

## **Board 80: Preparing Engineering Faculty for Inclusion of Civic Engagement in Curriculum**

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As a 2017 graduate from Tufts University, Marian served as Student Outreach Coordinator for Tisch College of Civic Life for the 2017-2018 academic year. In this capacity, she supported many initiatives around the College, including programs, communications, and research. Long interested in the fusion of civic engagement and education, Marian was proud to participate in the development of this project.

## **Preparing Engineering Faculty for Inclusion of Civic Engagement in Curriculum**

*“21<sup>st</sup> century engineers are faced with unprecedented challenges of developing a sustainable world in balance with the forces of nature to combat global environmental, social and economic crises... Engineers have much to offer society, but this can only be done if engineers actually participate in society.” (Foley and Leahy, 2010)*

University missions across the globe emphasize the importance of educating students to address world’s most pressing challenges. Engineers are particularly suited to be innovative leaders with jobs essential to the core functions of civic society, yet public engagement is not a core component in engineering education. Preparing students to serve as engineers must include education that contextualizes design challenges and incorporates knowledge of the underlying root causes, as well as an understanding of the ways in which even technological problems can have negative impacts on society. These connections between design, technology, ethics, and the public are essential to the foundation of engineering education. Faculty in higher education are poised to create opportunities for students to build an understanding of social issues through the development of skills in civic engagement (enabling engagement in moral, social, and political issues), in addition to the core skills of engineering practice, will allow students to create holistic solutions to address systemic challenges.

Civic engagement in society can take a variety of forms, with the most basic indicators being rates of voting in political elections. The National Study of Learning, Voting, and Engagement (NSLVE) explores college and university student voting, and surveys students in universities enrolled across the United States. Data from the NSLVE study demonstrated that students majoring in Engineering and Engineering Technology had the lowest turnout rates for both the 2012 and 2016 local and national elections in the USA (Thomas et. al, 2017). While college student voting rates are generally relatively low, with fewer than half of college and university students voting in presidential elections (Thomas and Brower, 2017), students who focus on STEM disciplines have even less of a commitment to making an impact in this way. Thomas and Brower (2017) explain that university students feel a combination of frustration with and alienation from American political systems, which is combined with logistical issues and a lack of political learning across disciplines. Voting is not the only measure of student civic engagement, but it is fundamental and, now, can be objectively measured as a basis for looking at civic engagement in higher education.

This is reflected in the document *A Crucible Moment* (2012), issued by a National Task Force on Civic Learning and Democratic Engagement and containing a call to action warning that the state of U.S. democracy was declining, and colleges and universities were failing to embrace educating for democracy as an educational priority. Others have warned that higher education’s civic purpose has yet to be realized (Saltmarsh and Hartley, 2011). Part of the problem is growing polarization and the challenges of bringing people together to discuss controversial issues (Hess and McAvoy, 2015), particularly across differences of ideology, identity, and lived experiences (Nash, Bradley & Chickering, 2008; Schoem & Hurtado, 2000).

The lack of civic learning across disciplines is particularly relevant in engineering courses, as faculty members are continuously working to fit core content, in addition to relevant skills and practice, into a relatively short period of time, while not feeling that there is room for additional civic and political discussion in tandem. In addition, faculty members in engineering do not necessarily identify a connection between the courses they are teaching and the link to civic education, and as Smith, Mayer, and Fritschler (2008) discovered, many faculty members agreed that they seldom discussed politics because these discussions were not related to the subject matter of the course. Thomas (2015) discussed how faculty may also feel hesitant to have political discussions in class due to the scrutiny placed on universities as being places of liberal indoctrination, and faculty do not want to contribute to polarization in the classroom.

