Teaching global perspectives: engineering ethics across international and academic borders

Mary E. Sunderland, Behnam Taebi, Cathryn Carson & William Kastenberg

To cite this article: Mary E. Sunderland, Behnam Taebi, Cathryn Carson & William Kastenberg (2014) Teaching global perspectives: engineering ethics across international and academic borders, Journal of Responsible Innovation, 1:2, 228-239, DOI: 10.1080/23299460.2014.922337

To link to this article: http://dx.doi.org/10.1080/23299460.2014.922337

Accepted author version posted online: 13 May 2014.
Published online: 19 Jun 2014.

Submit your article to this journal

Article views: 196

View related articles

View Crossmark data

Citing articles: 3 View citing articles
Recent policy reports on responsible innovation emphasize the need to make ethics integral to advanced engineering programs. Students, however, usually perceive ethics as a set of rules and principles embedded in codes rather than as a set of open-ended approaches and a potential source of innovative research questions. We report on the pilot offering of an intensive summer program for graduate students, *Global Perspectives: Engineering Ethics Across International and Academic Borders*, which aimed to shift this perspective by creating opportunities for students to explore the challenging situation of ethics within graduate engineering education and specifically to engage in collaborative, interdisciplinary ethics research. By synthesizing scholarship from the philosophy of emotion, student voice, and early engagement, we aimed to create a space for student exploration, collaborative learning, and active knowledge production. The student commentaries that follow the article serve as the program’s preliminary assessment and draw attention to the important role that students may play in shaping new pedagogical initiatives.

**Keywords:** engineering ethics; interdisciplinary collaboration; emotion; pedagogy; student engagement; graduate education

**Introduction**

How might educational institutions enable and support responsible innovation (RI)? The literature suggests that this could be accomplished by making ethics more integral to science and engineering curricula (National Academy of Engineering 2005; Van den Hoven 2013). Moving ethics from the periphery to the core of technical curricula requires a multidimensional long-term strategy that addresses cross-cultural, cross-disciplinary and institutional factors. With this in mind, we designed and piloted a summer program for graduate students: *Global Perspectives: Engineering Ethics Across International and Academic Borders* to bring together several scholars who were usually separated by many miles, and more importantly, by research traditions, methodologies, and institutional boundaries. The title of the program, which was part of our recruiting strategy, reflects the diversity of the participants rather than the specific course content. While we did assign background reading about the teaching of global perspectives in engineering education...
(Downey et al. 2006) and the challenges of interdisciplinary, collaborative scholarship (Pennington 2008), the core program objective was to foster collaborative relationships between students from different academic cultures and countries, specifically: graduate engineering students from the University of California, Berkeley and philosophy of technology graduate students from Delft University of Technology. Working toward this objective drew attention to the institutional and conceptual challenges that students encounter in interdisciplinary collaborations.

The paper starts by mapping out the program’s theoretical motivations and its larger research context: an overarching project whose goal is to move ethics from the periphery to the core of the engineering curriculum by engaging students’ emotions (Sunderland et al. 2013). For a variety of historical reasons, referencing the emotions is often discouraged in academic discourse, particularly in ethics, but there is a growing interdisciplinary scholarship that brings to light the important role that emotions play in both moral decision-making and learning (Lewis, Haviland-Jones, and Barrett 2008). Our program builds on this scholarship by creating a place for emotion in engineering ethics. Although the program was designed as a component of our larger study, the students were not and are not research subjects. Rather than involving students as “objects of inquiry” we invited them to become co-inquirers (Hutchings, Huber, and Ciccone 2011, xiii). Our pedagogical strategy sought to break down traditional academic hierarchies, including the teacher–student division, in order to draw out a diversity of authentic perspectives about the place of ethics in engineering; these viewpoints are communicated in the accompanying student commentaries (Hutchings and Huber 2010, xii). Insights from the commentaries are interwoven with the program description to demonstrate how “unwelcome” discussions fostered a kind of collaborative reflection that laid the foundation for interdisciplinary work (Bergen 2014). In closing, we discuss how the findings from our program might be put to work in different institutional contexts. Collaborative inquiry in a non-hierarchical environment is emphasized as an effective method for knowledge production (Calvert 2014), and as a strategy for shifting perceptions about engineering ethics, which is necessary for the success of RI.

