Dear Professor Blades,

Thank you for taking the time to share your perspectives on the field of Science, Technology, Engineering and Mathematics (STEM). Having only recently started a graduate program at the Ontario Institute for Studies in Education (OISE) in Toronto, Canada, my knowledge of STEM is limited. However, in order to pursue a career as a curriculum developer in science education, I believe that I will require a thorough understanding of STEM, given the numerous STEM-driven initiatives that are being implemented in Canada. In this respect, the ideas that you have expressed in your letter not only allowed me to become more informed about STEM but they also prompted me to become critical about its place in science education.

My overall impression of your letter is exceedingly positive because, although you are critical about the neoliberal agenda of STEM, you have not denied the possibility of broadening its perspectives to include the notions of ethics and responsible citizenry. Within your description of STEM, you have included a few comparisons to Science, Technology, Society and Environment (STSE), which is an aspect of your letter that resonated with me. This stems from my experiences with the science curriculum documents in Ontario, where STSE is still the primary objective, despite the growing popularity of STEM. Therefore, I would like to take this opportunity to engage in a discussion with you about why I believe that our engagement with STEM may not be justified, since we already have STSE.

Although I am aware that STEM can have more than one definition, my current understanding is that STEM allows students to appreciate the interconnectedness between the four disciplines represented in the acronym and to connect their knowledge to real world applications. This interplay of subjects can provide students with a more holistic perspective of the field of science. Another acronym in science education that also aims to provide an interdisciplinary approach to science, and one that I have been able to study in comparatively more depth than STEM, is STSE. Although Mathematics and Engineering are not a part of the STSE acronym, I would argue that there are opportunities to explore these disciplines within the STSE objectives. For example, one of the STSE topics in the grade 10 Ontario science curriculum document is the use of vision sensors in food safety and this would require students to have an understanding of the mathematical basis of optics and the design or engineering aspects of vision sensors that allow them to identify harmful substances in food products (Ontario Ministry of Education, 2008). Taken together, I believe that STSE and STEM are similar in the knowledge and skills that they impart to students through their interdisciplinary approaches.

However, as you have described, there are differences in the underlying purpose of these two acronyms. STSE encourages students to consider the ethical, social and environmental impacts of scientific and technological advancements, in an effort to promote responsible citizenship. On the other hand, STEM encourages students to pursue careers in science, mathematics, technology and engineering, so as to further the country’s economic agenda that is rooted in scientific and technological innovation and dominance. I suspect that when the driving force behind education initiatives, such as STEM, lies in the achievement of a competitive advantage, it is possible that the notions of social justice and moral values are considered secondary, or worse, are completely omitted from the discussion. My suspicion was further strengthened by Steele, Brew and Beatty (2012) who mention that ethics do not seem to be a priority for the funders of STEM initiatives. In addition, you have mentioned that the dominance of STEM in science
education suggests that it has overwhelmed or replaced STSE approaches; this causes me to be concerned about the eventual loss of STSE along with its ethical tenets. Therefore, given the similarities between the knowledge and skills imparted by STEM and STSE and the importance of providing a Canadian science education that develops citizens whose decisions about socio-scientific issues include a consideration of social, ethical and environmental notions, I question the need for engaging with STEM when we already have an ethically-sound version of STEM, which is STSE.

It has become apparent that my preference lies in advocating for STSE over STEM, given the absence of ethical considerations in STEM. Although you have expressed a similar preference in your letter, you have also suggested an alternative and creative way of approaching STEM that prompts educators to pay attention to the negative impacts of scientific and technological advancements. Your suggestion of infusing STEM with Nature of Science (NOS) perspectives by questioning the beauty of these advancements in a philosophical sense represents a more conscientious way of enacting STEM. However, NOS perspectives are the very tenets of STSE, which suggests that we already have a science education construct that is rooted in these perspectives. This, once again, brings into question the need to pursue STEM in the presence of STSE. Similarly, Steele et al. (2012) have expressed their concerns about the absence of ethical considerations from STEM approaches and have suggested a blend between STEM and STSE that would allow students to acquire STEM-related knowledge and skills within the ethical framework of STSE. Moreover, Blackley and Sheffield (2016) have suggested Environment and Ethics as possible alternatives for the Engineering component or ‘E’ in STEM education and have stressed the importance of these two alternatives in promoting responsible decision-making. A common theme within the above two studies is that the authors are attempting to change STEM by infusing it with notions of STSE, such as ethics and care for the environment. Therefore, this would ultimately lead us back to STSE, which prompts us to reflect on the need to create ethical versions of STEM, when we can continue to use STSE.

