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Developing a Framework for Civic Responsibility in Engineering Education

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Abstract

Civic responsibility aligns with the mission of engineering programs to graduate ethical engineers and the mission of many universities to graduate engaged citizens. Civic responsibility bridges engineers' obligations as professionals within society through their roles as members of communities. Thus, we argue that civic responsibility warrants separate consideration from other forms of responsibility in engineering education, including social, ethical, and professional responsibility. In this paper, we first present an exploratory conceptual framework for how civic responsibility manifests in engineering education by drawing primarily from literature in engineering ethics on responsibility and civic virtue. Second, we use this framework to understand engineering students' perceptions of the roles and responsibilities of engineers within communities. We conducted semi-structured interviews with eleven first-year engineering students whom we recruited from a mandatory first-year engineering course at a large Mid-Western land grant university in the United States. We identified three themes from the interviews: (1) the awareness of how engineers can serve their communities, (2) the belief that engineers should serve their communities, and (3) the distinction between personal and professional civic responsibility. We distilled these themes into the following dimensions of civic responsibility: personal and professional, virtue and obligation, and non-maleficence and beneficence. We close by connecting these findings to frameworks used to study other forms of responsibility in engineering education.

Introduction

Civic responsibility reflects individual responsiveness and engagement with community needs. Thus, civic responsibility aligns with the mission of many universities to graduate engaged citizens. For example, the mission statement of the Association of American Colleges & University is "to advance the vitality and public standing of liberal education by making quality and equity the foundations for excellence in undergraduate education in service to democracy" [1]. Many institutions of higher education across the United States prioritize similar goals of graduating engaged citizens who are committed to service and democratic ideals.

Civic responsibility also aligns with the goal of many engineering programs to graduate responsible engineers who contribute positively to society. For example, consider the mission statements of two engineering programs. The mission of the School of Engineering at MIT is "to educate the next generation of engineering leaders, to create new knowledge, and to serve society" [2]. Likewise, the mission of the College of Engineering at the University of Illinois at Urbana-Champaign is "to deliver excellence and innovation in engineering education, in research and scholarship, and in economic development to serve our community, the State of Illinois, the nation and the world" [3]. These mission statements suggest that the ultimate objective of engineering education is to promote student dispositions and skills that enable them to serve communities and society.

Though civic responsibility is reflected within mission statements such as these, civic responsibility has received little explicit attention in engineering education research. However,

responsibility more broadly has been a prominent thread of engineering education and engineering ethics research [4]. Scholars have characterized responsibility through several dimensions, such as personal responsibility, ethical responsibility, professional responsibility, and social responsibility. Broadly, these forms of responsibility draw attention to engineers' obligations towards society and the public good [4]; thus, each of these dimensions considers the health and safety of the public as engineers' primary objective [5]. Though these dimensions of responsibility share a common aim, we posit that each brings a unique focus to distinct facets of responsibility in engineering. For example, professional responsibility emphasizes an engineer's obligation to their profession's standards [6] while social responsibility emphasizes an obligation towards society [7].

Due to the limited explicit attention on civic responsibility in engineering education, our first aim in this paper is to offer a conceptual framework for how *civic responsibility* manifests in engineering education that accounts for similarities and differences from other types of responsibility (e.g., social responsibility, professional responsibility). Second, we explore this conceptual framework empirically by analyzing how engineering students perceive and experience civic responsibility in the first-year curriculum at a large Mid-Western University in the United States.

Background

The term "responsibility" often implies accountability [8]. Here we briefly discuss the limitations of focusing on individual responsibility and accountability in engineering ethics. We then argue that a focus on civic responsibility can address these limitations.

Responsibility and individual accountability

Engineers develop technologies through complex and interconnected technical and organizational processes. This complexity often makes it difficult to assign causal responsibility to actions of specific individuals when ethical, technical, or legal failures arise [8], [9]. While we maintain that individual actors in organizations have agency and thus may be deemed responsible for their actions, the chain of decision-making within an organization suggests that multiple individuals within that organization ultimately share responsibility [8], [10].

In addition, engineers cannot predict all possible uses and associated consequences of technologies when integrated in the real-world. It may be particularly challenging to assign blame and hold individual engineers responsible when users utilize their technologies in unintended (and sometimes abusive) ways [8], [10]. Because it is difficult to hold individual engineers accountable when consequences arise, it is important to consider aspects of responsibility beyond accountability.