However, research has demonstrated that the way for students to gain the essential civic skills of perspective taking and critical thinking is through discussions that challenges their ideas and presents opposing views (Flanagan & Bundick, 2011). Discussions that relate engineering practice to moral, social, and political issues will allow students to think reflectively and create innovative solutions to problems. While some faculty members in engineering readily embrace this concept and apply it throughout courses, others who may have the best intentions do not know where to start to provide students with the tools of political discussion and perspective taking, which are the foundational skills in civic engagement. Faculty were encouraged to utilize problem-based learning, which provides a dynamic platform for students to interact with the curriculum outside of a top-down approach to teaching. Cox (2004) point out how difficult it can be to measure the effect of problem-based learning, given the limitations to operationalize parameters for a class-based study. Nevertheless, Cox acknowledges two elements critical to active learning: (1) introducing student activity into the traditional lecture, and (2) promoting student engagement. Further, university structures and administrative obligations (e.g. ABET requirements; department mandated course, content, and sequencing constraints; or adherence to cross-section uniformity) can also present barriers to change and experimentation by instructors within particular courses.

This paper rests on the premise that political discussion and thinking around civic engagement is germane to the work that engineers do, and critical for faculty to incorporate into classroom spaces. The study presented here explores a partnership at Tufts University between the Jonathan M. Tisch College of Civic Life (Tisch College), the School of Engineering (SOE), and the Center for Engineering Education and Outreach (CEEEO) to implement engineering faculty training and supports to assist instructors with infusing civic education into several foundational courses. The intervention aimed to provide faculty members with the tools to implement civic engagement into existing curriculum for a collection of first year intro to engineering courses, and to support faculty to think broadly about the role civic engagement already plays in the courses they are teaching. This paper (1) details the faculty professional development and supports provided before and during the semester as professors implemented new civic engagement curricular modifications. Then, based on a qualitative analysis of interview data from the participating faculty, it (2) highlights the faculty-identified successes and challenges to including civic topics in engineering content courses and (3) explores the levels to which the professional development as designed and implemented was able to appropriately prepare this cohort of engineering faculty for the inclusion of civic engagement in their courses. It also (4) details the future modifications and changes the authors propose based on these findings, and (5) discusses suggestions for how

the program can be replicated and scaled (for instance, internally at Tufts University to all first-year courses and other faculty within the School of Engineering).

## **Methods**

The participants in this study were five engineering professors at Tufts University who all teach individually designed engineering courses for first-year students around different content, including: civil and environmental engineering, computer science, and electrical and computer engineering. For recruiting purposes, a call was put out to all eleven first year engineering professors who teach separate “Introduction to Engineering” first-semester courses within their disciplines, and the five participants (all tenured faculty, who all also teach upper-level courses within their departments) signed up with the understanding that they would participate in a multi-stage professional development that included (1) a summer faculty retreat filled with interactive skill-building exercises, group discussions, and conversations around civic engagement, (2) in-person small group and individualized “office hours” where the faculty would meet with content experts from both the Tisch College and the Center for Engineering Education and Outreach (CEEEO), (3) on-going virtual support for the faculty to assist with course redesign and curricular modifications, and (4) in semester cohort meetings for sharing best practices, highlighting successes, and dynamically addressing faculty needs as they arose. The participating faculty were given a stipend for the additional work required by this professional development, course modification, and curricular implementation.

At the beginning of Summer 2018, the participating professors began the work by receiving a two-day professional development workshop facilitated by staff members from the Tisch College, the Tufts University’s hub for civic engagement. In addition to providing students with opportunities to participate in co-curricular programming and courses focused on social change and civic action, Tisch College supports research in the fields of civic studies and political engagement. Staff members from these realms at Tisch College leveraged their existing expertise in administering professional development and led the two-day workshop.

The engineering faculty members participating in the group did not all know each other at the start of the project, as they hailed from different departments across the School of Engineering at Tufts University. The professional development took place at the beginning of the summer, both before the group had a chance to meet as a full first-year engineering course team (all first-year engineering professors already meet monthly leading up to and during the school year for sharing, reflection, and coordination across courses) and prior to summer modifications of course content in preparation for the fall semester. The professional development workshop aimed to create a smaller cohort of participants (e.g. those in the study, and those that opted in to participating) to specifically share best-practices in civic engagement, and who would then be able to share challenges and successes with each other around these concepts throughout the semester. In addition to providing an environment for sharing activities and curriculum components, the seminar aimed to set the stage to provide faculty with the time to think about the ways civic engagement was already infused in the work they did, and where there were opportunities to supplement the course with additional civic engagement. The summer professional development was broken up into five sections with activities designed to support

faculty and also role model techniques and methodologies for participating faculty to be able to replicate with their own students. These five sections are described below.