Engaging emotions

As a pedagogical initiative, the program was organized to engage students’ emotions. The pedagogical focus on emotion is part of our larger collaborative project, which involves studying the role of emotion in engineering ethics education (Roeser 2012; Sunderland et al. 2013). Emotion, perhaps unsurprisingly, is often absent from engineering ethics curricula. In his assessment of barriers to effective engineering ethics education, Byron Newberry identifies emotional engagement as a central challenge. Engineering ethics, he argues, has typically focused on intellectual engagement. Students may learn philosophy and moral reasoning but they do not learn to care about ethics (Newberry 2004, 344). In fact, a recent longitudinal study of undergraduate engineering students, which tracked students’ attitudes about public welfare, showed that students’ concerns about public welfare actually decline over the course of their engineering education (Cech 2014).

Despite the abundance of research that highlights how emotion shapes decision-making processes, the relationship between ethics and emotion is contentious. In the historically entrenched master–slave metaphor, for example, emotions are portrayed as inferior, primitive, unreliable and therefore detrimental to ethical and moral behavior (Solomon 2008). The notion that emotion clouds judgment is also implicit in the common engineering narrative, which applauds engineers for their superior ability to rationally solve problems by strategically applying scientific methods (Pawley 2009). We challenge the assumption that there is no place for emotion in engineering ethics. On the contrary, we argue that careful reflection regarding one’s emotional reaction to
ethically fraught scenarios and risky technologies can open up new questions and perspectives by redirecting the focal point of research (Roeeser 2012; Sunderland et al. 2013; Sunderland 2014).

In the program, one of the ways we intended to bring emotion into engineering ethics was by increasing student engagement. As a concept, student engagement has two dimensions: it refers to the amount of time and effort that students put into their learning, and also to the time, effort, and infrastructure that educational institutions contribute to support student learning (Wolf-Wendel, Ward, and Kinzie 2009). Understanding student engagement in the area of engineering ethics therefore requires a complementary institutional analysis to evaluate how and why students allocate their time. To do this, our pedagogical initiative drew on student voice approaches, which emphasize the importance of enabling students to articulate their perspectives in their own language. Student voice work holds that students’ perspectives on learning and teaching are critical for the development of effective educational programs and seeks ways to incorporate students in the processes involved with curriculum design and reform (Fielding 2001). Our basic premise was that by increasing student engagement, we would make it more feasible for preexisting emotional dispositions to be articulated and for students and instructors to address ethical issues in their personal and institutional complexity.

Our program drew engineering graduate students out of their labs and into a common space where we could build trust and break down disciplinary hierarchies. To make this strategy work, we tapped into the motivation and rewards that go along with the opportunity to publish. We reasoned that the goal of producing publications was likely shared by a diversity of graduate students across disciplines. The summer program was consequently designed as a research experience that would enable students to conceptualize the ethical dimensions of their own fields of endeavor and also enroll students in our efforts to interrogate the place of engineering ethics in engineering education. Along with the experience of discussing and learning, the aim was for each student to finish the week with: (1) the idea of a research paper sketched out, (2) a plan to further develop their proposed research ideas, and (3) a plan for including engineering ethics in their own field of study.

Program participants were invited to join us as partners in thinking about the role of engineering ethics in engineering education. The program was designed to cultivate new collaborative perspectives that would reflect the diversity of positions held by the participants, including ourselves. These student perspectives are critically important yet often missing from analyses of educational initiatives (Bovill, Cook-Sather, and Felten 2011). To ameliorate the dearth of student contributions regarding engineering ethics education, we invited students to write commentaries for this paper. Collectively, these responses offer an assessment of the program by highlighting its successes and failures. In addition, the reflective exercise of articulating their experiences led students to identify important conceptual and institutional challenges that make it difficult for students to engage with engineering ethics, and as a corollary, to promote RI. An important contribution from our program, illustrated by the commentaries, is students’ largely untapped capacity to play an active role in the development of effective pedagogical initiatives geared toward RI.

