Final Report

Study and Development Fellowship, 2017-2018

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A fellowship application was submitted to the Office of the Provost & Vice-President (Academic) to conduct pedagogical research entitled Teaching Controversial Science for Social Responsibility. This research aims to examine how do academics at the University of Guelph engage in the theory and practice of teaching controversial issues, such as genetically modified foods, biofuels, synthetic meat, and nanotechnology. The fellowship was approved for summer 2017 with some modifications to refocus on course redesign than primary research on teaching and learning innovation. This report summarizes completed as well as ongoing activities pertaining to the fellowship.

Completed Activities

I attended the Course reDesign Institute from May 8-11, 2017. As per the requirement of the Institute, I had to pick a course to redesign. Faculty & Academic Staff Relations staff at the Office of the Provost and I consulted the three departments where I have taught, School of Environmental Design and Rural Development, Department of Sociology and Anthropology and International Development Studies. The Department of Sociology and Anthropology offered me an opportunity to redesign SOAN 4500 Community Development, a course that I have taught for a few years now. In this course, I had to bring many contentious community development issues into the discussion to illustrate possible value incongruences within local communities and among development practitioners, regional planners, social activists, policy-makers, applied scholars and scientists. Out of my instinct, I was conscious to provide a balanced explanation of controversial development issues without necessarily disclosing my own preferred position. Did I do the right thing? Does it limit my academic freedom to engage in science advocacy? Is it ethical for educators to intentionally hide our positions on controversial issues that are so important for the society? Don't I have a moral responsibility to engage in public policy advocacy, especially when the issues at stake are so important for the well-being of human and nonhuman species? Where do I go for help to find answers to these questions? What pedagogical and curriculum development supports are available for new faculties, sessional lecturers and teaching assistants in controversial issues? These were the research questions I was expecting to answer through the proposed research on teaching and learning innovation in controversial science and technology.

Although the proposed research continues as one of my long-term research programs, the Course reDesign Institute equipped me with the required knowledge and skills to improve my teaching effectiveness. It helped me better articulate learning outcomes, and align them with teaching and learning activities, and appropriate assessment methods. One of the most significant revisions in the course is regarding the learning outcome about engagement in controversial issues, which specifically aims to identify and critically debate different values and moral duties in community development case studies. This outcome, nevertheless, relates to the proposed research on teaching and learning

innovation, but now in the interim, I am relying on secondary sources of information to redesign and effectively deliver this component of the course.

Science controversy is not a new phenomenon. One of the most cited examples is the Manhattan Project (1939), which involved the first development of the atomic bomb in the USA during the World War II, that led to critically questioning social responsibility of science and technology (Rhodes 2012). As early as the late 1980s, in his influential work, Kelly (1986) suggests a typology of educators' positions in teaching controversial issues: exclusive neutrality, exclusive partiality, neutral impartiality, and committed impartiality. While exclusive neutrality stops teachers from introducing any controversial issue into the curriculum, exclusive partiality motivates them to intentionally persuade students into accepting a favored position on the issue. Similarly, neutral impartiality requires teachers to permit their students to examine all relevant points of view on an issue and to direct them to honor the strongest argument. Contrary to this, committed impartiality inspires teachers to state their own opinions on controversial issues and then ensure that all competing points of views receive a fair hearing through a critically engaged discussion. However, recent literature suggests that science advocacy, possibly taking an exclusive partiality on controversial issues is impotent for the well-being of human and non-human species, and it would not hurt the credibility of scientists and legitimacy of science and science advisory institutions (Kotcher et al., 2017). It is because, with a changing landscape of science engagement in a post-truth world, scholars, educators and practitioners of responsible innovation increasingly feel compelled to resort to protest, denouncement, even despair to restore public deference in science and scientific research evidence (Fisher, 2017). Hence, it would be imperative to examine what pedagogical theory and teaching practice of controversial science and technology would be necessary for the postsecondary classroom.

