EDITORIAL: Facilitating students' research-informed actions on complex socio- scientific issues

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Humanity faces many grave environmental and ecological challenges. Intense discussions in the public sphere focus on climate change, growing energy demands, access to clean water, population growth, food shortages, social inequality, genetic modification and other critical socio-scientific issues of our times. The latest report from the Intergovernmental Panel on Climate Change (IPCC) warns that climate change is threatening global food stocks and human security, and that the cost of inaction is too high. In his Carbon Manifesto¹, Canadian environmental activist, David Suzuki, blames politicians for 'intergenerational crimes' and accuses both the government and corporations of 'immoral activity with devastating consequences.' Suzuki calls on everyone to take immediate action. While most socio-scientific issues are left to adults to debate, negotiate and hopefully resolve, little consideration is given to what young citizens in schools can do in response to deepening social and environmental injustices.

Christopher Emdin, Science and Technology Professor at Columbia University, has spoken eloquently at Tedx Talks² about re-positioning education as vehicle for social

and political action. Powerful voices of other transformative scholars in the field of science and technology education (e.g, Hodson, 2011; Bencze & Carter, 2011; Lester et al., 2006; Alsop & Bencze, 2012), whose work has inspired me, have supported this viewpoint.

Three years ago, I was faced with a series of questions about the purposes of science education in response to growing local and global concerns and started to think more critically about my practice and role as a science teacher. What would our classrooms look like, and feel like, if we let our students voice their opinions and positions on critical socio-scientific issues? How do we create conditions in which students would be learning science in the context of real issues and gain a greater sense of purpose through education, other than merely earning grades? How do we equip our students with the capacity and commitment to take responsible and effective actions on matters of social, environmental and moral-ethical concern?

Reflecting on these questions guided my teaching in ways that would allow my students to implement research-informed actions to address critical socio-scientific issues in their school and community. Fortunately, I had an

¹ David Suzuki's Carbon Manifesto <http://www.youtube.com/watch?v=HWPblU8VUyM>

² Christopher Emdin's video: Empowering children through urban education: <http://www.youtube.com/watch?v=ouudXr-csZg>

instructional coach on this journey, Larry Bencze, from the Ontario Institute for Studies in Education (OISE), who introduced me to the STEPWISE framework, which is an acronym for Science & Technology Education Promoting Well-being for Individuals, Societies and Environments.³

My engagement with issues-based, action-oriented science education came shortly after the 2008 revision of the Ontario science curriculum, which gave science, technology, society and the environment (STSE) education greater prominence. More attention to STSE in the science curriculum broadens students' understanding of science, helps them develop better critical thinking and decision-making skills and prepares them for active and responsible citizenship now and in the future.

I slowly became committed to building a more transformative and socio-politically engaged science curriculum and in the process I became an advocate of STSE education. I believe that learning science (i.e., development of cognitive skills by mastering content knowledge) should be balanced with doing science (e.g., learning to perform studies and controlled experiments) and learning about science (e.g., learning about socio-scientific issues and complex interactions among science, technology, society and environment). Hodson (1998) defined the multi-dimensionality of critical scientific literacy in terms of these three major elements, which are the critical components of a holistic science education. I would argue that our current practices are successful at helping students learn science and, to some extent, do science although more emphasis should be placed on student-led, open-ended inquiries. Enacting a new vision of the revised Ontario science curriculum therefore requires even more work if teachers and students want to realize substantial social and environmental transformations. In the words of Steven Alsop and Larry Bencze:

This is not a call to abandon the laws and theories that have occupied our hearts and minds for so long. It is an argument, nevertheless, against the boy with his old chemistry set engaged in solitary pursuit of knowledge, self absorbed and entirely disconnected with modernity. Our practices cannot afford to repeat the same experiments over and over again, mixing those same chemicals, when everything else has changed around us; we should not let our sphere of

influence slip to a semi-historical re-enactment of our own educational experience - reducing our remit to efficiently covering dislocated facts and leaving all matters of concern to the politicians, the popular media and other moralisers (Alsop & Bencze, 2009, p.ii).

Five years ago, Alsop and Bencze introduced the first issue of the Journal of Activist Science and Technology Education (JASTE) for audiences (mainly academics and scholars) interested in fundamental changes to science and technology education that would improve the well-being of individuals, societies and environments. Recognizing that young people also want to contribute to these improvements, I am delighted to introduce the first Youth Issue of the Journal of Activist Science and Technology Education (JASTE). At the heart of this issue is the desire to highlight student projects that awaken solidarity, peace, justice, and responsibility, and celebrate relationships between people, communities and life on earth.