From “unwelcome” discussions to collaborative reflection

The following description of the intensive, five-day program shows how we created a space for engineers, philosophers, and social scientists to collectively reflect on their experiences in educational institutions. This unfamiliar exercise, which involved describing and re-describing daily practices, led participants from different epistemic cultures to find a common language. Establishing a non-academic lingua franca allowed students to identify common concerns and initiate collaborative inquiry from an egalitarian starting point (Hoople 2014; Rolfe 2014;
Spruit 2014). By opening up the possibility of contributing to engineering ethics scholarship, the program invited students to consider their capacity and motivation to engage with the socio-ethical dimensions of their research. Putting students to the challenge of producing collaborative work set the stage for frank discussions about the practical hurdles and institutional arrangements that discourage students from taking ethics seriously. Key findings from the student commentaries are brought into conversation with the program description to provide a preliminary program analysis that highlights its successes and shortcomings. In addition, contextualizing the commentaries demonstrates students’ ability to contribute to open research questions that seek to identify the social, cultural, and institutional factors that promote and inhibit ethical research and practice in engineering.

In preparation for the program, students learned that the core objectives included: (1) creating ethics research opportunities; and (2) building new collaborations and identifying strategies to support these activities. To work toward the objectives, students were assigned specific readings and also provided with a curated library of background reading material, which was designed to offer students a standard introduction to engineering ethics (van de Poel and Royakkers 2011), and also to raise questions about how this material became standard. Mitcham’s (2009) historical analysis of engineering ethics, for example, was included to provide context, but also to prime students with questions about the factors that have shaped and continue to shape the field of engineering ethics.

**Barriers to creating ethics research opportunities**

The program was designed to show students that there is room for them to make a contribution without necessarily needing to become independent experts in a second established discipline. Indeed, this is one of the appealing features of engineering ethics – there are peer-reviewed journals where it is possible for junior scholars to publish interdisciplinary, collaborative articles, such as *Science and Engineering Ethics*. The common perception, however, is that there is a deterrent to publishing in these kinds of interdisciplinary journals. First, even though many of the journals that publish science and engineering ethics manuscripts have reasonable impact factors, they are considered to be less important within some engineering departments in addition to many humanities and social science departments. Many traditional departments question the academic rigor of applied ethics research and favor the kind of research that can be published in a well-recognized disciplinary journal. The perceived lack of rigor in ethics-related research also extends to ethics education research, as evidenced by recent analyses of publications in the *Journal of Engineering Education (JEE)*. Since the year 2000, for example, *JEE* published papers that featured ethics as a central subject at a rate of less than 2% of their total publications, with a notable decline after the journal implemented new standards that emphasized academic rigor (Riley 2012). Because rigor is a term with powerful rhetorical force it has been used to demarcate and legitimize particular qualitative research methods to an engineering audience, who associate research rigor with quantitative, objective results (Beddoes 2013).

Second, focusing on the ethical dimensions of engineering is perceived as a lower-status, and/or tangential activity that distracts a student or faculty member from engaging in research that contributes to advancing the home department’s mission. The perception that ethical and social concerns are secondary and detached from technical concerns is also embedded in the engineering profession and in engineering education more generally (Faulkner 2000; Cech 2014). As a result, the people who can most afford to engage in lower-reward, lower-status ethics work are senior, tenured scholars. Yet even senior scholars who make these kinds of interdisciplinary ethics contributions face the cost of impeding their movement up the academic ladder. Although we recognize that not every department discounts ethics research as an unscholarly distraction from core
research activities, we highlight the importance of considering how interdisciplinary ethics scholarship will be and has been perceived and evaluated by faculty supervisors, colleagues, departments, and disciplines.

Perceptions about what counts as good scholarship are important, especially to younger scholars and students. Is it wrong to encourage the junior scholars in our program to engage in undervalued interdisciplinary research? While academia has long been organized around specialists, it has been argued that interdisciplinary scholarship is necessary to achieve the aims of RI (Taebi et al. 2014). Additionally, there are increasing calls for scholars with interactional expertise, which is a skill that experts acquire through extensive communication and interactions with members from another discipline (Collins 2004). Immersion in a different academic community allows scholars to develop interactional expertise by learning the culture’s explicit and tacit features. The mark of success is when it is possible to pass oneself off as a member of the community (Gorman et al. 2014, 160). Although our program did not emphasize the acquisition of interactional expertise, philosophy of technology student Zoë Robaey’s (2014) commentary draws attention to the concept to highlight the challenges of interacting effectively with people from different disciplinary cultures. These calls from the RI community for scholars with interactional expertise, who are capable of making collaborative, interdisciplinary contributions, give us some hope that our program is providing students with a desirable skill set and valuable experience.