Back to the course redesign process, the preferred teaching and learning activities to deliver the learning outcome on controversial issues in community development include debate, value chain, and case studies. The available body of literature suggests that class discussion is the most appropriate pedagogy to teach controversial issues if educators take care of the following four conditions – effective preparation, accessible topics, strong and diverse views among discussants, and appropriate facilitation of the engagement process (Hand and Levinson, 2012; Levinson, 2006). Assessment of the learning outcome on controversial case studies will be done using critical reviews and case study assignments. Students will identify and discuss controversial issues in the assigned journal articles for reviews and conduct a case study of their choice on a controversial issue in community development.

Although the specific exercise in the Institute was about redesigning the existing syllabus on Community Development, I have already used the knowledge and skills that I gained from it in designing a different course, EDRD 4020 Rural Extension in Change and Development, that I am teaching for the first time this fall. This course has a specific objective of communicating science in society, including important controversial issues. Furthermore, this past summer, I had an opportunity to visit science museums to witness whether and how controversial issues are communicated to visitors of different ages. I clearly see a potential to work together with science museums and other stakeholders to better communicate controversial science to society.

Ongoing Activities

Although the proposed research was substituted by the participation in the Course reDesign Institute, out of my own curiosity and research track record, I have been conducting the research on Teaching Controversial Science for Social Responsibility revisiting the following initial objectives.

1. To review literature on critical science pedagogy and curriculum development in controversial issues at the post-secondary level;
2. To assess the ways in which controversial issues are currently introduced in the classroom;
3. To provide insights into perceptions of professors, new faculties, sessional lecturers and teaching assistants about the critical pedagogy of teaching controversial issues; and
4. To recommend strategies for critical science pedagogy and curriculum development in controversial issues.

I have been conducting the literature review (objective #1), and critically examined various ways in which controversial issues are introduced in the postsecondary classrooms across the world (objective #2). The second objective has been partially achieved because this assessment so far has relied on secondary sources. As a short-term strategy, this review has become helpful to introduce controversial issues in my classroom. In the long-term, it will help conduct research in this evolving field of study. The preliminary review resulted in the following lines of inquiry which will be pursued further in future research.

Controversial science and technology in a post-truth world

Many scholars disagree on whether science should be apolitical and scientists should refrain from engaging in science policy advocacy? This question is becoming more pertinent these days in a post-truth world, which is characterized as public policy decisions increasingly based on emotions, values and personal belief than scientific research evidence. Over two decades ago, Ziman (1996) casted a doubt about the relevance of objective value-free science where scientists were required to be more socially responsible to society. Further, progress in science happens when new evidence persuades scientists to challenge a previously held theory leading to a paradigm shift (Reiss, 2006). Hence, scientists are expected to create socially, ecologically and morally responsible knowledge in a changing context (Ziman, 1998). Just like scientists, science educators are also required to teach not only objective science but also controversial science, the latter can possibly lead to creativity, learning and transformational innovation (Cross and Price, 1996; 2002).

To handle controversial issues in the classroom and beyond, Oulton et al. (2004a) suggest considering the nature of the controversy in the first place. Scholars argue that science-society relationships become much complex when muddled by human values, beliefs, and emotions, which makes scientific facts further inaccessible to society (Cross and Price, 1996). For example, different interest groups base their views on either different sources of evidence or they interpret the same source in different ways. Further, controversial issues cannot always be resolved by recourse to reason, logic or experiment as various interest groups may interpret the world differently based on their values, beliefs and emotional intelligence (Oulton et al., 2004a; b).

Public engagement in controversial science and technology

Contrary to the notion of objective science, historians of science and technology urge scientists to speak for the facts directly with the public because the scientific evidence does not speak for themselves (Oreskes and Conway, 2010). This implies that scientists have a crucial role in public policy advocacy to bring the scientific basis of a controversial issue that is important to society. Scientists' reluctance to engage in policy advocacy may result in an unintended negative consequence, such as a loss of public confidence in science and science advisory institutions (Irwin, 2006). Scholars of responsible innovation argue that an early engagement of the public in priority setting and research implementation may not only reduce science controversies but also possibly result in downstream disruptive innovations (Fisher et al., 2006; Torgersen and Schmidt, 2013).