Civic responsibility and virtue ethics

Some scholars have theorized that responsibility is a virtue [10], [11] whereas others have deemed virtue to be an important aspect of responsibility [11], [12]. Virtue emphasizes what constitutes good or commendable behavior. Its focus is on acting in ways aligned with that

commendable behavior rather than emphasizing unacceptable ways of acting. Virtue is the part of responsibility that comes from a place of moral concern for others and is not tied to blame or fault. In this framing, responsibility means considering the effects of one's actions on the welfare of others; put succinctly, responsibility involves caring for others [12]. We can consider individual responsibility and virtue in tandem to evaluate whether individual decisions are responsive to the needs of others and if they align with commendable behaviors.

Virtue and responsibility have been explicitly connected within engineering ethics, where discourses in engineering ethics have shifted from a focus on retroactive blame to a focus on identifying what constitutes morally good ethical engineering practice [4], [9]. As part of this shift, virtue ethics has received increased attention in engineering ethics. Often, virtue ethics foci in engineering advocate for using professional expertise to contribute to or improve society [4], [9]. Practically, this shift involves engineers questioning, "How might my decisions or behaviors impact others in society positively?"

Though engineers make decisions that rely on their practical judgment and expertise, their character dispositions (i.e., moral virtues) such as objectivity, care, and honesty also influence their ethical decision-making and behavior [9]. Harris [13] identified virtues of good engineers that can promote ethical behavior, including technical excellence, techno-social sensitivity, respect for nature, and commitment to the public good. These virtues emphasize that it is an engineer's responsibility to use their expertise judiciously for public welfare. Hence, this approach equates responsibility and virtue in engineering [9], [10]; as Schmidt [9] states, "virtuous engineers are responsible engineers" (p. 999). However, we posit that virtue draws attention to the character traits that one exhibits; responsibility, on the other hand, emphasizes enacting virtues in practice.

Civic virtue draws attention to one's responsibilities to one's community or society [11], [12]. For example, Ladd [12] defined civic virtue as "a virtue required of all citizens as citizens" and wrote:

> A virtuous citizen, and that should include everybody, should have a concern for the common good and for the long-range welfare of other people in the society, even where this concern demands individual sacrifices of one sort or another or simply giving less priority to one's own private interests and to one's advancement on the escalator to worldly success [7, p. 90].

Civic virtue thus emphasizes character traits such as responsiveness to community needs. Civic responsibility refers to the feelings of obligation that arise from or in relation to one's civic virtue and that compels one to act virtuously. Though civic virtue and civic responsibility emphasize the same ideals, we theorize that virtue is related to one's disposition or value orientation whereas responsibility is related to one's actions.

Conceptual Framework: Civic Responsibility in Engineering

Murata [11] extended Ladd's framing of civic virtue into the engineering profession and argued that developing civic virtue among individual engineers would contribute to a culture of

collective responsibility within engineering organizations. Building on Murata's argument of the role of civic virtue in engineering, we argue that cultivating civic virtues among engineers is essential for promoting behaviors that are civically responsible. Williams [4] persuasively argued for the importance of civic responsibility in engineering education: "As stewards of technology, engineers design, develop, and maintain the mechanisms that make civil society possible… Engineering programs, therefore, do more than graduate responsible citizens; they graduate responsible citizens who determine the future of technology" (p. 2).

We theorize that civic responsibility is closely related to yet distinct from other dimensions of responsibility because it emphasizes the role of civic virtue, as opposed to other virtues that are also important to engineers. The notion of civic responsibility connects the engineers' role and obligations as both a citizen and a professional within their society [14]. In this sense, civic responsibility relates to some framings of social responsibility. For example, Colby and Ehrlich [15] posit that civic responsibility is a component of social responsibility, with civic responsibility focusing on understanding "how a community operates, the problems it faces, and the richness of its diversity, as well as fostering a willingness to work collectively to resolve community concerns" (p. xxx). In alignment with Colby and Ehrlich [15], we theorize that civic responsibility represents the civic nature of social responsibility concerning engineers' roles within the communities where they live and work.

Study Purpose

In this study, we aim to expand and refine our conceptual framework for civic responsibility in engineering by exploring engineering students' perceptions of civic responsibility. We consider this an exploratory study on how the concept of civic responsibility manifests within engineering students' perceptions of the roles and responsibilities of engineers within communities. In the discussion, we connect our findings on civic responsibility to discourses on other forms of responsibility in engineering. We hope that these findings will position the engineering education research community to understand how civic responsibility manifests in related but distinct ways from ethics, social responsibility, and other outcomes of engineering programs.