### *1. Setting Norms*

After introductions, the Tisch College staff led the engineering faculty in an exercise to establish ground rules and norms with the intention of empowering faculty to do this with their own students. This exercise aimed to recognize from the outset that people arrive with different lived experiences and values, and there can be a space created for people with different perspectives to share ideas and have conversation on social and political topics. There was recognition that fostering discussion and facilitating personal reflection with engineering students poses a greater challenge than other disciplines where students are regularly expected to engage in these practices. Therefore, the establishment of ground rules would be especially important in order to achieve buy-in from class members and create a space where all voices would be welcomed. For the purposes of the abbreviated faculty workshop, participants were provided with examples of statements from ground rules Tisch College staff preidentified as likely being relevant to the set of engineering courses. Participants were asked to reflect on the statements, discuss them, and determine whether statements needed to be added or removed to create a community for sharing. After all the statements had been collected, faculty were asked to verbally agree to abide by the norms for the duration of the training.

### *2. Perspective Taking*

To provide faculty with an opportunity to experience an activity that practiced hearing perspectives that are different from one's own, each participant was provided with a case study to read that provided a topic which would likely elicit varying opinions. This particular case study described a recent (Spring 2018) news story around the internal protest that a group of Google employees waged against their company to voice concern over the work Google was doing under contract with the Pentagon. From a *New York Times* article detailing the conflict, the professors read how the protesting Google employees involved did not believe their company should be involved in any activities that could contribute to, for instance, improving the targeting capabilities of drone strikes. This case study was utilized as an example of the intersection of engineering content with larger political implications, and the presenters stressed to the engineering faculty participants that a case study relevant to their own particular course content could be used in place of this one to accomplish a task relevant to the material being presented.

In the four corners of the room there were signs posted reading: "Strongly Agree," "Agree," "Disagree," and "Strongly Disagree." After the participants reviewed the case study, they considered the statement: "I believe Google should remove itself from any activity that could be considered aiding the war effort, such as the one described in the article." Participants were then asked to stand under the sign that best represented their views. They were given five minutes to talk with the other people also standing under their sign, and one spokesperson from each group presented the general opinions of that perspective. After hearing from other perspectives, participants were given the option to move to another sign if their opinion had been swayed.

Upon returning to the larger group, participants reflected on how the activity went for them and how they might be able to use it in their own classrooms with adaptations to encourage students to think deeper and publicly share about the material.

### *3. Common Language*

In an effort to bring people to a place of healthy communication, the participants spent time engaging in an activity to collectively define what “civic engagement” means in a variety of contexts. The participants were divided into groups to collectively brainstorm (1) Civic Agency, (2) Civic Skills, (3) Civic Inquiry, and finally (4) Civic Action, and to think about both broad definitions and also specifically how these components could be applied in an engineering context. Faculty were encouraged to talk about what they were currently doing in their courses, and how these pieces may already be present even if they weren’t previously identified in this way.

### *4. Skill-Share for Best Practice*

The staff leading the retreat recognized that a number of faculty in the engineering school are already doing excellent work incorporating civic engagement into their curriculum, and a portion of the training was dedicated to time for participating faculty to share their own lessons, strategies, and techniques in an abbreviated format. Fellow participants were able to ask questions of their colleagues and get a sense of what was happening across disciplines in engineering. The faculty that shared their experiences were also receptive to feedback provided by other participants on potential improvements to their strategies and curriculum.

