? Additionally, schools in marginalized neighborhoods may have local issues related to science and society to address, such as the best way to make and/or sterilize home-made masks, how to keep underfunded public school environments clean to prevent viral spread, as well as public awareness campaigns around these issues. In the spirit of community support and good will we have discussed in our conversation, more advantaged schools might work in partnership with less advantaged ones, sharing stories, knowledge and resources, in a community effort to both eradicate the spread of COVID-19, but as well to set up the conversations and relationships necessary to address racism and oppressions as we strive for a more just society. If the ultimate goal is to end systemic racisms and oppressions, these are the types of social interactions needed among citizens. Engaging students in these in school can foster a sense of agency needed to engage in citizen participation in social issues as an adult.

Steve, since racism is such an essential topic for schools, but made more visceral recently due to the high-profile deaths of George Floyd and ensuing protests during the pandemic, I welcome your thoughts. I also wonder if we might conclude this discussion by talking about the environmental implications of the pandemic, and how these are relevant to school science and activism.

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20 James, C. (2019). We Rise Together. Peel District School Board. Retrieved on June 5, 2020 from https://www.peelschools.org/aboutus/equity/Documents/We%20Rise%20Together%20report%20-%20Carl%20June%202019.pdf

21 Bencze, J. L. (2017). Science and technology education promoting wellbeing for individuals, societies and environments. Dordrecht, Netherlands: Springer International Publishing
Steve (Wednesday, June 17th): Hey Darren, you raise such fundamental questions and leave me wondering how I might appropriately respond in this somewhat constrained letter format. I notice that our letters are getting steadily longer and as I start a reply, I sense this is going to be a protracted response.

I am heartened by increasing attention given to STSE and various other approaches to science education that focus on socio-scientific issues and controversies. I suspect that our preceding curricula discussions align with some of these and depart from others. In my experiences, much science education practice and research - including approaches to STSE education – still downplay the histories, politics and economics of issues and controversies. The comprehensive review that you highlight brings attention to the lack of political analysis in STSE practices, which is taken up further in really thoughtful ways by Lyn Carter. This absence is, in part, a result of a legacy of thinking about science education with particular ‘liberal’ expressions of citizenship - the idea that science curricula should focus on scientific knowledges that future citizens need to know to make decisions to exercise their individual liberties most effectively and successfully. This is an important part of the picture; however, as critical commentators point-out, such notions of citizenship are restrictively homogenised, offering limited attention to gender, sexuality, race, colonialism, poverty, class and disability. Marginalised, disempowered groups continue to be excluded from the discourses and associated agencies of ‘science citizenship’ (as this pandemic demonstrates because of their subordinated position in society), shaped by these and many other intersecting and accumulating factors including age, qualification, geography and nationality. The point is that we need to place inequalities, injustices, power and privilege at the centre of science education reforms.

I still believe that individualised, technical, homogenised approaches to scientific literacy and civic engagement are by themselves unlikely to bring about necessary far-reaching social and ecological reforms. There is so much to celebrate in projects of community service and civic awareness. However, activism, advocacy, solidarity, mutual-aid and collective mobilization, I suggest, offer additional and fuller expressions of citizenship and democratic [politicised] empowerment. These commitments were, in part, why we started this journal (some 10 years ago now) with an explicit activist education agenda. It seemed necessary at the time because these discussions were not part of mainstream science education research and practice.

The murder of George Floyd by Minneapolis police is another sickening, brutal and needless death. This has happened before, far too many times. And it continues, including the recent shooting in the back (twice) of Rayshard Brooks just two days ago. In the US, on average the police kill 3 people per day (1 every 8 hours or so). Black people are three times more likely to be killed than White people. The film “13th”, released long before these recent incidents, prophetically ends with a video of choking by the US police with the cries of a restrained a Black victim calling out that they are “unable to breathe”. As you note, Canada also has a race-based problem with a history of police violence and killings especially against Black and Indigenous Peoples, including the recent high-profile filmed attack on Athabasca Chipewyan First Nation Chief, Allan Adam.