Part of what we set out to do in our program was to address perceptions about engineering ethics and initiate a discussion about how we might contribute to changing these perceptions by building opportunities that would allow students to engage in ethics work without suffering academically. Engineering ethics and ethicists have many negative connotations, which contribute to the earlier-mentioned phenomenon of departments placing less value on ethics publications than on more traditional disciplinary publications. For example, while faculty may intend to portray ethics as nuanced, interesting problems, a recent survey of undergraduate engineering students in the United States revealed that students generally perceive ethics as a list of rules and principles embedded in codes and laws to be memorized (Holsapple et al. 2012). Merging ethics with regulations and laws suggests that following rules leads to ethical results, yet it is often the case that new laws are more dependent on legal precedents than on overarching moral principles, particularly in the domain of emerging technologies (López and Lunau 2012). Science and engineering ethics is also criticized for promoting unwarranted speculation about the unknowable future, which is seen as wasting scarce research resources that should be allocated to support more pressing concerns. Another worry, which traces back to criticisms of the Human Genome Project’s Ethical Legal and Social Implications research program, is that ethicists and ethics approval are typically nothing more than “window dressing” – a way to show the public that controversial research activities have been given the green light by ethical experts (Guston 2013). In addition to carrying these negative associations, the idea of “ethics” is unclear in science and engineering contexts because it is so often deployed as a capacious term to refer to any studies of science and/or technology that are not conducted inside the laboratory (Calvert and Martin 2009).

**Building new collaborations: overcoming the barriers**

Rather than promoting the acquisition of interactional expertise via immersion in a new disciplinary environment, our program created a neutral space that enabled participants to see their peers from different academic cultures as epistemic partners (Calvert 2014). To start to break down the hierarchies that pervade academia, the instructors engaged the students in discussions and activities that allowed them to find common values and shared motivations. In his commentary, philosophy of technology graduate student Jan Bergen describes how the program allowed
participants to identify a shared moral drive, which involved describing the value-laden features of engineering that motivate their work (Bergen 2014). Like Bergen, Gordon Hoople, a mechanical engineering graduate student, concluded that the program’s success was the “shared understanding” that he was able to reach with the other participants. Descriptive discussions with his philosophy of technology colleagues drew attention to the ways in which Hoople had been overlooking the role of ethics in engineering (Hoople 2014).

The program’s greatest accomplishment, according to Bergen, was the creation of a common space where typically “unwelcome” discussions could flourish. Shannon Spruit, philosophy of technology student, discusses the challenges of engaging in these kinds of discussions in “the real engineering world” such as the power dynamics that dissuade students from initiating ethics-oriented conversations within their home laboratory culture.

A core program goal was to bridge disciplinary gaps by allowing participants to develop a shared moral language that is emotional rather than strictly and formally academic. Instead of focusing discussions on ethical concepts and philosophical terms, we created a space that allowed participants to find this shared moral drive by articulating their values, concerns, and interests in their own language. Although such discussions might be categorized as insufficiently academic for a graduate program, we argue that these kind of “unwelcome” discussions are fundamentally important because they allow students to articulate and work through their preconceptions, which in turn, lays the foundation for a shared language and opens the possibility of novel interdisciplinary scholarship rather than multidisciplinary work, which is a distinction that is further elaborated in Robaey’s commentary.