### *5. Follow-up Support*

After the initial training was completed, faculty took the next summer month to think about ways of incorporating an element (or elements) of civic engagement into the curriculum. The goal was not to update, change, or modify the curriculum in its entirety, but rather to supplement what was already happening and build in a recognizable new component to each course based on the skills learned from the training. One month after the professional development was completed, Tisch College staff met individually with faculty members to discuss the new custom component in each participant’s curriculum and provide feedback and support around the proposed implementation. Faculty were also encouraged to contact staff at any point during the curriculum development process for additional ideas, support, or suggestions.

## **Data Collection and Analysis**

The Institutional Review Board (IRB) at Tufts University approved the research associated with this project, and all five professors participating volunteered and signed consent prior to participating in project activities and any data collected. (It should be noted that students in the sections associated with these professors also consented and participated in data collection, such as their own pre/post surveys and a focus group interview, although that data is not being analyzed within this paper. Here we are only focused on the faculty participants and their

participation in professional development, modifications to their curriculum, and implementation of their courses.)

The participating faculty members were given a pre and post survey (although due to the small sample size the quantitative analysis isn't significant and, as such, not included here) to understand the professors awareness and inclusion of civic components in their engineering courses. The researchers also conducted 45-minute interviews individually with each of the faculty participants. The interviews were recorded, transcribed, and coded for recurrent themes. The qualitative findings described below, and associated quotes, come from these interviews and analysis.

### Course Modifications

Each of the faculty participants were successful in implementing some new civic component to their individual courses. Again, these varied based on the course description, engineering content, as well as the comfort level of the faculty member themselves in this space. While all participants were experienced instructors (all were tenured professors with many years of experience), there were multiple faculty members who entered the professional development at the beginning of the summer feeling hesitant and not prepared to do anything that felt outside the traditional curriculum (while other faculty members already felt that the civic component was currently deeply ingrained in what their courses focused on already). Based on this variance of starting points, all faculty participants were still required to create a new aspect or element of their own course, modifying their curriculum and leveraging the skills and techniques developed during the professional development. The following table illustrates the types of new components that faculty developed and implemented in their first-year engineering courses during the Fall 2018 semester.

Table 1: Faculty courses and new elements

Faculty	Engineering Course Title and Description	New Civic Element for Fall 2018
1	“Engineering in Crisis” A series of case studies to examine how engineering impacted crisis situations, from floods to hurricanes	New discussion on the political connections amongst infrastructure, policy, and government
2	“Introduction to Renewable Energy” Examination of different energy sources, and how none can stand alone	New discussion-based perspective-taking activity on fossil fuels (updated from traditional lecture)
3	“Introduction to Computational Design” Exploration of computation modeling and design in a digital world	New interactive blog assignment linking design to current-event social issues
4	“Music & Art of Engineering” Electronics and circuits, with a focus on creating digital music	New ethical dilemma discussion considering how laws regarding engineering impact society

5	<p>“Civil Infrastructure” An introduction to civil infrastructure with a focus on its transportation, water, energy and waste management components.</p>	<p>New discussion on the role government and politics play in infrastructure</p>
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All of the new elements focused on discussion-based activities, ranging from digital communication to interactive in-class activities that the faculty practiced during the previous summer professional development. The major themes that emerged from the faculty interviews reflecting on the implementation are discussed in more detail below.

**Results**

For the participating faculty, there were three key areas of interest that emerged as important themes, based on the interview data collected at the conclusion of the semester: (1) Shift in Student’s Personal Responsibility, (2) Impact of the Professional Development, and (3) Barriers Associated with Implementation.

*1. Shift in Student’s Personal Responsibility*

In the follow-up interviews after the semester had ended, faculty were all asked to describe how the students reacted, from the faculty member’s point of view, to the new element focused on civic engagement introduced into the curriculum. All the participants in the study felt the students had positive reactions, and although there were implementation challenges to work through in some cases, the faculty felt the students all gained positive learning experiences from the new additions (and all expressed desire to implement similar activities again).

According to faculty, a major component of what students gained was *an increased feeling of personal responsibility around the community issues the engineering work the individual course was addressing*. For instance, one faculty member explained:

[The students] think of engineering as, “I’m going to build something,” which is not right at all. That’s what technicians do; technicians build something. Engineers design it ... the technicians build whatever the design is. [The technicians] are kind of off the hook for what the whole thing does.