Carter, L. (2014). The elephant in the room: Science education, neoliberalism and resistance. (pp. 23-37) In L. Bencze & S. Alsop (Eds.) Activist Science and Technology Education. Dordrecht: Springer.

Wilson Gilmore, R. (2020). Ruth Wilson Gilmore makes the case for abolition (an interview with Jeremy Scahill). The Intercept. Available online at: https://theintercept.com/2020/06/10/ruth-wilson-gilmore-makes-the-case-for-abolition/

Statista (2020). Number of people shot to death by the police in the United States from 2017 to 2020, by race. Available online at: https://www.statista.com/statistics/585152/people-shot-to-death-by-us-police-by-race/

Simpson, N. (2020). Canada has race-based police violence too. We don’t know how much. The Tyee. 2nd June. Available online at: https://thetyee.ca/Analysis/2020/06/02/Canada-Race-Based-Violence/
Black and Asian people are up to 50% more likely to die from COVID-19. In Canada, race-related data has not even been gathered other than anecdotally, which also paints a similar picture. This is another education moment: an invitation to discuss the presence and absence of data (and the associated politics of evidence). It is also an invitation to question reproductive mechanisms of wealth, power and privilege. Whose lives matter, whose voices are being silenced in this pandemic, being overlooked in policies and practices, including medical treatments, as well as the testing, development and hopeful rollout of COVID-19 vaccinations.

The associated uprisings in the US by Black Lives Matter and those held in solidarity in many countries around the world have brought these injustices home. The BLM matter movement has ripped open assumptions and orthodoxies upon which society has rested and in so doing ushered in new sensibilities, aesthetics, politics, ethics and responsibilities. They have forced those of us working in [science] education to take a deep look at ourselves and reflect on ways that our practices and silences are implicated in sustaining White, patriarchal supremacy and anti-Black racism. There have been immediate responses and science educators and advocates have made statements condemning police brutality and recognized the need to systemically dismantle systems and practices of racism in science. It is important that all science education organisations join in solidarity. I am thinking here of a number of large professional research organisations which have not, as yet, released statements about BLM or COVID-19. There has been much discussion of reforms in universities, including faculties of education (our own included) and faculties of science. Curriculum resources are now being widely circulated, including the Teaching for Black Lives resource and other publications by rethinking schools, which play a central role in my preservice teaching. These resources add to the work of curriculum innovators and researchers who have worked for many years with anti-racist commitments. A publication that influenced my early work was Gill and Levidow’s Anti-Racist Science Teaching and last year my graduate students really enjoyed reading Angela Saini’s book, Superior: The Return of Race Science. These publications forge connections between science, colonialism, capitalism and racism. It is important to recognise that, although this moment is a rupture and feels new, there are still education resources that can offer commentary and helpful teaching activities. I also want to acknowledge and celebrate all those teachers and social justice organisations working on the ground, struggling day-by-day for better worlds. These acts, these alternative histories if you like, can be too easily overlooked in moments of radical change or “the coming of the new” to use Hannah Arendt’s words.

You conclude by raising environmental issues. Here, I am reminded that the BLM and solidarity demonstrations bring people together with multiple struggles in defiance of allied injustices, subjugations and oppressions. These include struggles against environmental racism. It is also important to acknowledge feminist, LGBTQ2, anti-capitalist, Indigenous, anti-colonial, class, and environmental justice intersectionalities as well. The BLM movement invites explorations of whose lives matter in environmental policies, practices and politics. This includes lots of important questions, such as: who has access to green spaces, clean air and water. Who has access to fresh food and produce? Who has access to transportation? Who has access to scientific expertise and environmental monitoring? Who lives in polluted and toxic environments? Who is most affected by climate change? This type of critical place-based analysis offers a