We spent the first day of the program exploring the multiple ways engineering ethics is interpreted. The day was oriented around the program goal of identifying ethics research opportunities. As an introductory exercise, we set out to portray the different ways that the instructors participate in ethics, broadly construed, both through research and teaching. Each of the co-instructors answered the questions: What is engineering ethics and why do I teach it and/or study it? By depicting engineering ethics as a diverse and active research field, we intended for students to begin planning how they might make a contribution to the scholarship. To spur thinking about research, we finished the day with a brainstorming session that asked students to answer three questions: (1) What are the big questions?; (2) What are the issues in your field?; and (3) What are theories and concepts that most interest you? Students shared their ideas by writing answers to the questions on white boards, which provided the instructors with important information about how to best structure the program to engage the students’ interests.

The discussion of what it would mean to do engineering ethics research continued throughout the program and is addressed in the student commentaries. Michael Poznic, a philosophy of science graduate student, points out that the field of engineering ethics research was also new to many of the philosophers, not just to the engineers. Although the philosophy students had experience with teaching introductory engineering ethics courses, they had not considered how their expertise might enable them to ask research questions in the engineering ethics domain (Poznic 2014). In addition to envisioning specific engineering ethics research questions, such as those outlined in Poznic’s commentary regarding modeling, students also developed working definitions of engineering ethics that reflected their experiences in the program. For example, David Rolfe, a mechanical engineering student, came to understand engineering ethics as “an involved discussion where you can consider both facts and intuition, and you can change your views many, many times as the conversation evolves” (Rolfe 2014).

Building on the momentum from the brainstorming session, the second day also focused on the objective of developing researchable ethics questions. We asked targeted questions to narrow in on specific topics and facilitate small-group discussions. As a result, a number of groups began articulating research questions and sketching out possible outlines for papers. Although this might
...seem premature, we emphasize that the students enrolled in the program because they were interested in participating in a collaborative research experience and therefore many of the students arrived with well-organized research ideas. These outlines and ideas were then work-shopped as a larger group to allow students to make contributions to the different emerging projects. As the instructors, we were encouraged by the developments and made adjustments to the program that would allow students to continue working on their ideas.

The third day was oriented around the second core program objective: developing collaborative relationships. We organized a field trip to San Francisco with the aim of strengthening interpersonal connections and allowing the participants to establish more common ground, which is an important factor that predicts the ease of distance communication, and in turn, the success of collaborative projects (Olsen and Olsen 2000). Intentionally planned as a social day, the midweek trip allowed students to develop their ideas in a less formal setting. Although not all of the students and instructors participated, the trip initiated a shift in the group dynamics and opened up candid discussions about institutional hurdles to implementing engineering ethics initiatives. Rolfe describes how spending a week with new friends allowed students from different academic cultures to “appreciate the struggle that each of us makes in our work” (Rolfe 2014). It is relevant that Rolfe refers to his fellow program participants as friends because the field trip was designed to support the development of the sort of mutual trust and shared interests that also characterize many friendships. While some may worry that friendship complicates research by skewing the possibility of engaging in objective analyses, our program builds on scholarship that draws parallels between the features of effective collaborations and friendships, such as mutual interest and critique, sustained proximity, good times, and dedication (Fortun 2005; Calvert 2014).

The topic of the fourth day was the theory and practice of collaborating across disciplines. Effective collaboration requires more than just putting people with the right knowledge together. It is equally important to construct an environment that guides group learning and interactions in a way that enables knowledge sharing. By discussing the practical challenges of doing collaborative work, we worked toward the program objective of developing strategies and infrastructure to support the students’ collaborative efforts (Pennington 2008; Calvert 2014). The conceptual and institutional hurdles that were discussed during this session are articulated in the student commentaries. Spruit, for example, suggests possible curricular adjustments that might be implemented to better prepare students to surmount these hurdles. If students are expected to act ethically and engage in RI, Spruit emphasizes the importance of creating new learning opportunities with the capacity to equip students with change management skills and also empower them to use these new skills. Such learning outcomes might be achieved, she suggests, by involving students in research projects that allow them to study how ethics is situated in local institutions by explicitly articulating the values that are embedded in and promoted by particular institutional arrangements and practices (Spruit 2014).