Methods

Data collection

Interview procedures. We conducted interviews in-person in early Spring 2020 and virtually via Zoom late in the Spring 2020 academic semester due to the COVID-19 pandemic. Interviews were semi-structured; while we brought a protocol, we often asked follow-up questions to gain more insight into participants' perceptions and experiences. We recorded and later transcribed interviews by hand.

Interview protocol. Interviews addressed students' experiences with community engagement and their developing understanding of the role of the engineering profession in communities. Thus, interviews included five sections: (1) perceptions of community, (2) perceptions of engineering, (3) community-engagement experiences (i.e., current or prior volunteering and community service experiences), (4) perceptions of engineering for social change, and (5) politics. During

the interviews, students conceptualized community, engineering, and related phenomena and identified how these conceptions manifested in their prior experiences. The "communities" within which most students grounded their experiences included the local university community and previous towns or cities where they lived. We did not explicitly prompt the conception of "civics" during interviews, but rather we applied civic responsibility as an analytic lens when coding data.

Participant recruitment. We recruited interview participants from a common first-year engineering course by sharing a recruitment script and survey link with course instructors. Interested students completed the survey link, and we then followed up with them to schedule interviews. We incentivized participation with a $10 Amazon gift card.

Participant overview. All participants were enrolled in a first-year engineering course at a large, public university in the Midwestern United States. Most students had hometowns outside of the university's state, including one international student. Some students identified their hometowns as small towns, while others hailed from larger metropolitan cities. Participants included six females and five males. Students participated in one of the following design projects in their first semester at the university: (1) designing a recycling sorting process for hand towels in a local basketball arena; (2) designing a modality to improve safety of campus infrastructure; (3) designing toys for differently abled children in collaboration with a local partner; or (4) participating in a separate community-engaged experience. Thus, most students did not participate in a course explicitly focused on service-learning, but all students participated in a community-oriented design project. Table 1 includes participant pseudonyms.

Table 1. Participant overview

Student	Interview Mode
Amelia	In-person
Ethan	In-person
Grace	In-person
Isabella	In-person
John	In-person
Julia	Virtual
Larry	In-person
Leo	In-person
Madison	Virtual
Noah	In-person
Sara	Virtual

Data analysis

Inductive thematic analysis. We analyzed interviews using an inductive thematic analysis approach adapted from Braun and Clarke [16] to explore student experiences and perceptions. To facilitate analysis, the first author transcribed all interview transcripts by hand and began recording notes and thoughts. Both authors then coded interviews using qualitative analysis software (NVivo 12) in an iterative manner.

Author 1 (Lin) developed an initial coding scheme using three interviews. Author 2 (Hess) reviewed the coded transcripts. Both authors met to reconcile coding conflicts and developed a modified coding structure. With this refined coding scheme, Author 1 coded the remaining eight interviews and again Author 2 reviewed all coded passages, providing comments and suggestions. Throughout this process, the authors met regularly to resolve coding conflicts and finalize a coding scheme.

Once we reached agreement on the coded transcripts, we developed themes by reviewing codes from the lens of civic responsibility. We sought to identify how themes showed evidence of student experiences or perceptions of civics-related phenomena, such as accountability, responsibility, or virtue.

Results

In this study, we investigated engineering students' perceptions of the civic responsibilities of engineers. We identified three themes related to how students perceived the civic responsibilities of engineers as outlined in Table 2.

Table 2. Overview of themes

Theme	Description	Exemplary Quote
How Engineers *Can* Serve their Communities	Perceptions of ways that engineers could or might use their skills to serve others in their community.	"I think with all the skills that you're gaining from engineering, you can get involved by using those skills to help people… They give back to the community by using the knowledge we've learned to design something to help people." - *Julia*
How Engineers *Should* Serve their Communities	Perceptions of the obligations and responsibilities that engineers have towards their community.	"I think engineers have the responsibility to use what they've learned for the sake of helping the community, for specifically improving what they were taught to be experts on." - *Amelia*
Personal Versus Professional Responsibilities	Distinctions between the civic responsibilities that engineers have as professionals versus the personal responsibilities they have as community members.	I think engineers do just as much as anybody else in the community. Everyone has a part. I think specifically, they are suited more so that they could help come up with more ideas or something. But again, everyone has as part, so it's not like these people have more of a part. – *Larry*

Students recognized that engineers can use their skills to serve others in their community.