A systematic assessment of the perception of social and natural scientists about credibility impacts of their engagement in policy advocacy would potentially inform critical science pedagogy and effective curriculum development (Santos, 2008). Students and educators would benefit from the study of controversial issues to improve their core competency in teaching and learning innovations (Pant, 2012). It is not only necessary to examine controversial issues in the classroom but also engage the broader public through science communication, such as science cafes, science museums, and conventional and social media.

Moral framework of public engagement in controversial science and technology

Controversial science and technology are likely to become more prevalent as new and emerging technologies continue to ingrain more deeply into our cultural milieu (Gardner and Jones, 2011). A preliminary review of the literature on critical science pedagogy reveals at least five moral frameworks that can potentially inform teaching and learning of controversial issues – consequentialism, autonomy, rights and duties, care ethics, and pluralism (Reiss, 2006; Saunders and Rennie, 2013) (Table 1). Scholars suggest that these frameworks can inform citizen science education to make the world a better place for human and nonhuman species (Oulton et al., 2004; Vesterinen et al., 2016). These five frameworks, which are by no means exhaustive or mutually exclusive, may inform educators, research scientists and science advisers.

Table 1. Moral frameworks to inform public engagement in science and technology

Framework	Explanation
Consequentialism	Assesses utilitarian benefits against the harms or risks of an action. Promotes the common good to help everyone have a fair share of the benefits.
Autonomy	Promotes individual decision-making and self-determination through science literacy. Respects people's independent decisions to enable individuals to make informed choices.
Rights and duties	Defines what people can expect as their rights, so far as it is under their control. Recognizes that duties associated with rights, legal as well as moral.
Care ethics	Acknowledges virtues in society, such as honesty, truthfulness, courage, fairness, and compassion. Considers virtue as central to moral action but it is not necessarily legally binding.
Pluralism	Considers ethical thinking in terms of multiple identities, including cultural, ethnic, religious, spiritual, or gender perspectives.

The available body of literature reveals that those who incline towards objective science would embrace utilitarian traditions whilst those who believe in subjectivity would recognize the importance of self-determination, citizen rights, care ethics and pluralism. The expert culture of science that focuses on science literacy assumes public as ignorant of science but it is not necessarily true in a post-truth world; science controversy is more about conflict of religious, ideological, indigenous and spiritual values than illiteracy about scientific facts (Wynne, 2001). The frameworks, such as care ethics and pluralism, move beyond consequentialism and focus on epistemological foundations, moral values and ethical development, and emotional intelligence (Tait, 2001; Zeidler et al., 2005). Care ethics framework is particularly useful to inform why the consequentialist framework narrowly focuses on the risk-based governance of science and technology (Groves, 2015; Preston and Wickson, 2016). The literature on feminist care ethics takes this discussion further to include social inclusion and gender equity as elements of socially responsible science and technology. Similarly, pluralism as a moral framework considers ethical thinking in terms of cultural, indigenous, minority, religious, spiritual and gender identities (Saunders and Rennie, 2013). From the perspective of critical science pedagogy, pluralism embraces contested exchanges among multiple interest groups than the seemingly unrealistic goal of reaching a consensus on controversial issues (Castle and Culver, 2013).

Finally, I would consider applying for an appropriate SSHRC grant or any other funding to further pursue this research (objective #3 and #4). I am open to research collaborations from disciplinary and interdisciplinary scholars who are interested to pursue research in this field of study. Further, I will keep exploring opportunities to collaborate with science museums, civil society organizations and school boards so that this program of research on controversial science and technology could potentially have larger societal impacts.

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