We also recognized that it might not be possible to bring people from different countries together for future programs and discussed the feasibility of developing a similar program online. In general, the feedback that we received suggested that bringing people together virtually would not have the same effect because the program’s success was dependent on the Delft and Berkeley contingents’ physical co-presence. This feedback resonates with the scholarship on collaboration, which emphasizes the importance of face-to-face time in successful collaborations (Olsen and Olsen 2000; Pennington 2008). Before finishing the fourth day, we revisited both of the core program objectives: (1) creating ethics research opportunities; and (2) building new collaborations. We asked students what they needed to help them to satisfy these goals and were encouraged by their request for more focused time to work on developing their shared projects.
In response, we used a problem-based learning model to organize the fifth and final day of the program. With the support of the instructors, students worked in small groups to fine-tune their research questions and plans. As instructors, we avoided offering didactic advice, but instead fielded questions from students about what resources were available to inform their projects, including possible journals to consult during literature reviews, potential conferences and journals that might be interested in their work, and different scholars who might be willing to offer feedback on their ideas. The goal was also to connect students with faculty mentors. To that end, we finished the program with a social gathering that was attended by engineering faculty members who had participated in Berkeley’s Minner Program in Engineering Ethics.¹

Commentaries as an assessment strategy

Effective assessment of ethics initiatives is complicated by a number of practical and theoretical challenges. In general, it is difficult to measure how or if students have changed the way they feel and think about ethics with traditional assessment tools because students are able to score well on tests without actually changing their beliefs (National Research Council 2005). Although we know how to evaluate students’ test performance, it is more difficult to gauge if and how new ideas translate into action beyond the classroom, particularly in a short time frame. Assessment, however, is necessary when institutions face demands to demonstrate how students are meeting learning outcomes (Felder and Brent 2003; Shuman, Besterfield-Sacre, and McGourty 2005). As a result, there are a number of new methods for assessing ethics, which map onto different instructional approaches (Borenstein et al. 2010; Berry, Borenstein, and Butera 2013; Canary et al. 2012). Our larger project considers these ongoing efforts to innovate in the area of ethics assessment, but also takes seriously the warning that focusing on a specific set of predefined learning outcomes can stifle pedagogical creativity and constrain educational reform (Riley 2012).

To measure the success of our program, we invited students to share their feedback and experiences publicly as commentaries to this paper. While not every student accepted our offer to write a commentary, we are more concerned with the quality rather than the quantity of responses. Although we recognize that a self-selected participation model introduces a bias into the perceived objectiveness of the results, we reiterate here that our program did not involve students as research objects, but instead, invited students to become research partners and co-inquirers (Bovill, Cook-Sather, and Felton 2011; Hutchings, Huber, and Ciccone 2011). Therefore, rather than portraying the commentaries as objective assessments or as results, we present them as an assessment-research hybrid and also as evidence of the sort of collaborative knowledge production that is needed to further the goals of RI.

Collectively, the commentaries highlight lack of time, negative perceptions, competing research expectations, and inadequate institutional rewards as significant obstacles that impede their engagement with engineering ethics. Many students also shared the conclusion that the program’s success was its creation of a safe space for fruitful discussions about the ethical aspects of engineering research and education that are unwelcome in typical educational contexts. We emphasize these findings here because they can be applied in many different institutional settings to develop strategies to increase student engagement in engineering ethics throughout the curricula, especially considering recent research that identifies progressive disengagement as a core problem in engineering education (Cech 2014).

The commentaries also raise questions about the program’s scalability and draw attention to the significant costs that would be involved with larger-scale initiatives (Hoople 2014). The question of how to effectively bring innovative ethics learning opportunities to larger audiences is elaborated in Robaey’s commentary. Initially, we had planned to spend time during the program discussing teaching, but instead we opted to allocate additional time for students to develop
their research plans. The decision to remove the teaching session from our program was informed by the students’ enthusiasm to pursue their research ideas. But it also reflects how teaching is valued in higher education. Robaey explores the repercussions of undervaluing teaching in her commentary and highlights the institutional constraints that discourage students from pursuing teaching opportunities that have the potential to spur RI (Robaey 2014).