This theme captures students' perceptions that while engineers can respond to their community's needs, engineers are not obligated to apply their knowledge and skills outside of their jobs. Students identified general skills of engineers that could be used to serve their community, including problem-solving and design. Students recognized that engineers have specialized knowledge and skills that they can use to serve their community. For example, Julia stated:

> I think with all the skills that you're gaining from engineering, you can get involved by using those skills to help people… Engineers give back to the community by using the knowledge we've learned to design something to help people. - *Julia*

Other students described specific skills engineers learn through their education and shared examples of how engineers could use these skills to address community issues. For example, Leo explained how engineers' technical expertise and problem scoping skills could be applied to community improvement projects:

> Engineers in general have very good technical problem-solving skills. They're very analytical, they like to look at all the specifications of every single component that goes into the final project before they even decide to go forward in the project. So say a community wanted to build a new housing development. Engineers could look at the where the housing development is, what it's going to impact. They could put their analysis skills to use in providing feedback to leaders in their community. - *Leo*

Leo's example showed how engineers' problem-solving skills could impact a specific community issue and provide valuable feedback to community leaders. Another common example students cited was engineers' knowledge of design. For example, Isabella highlighted that engineers can lend their design skills to help respond to a community need:

> Engineers can do programs like Engineers Without Borders, or they can do something kind of for a local community center, like re-design some process for signing up for summer camp, even if it doesn't apply to what kind of engineering they're doing. - *Isabella*

*Students recognized that engineers have civic responsibilities as professionals***.**

Some students not only recognized that engineers could serve others in unique ways based on their disciplinary knowledge and skills but also perceived that engineers *should* use such expertise to improve their community. These students described how civic responsibility manifested within engineers' professional work. For example, Amelia said: "I think engineers have the responsibility to use what they've learned for the sake of helping the community, for specifically improving what they were taught to be experts on." Hence, Amelia felt that engineers had a responsibility to use their expertise as professionals to benefit the community.

While a couple students talked about the responsibility to contribute positively to their community, more commonly, students talked about engineers' responsibility to avoid harming communities as professionals. For example, Julia said, "I think it's important that engineers don't use their skills for harm. With all the knowledge we have, people could 3D print weapons or something. I think it's a responsibility that people don't do that." Thus, Julia recognized that engineers could have skills or access to tools that could harm others and emphasized that engineers had a responsibility to avoid causing harm. We see this emphasis on responsibility as *avoiding harm* as distinct from the virtuous ideas of *doing good* emphasized in the first theme.

While Julia described an overt form of harm (3D printing weapons), other students described how engineers could cause harm more subtly, such as through deprioritizing environmental impacts in their work. In this vein, Sara urged engineers to bring environmental concerns to the forefront of their work. As Sara explained:

> I think cleaning the environment and preventing more damage is where engineers need to focus more. I think it's a lot more important than pretty much anything else. There needs to be more innovation and less pollution. Engineers need to make these innovations, and things need to change at a governmental level with stricter regulations. - *Julia*

Madison echoed Sara's argument that engineers were responsible for considering the environmental impacts of their work: "Engineers have to take into account how our solutions would affect the environment, like pollution or how much material we use to build something, or waste." Both Madison and Sara emphasized that engineers' responsibility to minimize harm to the environment by controlling pollution and waste. They both felt that mitigating environmental consequences was a part of engineers' responsibility to their community.

Students distinguished between the engineers' civic responsibilities as professionals and as community members.

In addition to engineers' professional responsibilities towards their community, students also described the personal responsibilities that engineers have towards their communities as citizens and community members. Some students felt that engineers did not have civic responsibilities beyond those of other people in the community. When asked about the civic responsibilities of engineers, these students responded that engineers' civic responsibilities were similar to the responsibilities of any community member. For example, Isabella responded:

> I think it's pretty similar to community members in general, be respectful and only create a positive outcome or a neutral outcome; don't negatively impact. And in general, make decisions that you believe will help the community, to your best knowledge in that situation. – *Isabella*

Thus, Isabella named the responsibility of individual community members, including engineers, to create positive outcomes for the community and make decisions with the community's best interests in mind. Larry also felt that engineers had equal responsibilities to other community members:

> I think engineers do just as much as anybody else in the community. Everyone has a part. I think specifically, they are suited more so that they could help come up with more ideas or something. But again, everyone has as part, so it's not like these people have more of a part. Everyone has about an equal amount. – *Larry*

Even though Larry recognized that engineers could use their skills to help generate solutions to a community issue, Larry's response suggests that engineers do not have additional responsibilities to help beyond other members of the community. Similarly, John acknowledged that engineers could choose to become more involved in their community if they wanted to but that they were not obligated to:

> If they [engineers] want to get super involved in their community, they can be the one who fixes everyone's problems. But I don't think engineers should have extra responsibilities in the community. Because everyone has their own specialty. So engineers do what they can. I don't think anyone should take more responsibility in the community. - *John*

Thus, John, like Isabella and Larry, felt that engineers could use their skills to help the community but did not bear more responsibility to serve than other people in the community. In contrast, Noah felt that engineers do have additional responsibilities to their community because of their higher education. He felt that engineers have an obligation to use their higher education to give back to their communities:

> I feel like they have a little bit of responsibility to use their education to give back to the community. Because not everybody goes to college and has this experience. Since you're here, they should be able to give back to their community a little bit to help everyone. - *Noah*

Though Noah felt engineers should bear greater responsibility to serve their community, he argued that this responsibility arose from their higher education and not specifically from their role as engineers within the community.

In sum, many students recognized that engineers possessed skills that could help address community needs, though students generally did not believe that engineers were responsible for using their skills to benefit their community outside of their professional roles. Some students emphasized that at a minimum, engineers should avoid using their skills in ways that could harm their community. Students also expressed that engineers were responsible for considering the impacts of their work on their community.

Discussion

In this section, we integrate engineering students' perceptions of civic responsibility into our conceptual framework for civic responsibility. Based on our findings, we propose that a framework for civic responsibility should consider these dimensions of civic responsibility, at a minimum: personal and professional, virtue and obligation, and non-maleficence and beneficence.

Civic responsibility as personal and professional

Students perceived that engineers have professional civic responsibilities arising from their expertise and job as well as personal civic responsibilities that arise from being engaged community members. Multiple extant frameworks distinguish between personal and professional responsibility. In this section, we consider how Canney and Bielefeldt [7], [17] employed these conceptions in their model for the development of professional social responsibility and how their model aligns with our findings.

Canney and Bielefeldt [7], [17] defined social responsibility as one's "feelings of obligation to help others as both a person and a professional, with a special focus on helping disadvantaged or marginalized populations" (p. 415). Thus, their definition of social responsibility encompasses and distinguishes between personal and professional aspects of responsibility. Canney and Bielefeldt [7] theorized that these aspects can develop independently but emphasized that they also inform each other. Thus, their framework reflects the interconnectedness between one's feelings of personal obligation to help others and one's obligations to help others professionally as an engineer [7].

Canney and Bielefeldt's [7] model for developing social responsibility contains three realms. First, *Personal Social Awareness* describes one's feelings of moral obligation to help others outside of their professional work. Second, *Professional Development* describes how one develops their professional abilities with the awareness that these skills could help others. Finally, *Professional Connectedness* describes one's feelings of obligation to use their professional capacity to help others [7], [17].

Our results showed that students' perceptions of civic responsibility aligned well with the *Personal Social Awareness* and *Professional Development* realms of Canney and Bielefeldt's [7] model. In alignment with the Personal Social Awareness realm, students recognized the importance of personal civic responsibility and indicated that community members had obligations towards their community. In alignment with the Professional Development realm, students recognized that engineers possessed skills that they could use to benefit their community. Lastly, we found some misalignment in our results with the Professional Connectedness realm; students' notions of professional civic responsibility often emphasized avoiding harm and seldom emphasized helping others. We explore this misalignment further in the following sections.

Thus, we suggest that a framework for civic responsibility should include dimensions of personal and professional civic responsibility. This framing is represented within existing frameworks for responsibility in engineering education research, especially Canney and Bielefeldt's [7] model for social responsibility in engineering students.

Civic responsibility as a virtue and an obligation

We also saw evidence for framing civic responsibility in terms of both virtue and obligation. We saw the virtue aspect of responsibility reflected in students' awareness of how engineers could use their skills to help address community needs, both in their capacity as community members

and in their professional capacity. We described this awareness as *civic virtue*, or value orientations that inform what it means to do "good" in one's community. Another aspect of civic responsibility is obligation, which constitutes feelings of what one ought to do to support one's community. Thus, this aspect of civic responsibility obliges one to support community members in certain ways when needs or opportunities arise.