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26 McKay, H. (2020). Black and Asian people in England more likely to die from COVID-19, public health report says. CBC, Jun 2nd available at: https://www.cbc.ca/news/world/coronavirus-Black-asian-england-1.5594608
27 March for Science (2020). Unite behind the science. Available online at: https://marchforscience.org/
28 Watson, D., Hagopean, J. & Au, W. (Eds.) (2020). Teaching For Black Lives. Milwaukee: Rethinking Schools Publication.
29 Gill, D. & Levidow, L. (1987). Anti-Racist Science Teaching. London: Free Association Books.
30 Saini, A. (2019). Superior: The return of race science. London: Penguin.
rich basis for educational explorations in science, health and environmental justice education. Here, I am reminded of the ENRICH (Environmental Noxiousness, Racial Inequalities and Community Health) and their inspiring work publicly disclosing locations of industrial polluters, which are disproportionately located next to Indigenous communities, communities of colour and working poor communities in Nova Scotia Canada. Monitoring and disclosure, I think, are an important part of scientific literacy and citizenship.

There is so much to admire in the educational work of feminist and racialized environmental organisations and Indigenous groups: to name a few in Canada and the US - Indigenous Environmental Network [Canada]; Indigenous Climate Action [Canada]; ECOGirls [Ann Arbor]; the Radical Monarchs [Seattle]; and Rooted and Rising [Toronto], which I am so proud to be a part of. These organisations stress the importance of human and non-human lives. They give environmental stewardship and environmental education a political edge, which it too often lacks. I still maintain that science education and new social movements have so much in common and can gain so much by working more closely together. This inspires my educational work. In the Faculty of Education at York University, I stand by our decision, taken nearly a decade ago now, that teacher candidates (in all grades and subject areas) conduct their first practicum in a community organisation, including many organisations with explicit social and environmental justice agendas. This provides important perspectives and experiences with which to center the teaching profession.

That is probably more than enough. I sense that it is time to bring these discussions to a close and hand over the baton to you for the last time. I conclude by returning your questions: what do you see as some of the implications of the recent events for science education and activism? And in returning to our opening discussions, what questions do we need to embrace as we move forward in our work as science teacher educators and researchers? As always, Darren, I welcome your thoughts.

Darren (Sunday June 21st): Thanks Steve for your insights and wisdom during this conversation. What started as an exercise of two science education scholars to articulate what post-COVID-19 science education might/could/should look like has turned into a conversation because we have realized in our ponderings that this sort of top-down prescription is exactly what is not needed for teachers and students to engage in activism relevant to the pandemic. What has become clear in our discussion, which I think you bring to a point very cogently in your last response, is the need for communities to consider and discuss the politics surrounding the pandemic, racism, and school science, rather than look to technoscientific solutions, which in this case might be represented by curriculum and teaching resources developed by ‘outside’ agencies or scholars.

Building on your argument, Steve, I see the COVID-19 pandemic creating an ‘opening’, into which many agents are rushing, to fill with ‘expertise’, be it scientific, technological, economic, or educational, to name a few. Who can move the fastest, who is already in position, and who has the resources to fill the space is already a function of privilege, with the forms of capital conducive to solutions and production of knowledge and practices historically aligned with those that have come before, such as the White patriarchal systems of knowing and knowledge you write about.

What both the recent Black Lives Matter protests, and the pandemic share is that these diverse moments embody characteristics of an ‘event’: That is, they have happened rapidly; they throw institutions and role definitions into turmoil or disarray; their antecedents often seem insufficient to explain their
emergence and amplifications; their settlement is uncertain; and they make a real difference in the world\textsuperscript{31}. These events started out of apparent uncertainty and, particularly with the pandemic, foment greater uncertainty as they evolve. These events have emitted contagious and infectious energies. Numerous social institutions appear to be at risk of radical rapid evolution and change. Education/science education is one of these institutions. The pandemic has startled, provoked and energised; it has also disturbed, alienated, over-whelmed and incited resentment against the place and prosperity of some human beings relative to others.

