Giving STEM a Context: The Beauty of STEM(S)

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Responses

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Reflecting on the process of compiling this Special Issue, we see how the journey has provided us with a rare opportunity to make public the initial articulations, critical feedback, and eventual refinement of ideas about science, technology, engineering and mathematics (STEM) and the role of beauty in science teacher education. It is almost as if we are still in conversation with the authors of the various letters; in this sense, the conversation lives on. We start our final reflection by commending the authors for the depth of thought, care, and insight demonstrated in their well-crafted responses; we will attempt the same as we draw together and re-examine some of the central themes that have emerged in these exchanges.

In our opinion, the search for a depoliticized science education agenda is neither realistic nor desirable. If we can agree that all education is inherently political then the blind adoption of any initiative without the commensurate reflection on the political nature of the adoption can be risky. While we acknowledge the rapid, and perhaps uninvited, integration of the STEM construct into Canadian education discourse, we recognize that, as science educators and researchers in Canada, we cannot afford to ignore the neoliberal driver of national competitiveness that has formed, framed, and continues to attend the STEM acronym for our neighbors in the United States. In retrospect, it might have been somewhat misguided to suggest that “STEM is an acronym in search of a meaning” (Burke & Bazzul, 2016, p. 572) as this gives the impression of a benign term that is awaiting definition. We prefer the interpretation presented by Mannone in this Issue where he states that, “acronyms in science education are just guiding frameworks, not binding contracts.” In agreement, we assert that, as a community of researchers and educators, we have a responsibility to examine what STEM, and its sociopolitical trappings, might, could, or should mean in the context of science teacher education and K-12 science classrooms in Canada. This deconstruction and re-theorization could help to redirect the trajectory of this fast-paced object.

Canadian science education has an established history of, and strong philosophical base for, emphasizing scientific literacy, social relevance, and inclusion through the science, technology, society and environment (STSE) framework. As many of the authors in this Special Issue highlight, the STSE construct already has meaning and relevance in Canada but educators are still quite varied in the extent to which they infuse STSE into their pedagogy so perhaps we should be asking in what ways newly adopted constructs, such as STEM, can support and augment the STSE agenda. We might also question the very need for STEM given the progress made on adopting an STSE approach in Canadian schools. However, we also agree with the conversations in this Special Issue that STEM is the new authority in science education at all levels. Given this, how can we reconcile STEM in Canada with the Canadian scholarship on STSE science education? Loathed as we are to add yet another letter to the acronym, we suggest that one idea might be to add an “S” to STEM: STEM(S). This does not pluralize STEM but instead points out that STEM topics should be considered from the perspective of the intersection of these fields in society; this provides a context for interpreting the S, T, E and M. We believe that this emphasis must be woven into the very fabric of any STEM-based approach.

In Canada, the majority of secondary school students do not go on to pursue STEM-related careers but every student can utilize science literacy today and in their future to critically engage with societal issues that arise from developments in science, from technological innovation, from approaches to engineering, and from applications of mathematics. Young people need to understand STEM and the impacts of STEM on their lives and the lives of others. School science is the place to develop this critical literacy and this is why, in the face of inevitable STEM, we...
suggest Canadian teachers place societal concerns and issues at the centre of any approach to STEM education: STEM(S).

One way to help students understand the interconnections between the various parts of STEM and their societal contexts was suggested in the paper that stimulated this Issue (Blades, 2016): exploring the beauty in science. Alongside the ethical dimensions of science that STSE demands we examine, we see the potential for an integrative/interdisciplinary STEM approach to be used as a means of recapturing the long-neglected beauty of science. It is not a far stretch to see how the creativity aspects of STEM design processes could support the return to an area of science that the natural philosophers and scientists of the 18th and 19th centuries captured so well; indeed, in this Issue, Yung has eloquently and persuasively drawn on the aesthetic facets of science as ways of developing a student’s depth of connection with the field of science. The concept of beauty as a foundation for studies in STEM goes beyond the integration of arts into STEM—the so-called STEAM approach. We argue that simply adding some aspect of the arts to STEM, as an additional element as is often the case with STEAM, does not go far enough in truly integrating the different facets of the acronym.

We envision beauty as a more foundational approach to STEM. As argued in the various conversations, beauty is complex and difficult. We believe that this is the strength of this concept: the difficulty in deciding what is “full of beauty” and what is not. Imagine, for example, discussions by students about the aesthetics of an engineering design. What is appealing? In what ways are the social effects of a particular creation by engineers beautiful? Beauty weaves through mathematics in the form of elegance, introducing students to the philosophy of mathematics. We might explore the beauty of a technology and ask if this technology also has possible effects on society that we find ugly. Such discussions reveal to students the deep, human nature of STEM, removing from activity in STEM any sense that STEM is somehow socially neutral. Beauty is complicated precisely because beauty calls us to the societal aspects of STEM education. Bringing beauty to the science classroom represents a returning to the history of STEM. For example, the introduction of the technology of coal-fired steam trains in England brought tremendous controversy as people found the noisy, smoke-belching train technology greatly depreciated the beauty of the countryside. Students could benefit from an examination of the controversy surrounding the introduction of such technologies, for we continue to introduce new technologies today and anticipating how these technologies can and might be adopted in society is one way to be engaged in the social order as a citizen. Examining the example of the trains even more, we might find that the organization of pistons, wheels, cogs, and hoses forms a network that is beautiful in design and symmetry, providing another facet for examining the STEM of trains. This illustration shows that the possibilities are endless when STEM topics are linked through a foundation of beauty that invites, questions, and critiques STEM in science education, driving us back to the challenges and subjectivities of social context that underlie science education in our country.

The history of science reveals how scientists shared their rapture of the natural world. The diaries of the women and men who surveyed mountains, studied newly discovered elements or saw microbes for the first time, speak of the beauty of the world. What did they mean when they said that the world is beautiful? Have we lost this aesthetic sense in science education? If so, can we recover this sense through beauty in STEM? Would such instruction bring students closer to an authentic experience of science in the way that professional and amateur scientists experience science? We can imagine astronomers sharing with students what first inspired them to study the night sky or a geologist describing when they first fell in love with rocks. We argue that bringing beauty to STEM would likely provide similar inspiration, and perhaps even more students would consider a career in a STEM-related field. Our hope is that those who enter STEM fields do so because they are inspired or have fallen in love with one or more areas in STEM but for those who do not, we hope that beauty encourages and fosters the critical literacy towards STEM topics so very much needed to inform and direct the decisions that students face today and in their futures.

References