**Conclusion**

Many of the approaches that have been developed to facilitate upstream or midstream ethical reflection and encourage RI emphasize the challenges of modifying fully developed technologies that are woven into larger systems (Schuurbiers et al. 2014, 5). In the same way, educational trajectories become more difficult to modify during graduate school because students are often dedicated to realizing the objectives of specific laboratory projects and grant proposals in which their training within educational institutions is enmeshed. Because of this, there are a number of hurdles that prevent advanced engineering students from engaging with the socio-ethical dimensions of their research. How might the educational experience of engineers be modified to overcome these institutionally entrenched barriers? Our program shows that facilitating interdisciplinary collaborations among students from different academic cultures is an effective method for generating ethical engagement, and also points to the important role that students may play as co-inquirers in projects that aim to analyze how different factors promote and inhibit ethical research and practice.

While there are some institutional initiatives offering proof-of-principle that engineers, scientists, social scientists, and humanists can collaborate to gear technological innovation toward desirable social needs, these examples remain outliers (Guston 2013). Skepticism about the relevance of ethical reflection, as well as the social sciences and the humanities, is historically embedded in engineering’s educational infrastructure (Florman 1997; Sorensen 2009; Wisnioski 2009; Sunderland 2013). By recasting engineering ethics as an area of research that is accessible to students, the program set the stage for new research partnerships. Importantly, these new collaborations were formed in the context of frank discussions about the pragmatic and conceptual challenges involved with collaboration. The program therefore invited students to consider both the opportunities and challenges surrounding collaborative ethics work. Although there are a number of scholarly resources that might be categorized as essential reading in engineering ethics, ranging from the philosophy of technology to science and technology studies to moral theory, our program did not set out to educate students in each of these distinct fields. Instead, we recognize that despite this scholarship, it remains difficult for engineering students to engage with the ethical and societal dimensions of their research. Our program invites students to become collaborators in thinking about the place of ethics in engineering curricula and demonstrates that they are valuable partners in envisioning the curricular reforms that are necessary for attaining the goals of RI.

**Acknowledgements**

The observations in this paper do not necessarily reflect the views of the NSF. Thank you to Alison Cook-Sather for helpful suggestions regarding student voice theory. Thank you to David Guston and to two anonymous reviewers for helpful guidance and feedback on earlier drafts.

**Funding**

This work was supported by the National Science Foundation (NSF) under grant #1237830. Work on this contribution was supported by the Netherlands Organization for Scientific Research (NWO) as part of the research program “New Technologies as Social Experiments” under project number 277-20-003.
1. The Minner Fellows Program is aimed at selected College of Engineering faculty members each summer who attend an intensive short course focused on engineering ethics pedagogy. Minner Faculty Fellows then integrate ethics and social responsibility considerations into their courses.

2. Recognizing that engineering ethics education needs reforming, Delft is piloting new initiatives to involve students from engineering faculties as ethics co-teachers. While there are some small-scale experiences that report on the benefits of joint teaching (Zandvoort, Hasselt, and Bonnet 2008), the university has expressed the ambition to scale up this model by supporting a program that would enable engineering students to become co-teachers. The involvement of graduate students from engineering faculties would bring more relevant substance from each specific field to reform the content of teaching. In her commentary, Robaey emphasizes that the success of this kind of co-teaching program will require institutions to modify the incentive structures that motivate students.

## References


**Notes on contributors**

Mary E. Sunderland is a historian of science and technology at UC Berkeley where she is affiliated with the Center for Science, Technology, Medicine, and Society and the Department of Nuclear Engineering. She is especially interested in science and engineering education, the life sciences, and translational research.

Behnam Taebi is an Assistant Professor of Philosophy of Technology at the Faculty of Technology, Policy and Management, Delft University of Technology. His research interests lie in energy ethics and responsible innovation. He is currently co-editing a volume on “Ethics of Nuclear Energy” (under contract with Cambridge University Press) and a special issue of Journal of Risk Research on “Socio-technical challenges of nuclear power”.

Cathryn Carson is a historian of contemporary science and technology. At UC Berkeley she is affiliated with the Center for Science, Technology, Medicine, and Society. Since 2010 she has served as Associate Dean of Social Sciences.

William Kastenberg is currently the Daniel M. Tellep Distinguished Professor of Engineering, Emeritus at the University of California, Berkeley. His interests include risk analysis methods for complex technological and natural systems, and engineering ethics. He is a member of the National Academy of Engineering, and is a Fellow of the AAAS and the ANS.