I invited all interested secondary school students in the Region of Peel to submit their original research-informed activist projects to the Journal via a letter sent from Harpreet Neelam, Science and Technology Instructional Coordinator, to all the science department heads in the Peel District School Board. Since the idea of conducting student-led activist projects is a relatively new form of pedagogy in science, it was mostly my students, who were exposed to the issues-based, action-oriented science curriculum, that submitted their work. One project was submitted by students from the class of a colleague who, for the first time, led her Grade 10 Academic Science students through research-informed STSE action projects.

When all the students submitted their projects, I organized a peer-editing group to revise each other's submissions in light of my pre-determined criteria. Finally, I edited their work and submitted all projects to Evan Gerber, a former student from Fletcher's Meadow Secondary School whom I had the pleasure of teaching five years ago. Evan used his creative talent and his degree in art and design to develop a layout for the journal. Countless hours were invested by many people to make this issue of JASTE come to life!

³ For a fuller description of STEPWISE, please visit www.stepwiser.ca

Figure 1: A Pedagogical Framework for Promoting Sociopolitical Actions on Socioscientific Issues

Students have put their brains and their hearts toward addressing global issues through their local actions. They learned to engage in student-directed, open-ended, primary (e.g., experiments and correlational studies) and

secondary (e.g., Internet searched) research as bases for developing and implementing plans of action to address socio-scientific issues. Students' action projects featured in this issue of JASTE address a multitude of socio-scientific issues such as:

- Creating a prominent energy source for the future
- Standing up against gene patenting
- Lobbying for solar panels in schools
- Organizing a 'No Car Day' at the school
- Raising awareness about birth control
- Encouraging healthier diets
- Opening 'the Trojan horse' of beauty products (e.g. lip balms and lotions)
- Addressing the issues of underrepresentation of women in science, coltan mining, and privacy invasion on the Internet.

Figure 1 illustrates the pedagogical sequence I took when first starting to implement issues-based, action-oriented science curriculum.

As I became more experienced with the STEPWISE instructional framework, I provided students with more 'basic' and 'advanced' research-informed action (RiA)

Note: 'RiA' = Research-informed Action(s)

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Figure 2: A 'More Advanced' Pedagogical Framework for Promoting Sociopolitical Actions on Socioscientific Issues in Grade 10 Academic Science

apprenticeship activities (e.g. teacher demonstrations and guided student practice). Eventually, students developed expertise and confidence to self-direct RiA projects and tackle STSE issues of interest and concern to them. Figure 2 illustrates my current pedagogical sequence in a Grade 10 Academic Science class.

For teachers interested in orienting science and technology education towards promoting the common good, I have prepared ready-to-use resources and they are freely available at <http://mrkrstovic.pbworks.com/w/browse/#view=ViewFolder¶m=STEPWISE>.

I hope that the RiA projects featured in this journal will be a source of motivation to teachers, administrators and students. As Alsop and Bencze (2009) write in their first editorial for JASTE: "Science and technology education, we believe, grows when it helps learners and teachers come together to look outward to the world and inward to the needs, hopes and the possibilities of change."

In his article "What would Ghandi do," Petric (2012) applies the three pillars of Ghandian educational philosophy: i) resisting injustice through constructive conflict resolution, ii) the importance of educating the 'whole' individual – mind, body and soul, and iii) seeing ourselves as part of our broader community. I believe that the projects in this issue of JASTE demonstrate all three pillars of Ghandian educational philosophy. These projects also illustrate examples of valuable student character attributes in action, such as care, compassion, integrity, responsibility, and courage.

Wolff-Michael Roth writes in great detail about the importance of students becoming active citizens and campaigning for social and environmental transformations. Roth (2009) wrote that:

Not only does the world change when students participate in activism, but they change as well. With activism as a practice, therefore, we set up the potential for a system that snowballs, one that develops exponentially, because the rate of the evolution increases when more and more students become activists in a world that they inhabit and that they shape themselves (Roth, 2009, p.29).

Activism, viewed through the lens of Ghandian educational philosophy, is an incidental (though not accidental) result of a holistic science education. My hope is that this issue of JASTE will inspire growth and change toward a more transformative, inclusive and action-oriented science education. Here we see the contributions that students can – and want – to make to in our world, and how they can learn about the complex interactions among science, technology, society and environment. I call on my fellow colleagues to join me on a journey to individual and collective transformation in hopes of providing an education to our students that will allow us – adults and youth together – to stand against personal, social, and ecological injustices.

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