We are currently living at a time of real turmoil and uncertainty. Moments such as this both demand and foster incidents of real creativity, a novel response to a condition from the past that engenders a new result that is less than chance and more than simple determination. In our disequilibrium, notions such as criticality, asymmetrical rhythm, vague intensity, system resonances, self-organisation, amplification, emergent causality and real creativity become pertinent concepts to describe and understand an incipience, an impending fundamental change in the fabric of the social order, resulting from the event. Unexpected events, such as the pandemic, creates a flurry of discussion, such as the one we are having, between those who think politics can be comprehended in classic categories of explanation, those who wish they could believe that but actually cannot, those who adopt qualitative or interpretive approaches, and those, perhaps becoming prominent again, who think that attention to the event carries you into territory that may not be entirely reducible to any of these perspectives. I think what we have argued in our conversation adheres to the latter point, which is both thrilling in its possibilities, and intimidating in its uncertainties.

What conversation does is demand that we pause and consider the very systems of privilege and power that have gotten us here, and how these affect the everyday lives of people and communities, before rushing forth with technoscientific solutions that reproduce oppressive systems. The void in education created by the pandemic already has several actors awaiting, and pushing to fill the void, such as the Ontario government, which has tried to make online learning a priority in the province, to the dismay and resistance of many teachers and students. You and I, Steve, are not the only people thinking about COVID-19 education, and many are likely much further along, with unit plans, PowerPoints\textsuperscript{TM}, and resources already developed. We can hope this education has been produced with socio-political aspects of the science of the pandemic considered first and foremost. Since this is an emergent area, however, it does cause one to wonder how dynamic and unknown socio-political aspects of the pandemic might have been captured by these precocious educational products. Who have they been developed by, and for what purpose? These are questions that educational communities are hopefully asking before implementing them.

Rather than see the opening created by the Pandemic as an event that will simmer and fizzle for a while before settling down to the familiar rhythms and routines of (neo)liberally influenced school science – COVID-19 edition, I’d rather explore the possibilities of this time as providing the energies and disequilibrium conducive to an incipieny in science education where we can finally address historic oppressions related to socio-economics, race, gender and sexuality. In other words, we might see this as an opportunity for science educational reforms that pays attention to Black, Indigenous, gender, sexual and other marginalized identities in ways that stick. In order to achieve this, I come back to my earlier point of the need for the voices of teachers and students to lead the conversations about science education in a time of COVID-19. The ‘experts’ in this conversation must be those who’s everyday lives are entwined

\textsuperscript{31} Connolly, W.E. (2013). The ‘new materialism’ and the fragility of things. Millennium: Journal of International Studies, 41(3), 399-412.
with the science education of which we are speaking. What do the teachers and students in marginalized Black communities need from science education in a time of COVID-19? How do we, as science educational scholars, contribute to an event in the making in which teachers and students voices are the driving factors in science reforms that are oriented towards equity, social and environmental justice? The coincidence of Black Lives Matter with the Pandemic has amplified energies and provided models of what community generated social activism for COVID-19 education might look like. The George Floyd murder set of a cascade of stories of Black lives that have been oppressed in similar ways, evolving into social awareness of institutionalized racism. This begs the question: How might groups of public-school teachers and students mobilize their stories and experiences during the pandemic, revealing to the public the fabric of institutionalized racism and other oppressions in school science education, that reproduce inequities in the way students and teachers experienced the pandemic? As we have seen with BLM, the turmoil and disarray, or disequilibrium offered by recent events may have primed society for radical social change. Indeed, we seem to be at an auspicious time for such change. It is my hope, Steve, that our conversation might inspire others, between teacher, students, and authorities involved in public school education, that enable community-grounded science education reforms in a time of COVID-19 that, in addition to addressing questions of science literacy related to the epidemic, finally recognize the differential ways science education must be leveraged to address social inequity.