After reading your letter, I was eager to learn more about STEM within the Canadian context. This led me to DeCoito’s (2016) article, where the author has outlined a wide range of STEM-based initiatives in Canada that are being implemented by universities, non-profit organizations, public-private institutions and government agencies. The author has also mentioned that the Toronto District School Board (TDSB) provides and promotes STEM-based activities for students. However, the absence of STEM in the curriculum documents demonstrates that it has not officially made its way into the school system. In light of STEM’s growing popularity in Canada and the support it is receiving from school boards, I suspect that the inclusion of STEM in the curriculum documents will be considered by members of the Ministry of Education in discussions about curricular reforms. So far, I have presented my viewpoints on why I believe that we should not only question the need to engage with STEM but we should also question the need to create newer versions of STEM that are infused with ethical perspectives as this would ultimately lead us back to STSE. Therefore, for the moment, I would like to imagine myself as being a part of the discussions on curricular reform, where I have expressed my disagreement with including STEM in the curriculum, given the presence of STSE, and I imagine that my viewpoints would be met with some criticism. For example, there may be concerns that the exclusion of STEM would lead to fewer students becoming scientists and engineers, which would cause Canada to fall behind in the race for innovation. In response to this concern, I would explain that even though the scientific knowledge provided by STEM and STSE are similar, neither construct guarantees that science students will pursue careers in STEM fields. However, unlike STEM, the scientific knowledge that is learnt through STSE is embedded in ethical and moral values. Therefore, even if students decide against science-related careers, a science education that is driven by STSE will at least prepare students to become responsible citizens, who will strive to make just decisions about socio-scientific issues.

In an effort to encourage other members of the research community to question the need for STEM in science education, I would like to borrow your strategy of using plays at a conference to examine the STEM discourse, which I found to be a creative and engaging (Weinstein, Blades, & Gleason, 2016). However, I would like to broaden Marie’s character, who plays the role of a STEM critic, by adding to her script the ideas that I have presented in this letter regarding STEM and STSE. By bringing together multiple experts from the fields of STEM and STSE, including yourself, I believe that the conference context would provide an opportunity to consider multiple viewpoints regarding the need to engage with STEM, given the presence of STSE.

That being said, it would be naïve of me to believe that such strategies would end in STSE regaining its dominance in science education and I would like to emphasize that this is not my goal. I do, however, believe that before choosing to promote new educational initiatives, it is necessary to compare them to older initiatives, in order to
truly comprehend the need for the new initiatives. You have rightfully mentioned, in a previous paper, that we should “disrupt the taken for granted belief that science education should be oriented toward STEM; we simply ask, “Why should it?”” (Weinstein et al., 2016, p. 209). Keeping the Canadian context in mind, my aim is to simply extend this question by rephrasing it as follows: “Why should it, when we already have STSE?”

Although I stand by my viewpoint of continuing to use STSE, instead of engaging with STEM, I acknowledge that the prominence of STEM in Canada and the emphasis on developing new STEM initiatives are undeniable. Therefore, STEM’s continuing influence on science education cannot be ignored. This has encouraged me to explore ways in which both approaches can exist harmoniously. Shanahan, Burke and Francis (2016) have provided a useful technique for accepting the place of STEM and incorporating it into science education without foregoing our existing loyalty to STSE education and its objectives of responsible citizenship. This technique involves using STEM as a boundary object, which accepts multiple interpretations of STEM and, consequently, helps to maintain the place of other educational priorities, such as STSE. This combination of STEM and STSE may be useful for responding to potential calls for the inclusion of STEM in curriculum documents.

Given my limited experience in the field of science education, I am eager to expand my knowledge of STEM and STSE by seeking your thoughts on the ideas that I have presented. I would like to thank you for taking the time to consider my perspectives on STEM.

Sincerely,

Zoya Padamsi

References