This sentiment of fostering a sense of responsibility was echoed by other participants as well, including one faculty member who discussed how these types of civic discussions moved students away from trying to find the “one right answer” to thinking more deeply about the real-life situations (and effects of the engineering decisions) at hand.

*2. Impact of the Professional Development*

The faculty participants in the study discussed how the two-day professional development during the summer leading up to the semester prepared them for adding the new elements into their curriculum. But more broadly, they highlighted themselves how it helped to frame the engineering work with a civic engagement lens that they may not have previously considered.



One faculty member explained, “I never considered the fact that it’s never too early to start thinking about how your design interacts with the world,” meaning that although he had not focused on the practical connections of what his students created in the classroom, this clearly added a new dimension of effectiveness. He continued by discussing how he had been hesitant to incorporate these elements of real-world discussion at first because he did not feel prepared to handle a situation in class where a discussion might “go off the rails.” However, he felt the training (e.g. around “difficult dialogs”) allowed him to become hyper-aware of when things “might start getting edgy, ... imagine how that might happen, and having some pre-planned interventions on my own part.”

All the faculty participants mentioned in their interviews that it was important to them that the new civic element they introduced to be meaningful, and not a single “add-on” activity that did not provide significant substance or connection to the rest of the course. One faculty member explained that incorporating new elements from the professional development was less about telling students that it was important for them to think about the civic pieces because they are going to be engineers, and more about encouraging them to take personal responsibility for the work they do.

Faculty also described the impact on their relationships with the students in their classes. Adding discussion and dialogue about civic issues to the curriculum, engaging students to formulate opinions about policy that directly impacts engineering, and requiring students to write blogs to make their perspectives public not only allowed the students to learn more about each other but provided faculty with more insight about their own students. This led to not only a more empathetic connection between the faculty members and their students, but an ability for them to better customize other aspects of the content to fit the viewpoints and interests of the students.

### *3. Barriers Associated with Implementation*

A common thread that also emerged from the interviews was how challenges and new barriers arose in the different courses, based on the new civic element and the particular focus of the course. For instance, in one discussion about policy legislation, a faculty member was informed by students that they felt he had phrased the assignment in a way that was biased toward his own opinion, even though this had not been his intent. (Noteworthy to include that this implies in itself the success he also had in now creating an inclusive classroom environment that allowed these students to come forward to discuss their viewpoint with the professor.)

Another challenge that arose in the interviews with multiple faculty members was a fear of saying the wrong thing and having this be posted on social media channels. Participants struggled with creating an environment that felt safe for students (and themselves) to speak freely while also being aware that some statements could be construed to have partisan meaning. As one faculty member wondered, “how do we break past that, and say ‘the students are super interested in this,’ because they are growing up in a culture where climate change is not just real but happening.” There was a clear desire on the part of all faculty participants to bring these discussions into the classroom, and the concern about creating an environment that felt supported and safe for sharing differing opinions was a concern.

## Conclusion

It is clear that this intervention made significant headway with participating faculty members in terms of their own involvement with implementing civic education in engineering curriculum, and follow-up work can be done in a number of ways. This study was limited to only five faculty members who teach first year courses in engineering and volunteered to be in the study, although there is a total of eleven faculty members who currently fit this role at the university. One next iteration in the works is to include all first-year faculty members in workshops and training around sharing best practices in civic education and working with faculty to think broadly about the implications that building in real world application and discussion can have on their courses. In addition, steps should be taken to build in civic engagement training with faculty who also teach courses to students later in their undergraduate careers. In addition to experiencing directed civic engagement curriculum and discussion within the first year of coursework, students will benefit the most from having this type of thought-provoking mindset throughout the entirety of their college experience.

In addition, the research in this study primarily focused on the faculty preparation and implementation experience with new elements of civic engagement embedded in the curriculum. Future analysis will focus on the student experience and the student perspective, and how this type of focus can shift student attitudes on how they see themselves as engineers moving out of academia and into the world with a civic mindset.

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