Students in our study more often discussed civic responsibility as a virtue rather than as an obligation. In general, students described how engineers could use their skills to help people in their community but did not feel that they were obligated to if it was not related to their job. In these examples, students spoke about ways that engineers could contribute their problem-solving skills generally towards community issues or in a professional capacity if their expertise allowed. This distinction is important because students' responses reflected the mandate for engineers not to practice outside of their expertise [5].

Since students tended to describe civic responsibility as a virtue rather than an obligation, we might theorize that students have not yet internalized feelings of professional obligation aligned with service to society. Because we studied first-year engineering students, it is possible these feelings of obligation will continue to develop as their understanding of engineers' roles within society matures.

Civic responsibility as non-maleficence and beneficence

Students described civic responsibility as an obligation to avoid harming others as well to help others. These ideas align with the ethical principles of non-maleficence and beneficence, respectively, which are two of four foundational principles in Beauchamp's [18] principlism approach to ethics (the other principles include respect for autonomy and justice). In short, non-maleficence aligns with the doctrine, "Above all else, do no harm." Beneficence, on the other hand, emphasizes utilitarian considerations of goodness. Reflexive principlism [19] holds that both principles are important; this principlist approach involves balancing these principles in situ. We argue that applying these principles can also drive discourse regarding what character traits constitute virtue and how engineers ought to act with civic responsibility.

The distinction between non-maleficence and beneficence has also appeared within studies of social responsibility in engineering education. For example, Lin and Loui [20] proposed extending Canney and Bielefeldt's [7] model of social responsibility to include the dimension of non-maleficence based on students' perceptions of social responsibility as the obligation to avoid causing harm to others.

Like these authors, we theorize that non-maleficence and beneficence are important dimensions of civic responsibility in engineering. As our participants gave voice to, these principles (ideally) involve community-specific considerations of minimizing harm or maximizing goodness. Even when well-intentioned, engineering decision-making that lacks a holistic understanding of context is prone to have negative ramifications. Thus, engineers can use moral imagination to identify potential uses and impacts of their technologies in society [21]. Civic responsibility may inform a more holistic approach to technology implementation that helps individuals and organizations evaluate the use of their technologies in the real-world.

Limitations and Future Work

We intend for this framework to be a starting point for the engineering education community to consider the role of civic responsibility in engineering education. Our findings represent a limited insight into students' perceptions of civic responsibility because we generated our findings from a convenience sample of first-year engineering students. We encourage further research on this topic with students in various stages of their engineering programs to develop a more comprehensive picture of how civic responsibility manifests within engineering education. It is especially critical to understand how engineering students' beliefs about civic responsibility change over time because there is evidence suggesting engineering programs tend to weaken students' concern for public welfare [22].

Conclusion

We introduced a conceptual framework for civic responsibility in engineering education by (1) situating civic responsibility within broader discourses of responsibility and (2) applying civic responsibility to analyze interview data with first-year engineering students. We theorized that civic responsibility was closely related to yet distinct from other dimensions of responsibility. We also described the relationship between civic virtue and civic responsibility within engineering. Within prior literature and our analysis of student interviews, we found many parallels between civic responsibility and social responsibility. Both civic responsibility and social responsibility pertain to engineers' responsibilities to consider the impact of their work on the welfare of others. However, we operationalized civic responsibility as slightly distinct from social responsibility in that civic responsibility emphasizes engineers' roles as both professionals and community members within society.

Our qualitative findings indicated that students were aware of engineers' ability to respond to community needs but did not necessarily feel that they were obligated to be responsive to these needs outside of their professional roles. Students emphasized that, at a minimum, engineers should avoid using their skills in ways that could cause harm to others. Moreover, students differentiated between the responsibilities that engineers have as professionals versus as community members. These findings led us to several nuances to consider when studying civic responsibility. First, there is a distinction between personal and professional civic responsibility. Second, civic responsibility involves considerations of virtuous dispositions and calls forth behavioral obligations. Third, we noted that civic responsibility could also be framed through the ethical principles of non-maleficence (avoiding harm) and beneficence (doing good).

We hope that this emergent conceptual framework can help further other studies about civic responsibility in engineering education and contribute to broader efforts to support engineering programs in their aims to graduate engaged professionals and community members.

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