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Training for Life: Reimagining a Codes and Regulations Course

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Abstract

Codes and regulations provide a baseline of expectation for civil engineering practice, and in turn, engineers influence the codes and regulations to create new best practices. To address a need for embedded ethics instruction at the upper level, a reimagined Civil Engineering Codes and Regulations course allowed students to examine how common civil engineering codes and the ASCE Code of Ethics relate to the need for community engagement and professional best practices to realize equitable civil infrastructure. By expanding the definition of codes and regulations to include the ASCE Code of Ethics and professional ethical expectations, students learned and practiced professional skills to prepare them for their capstone design project experience and the workplace.

In this paper, we describe our approach to reimagining a Civil Engineering Codes and Regulations course in the Civil and Environmental Engineering Department at Rose-Hulman Institute of Technology. We describe our learning objectives and modules, and our model that includes leveraging internal and external professional speakers. Using survey data, we describe how students learned from these modules. Students benefited, but the impact of the modules depended on students' previous exposure level to the skills associated with these topics. While describing students' perceived improvements, we also discuss expectations for time and resources needed for development of the course. Finally, we share lessons learned so that individual modules or the full approach could be adapted for use at other institutions.

1. Introduction

As professionals, engineers are obliged to contribute positively to human welfare through their professional work in an ethical and socially responsible way. To guide engineering practice, professional codes of ethics have been formulated by many professional engineering organizations throughout the world [1-3]. Future engineers--students--need to be well-versed in ethics, codes and regulations, and socially responsible engineering practices right from their student tenure, so they can be successful in their careers.

In the student academic space, in the absence of ethics enforcement, it was reported that nearly 80% of engineering students were not required to take any type of ethics-related course [4]. To overcome this issue in the academic and work environments, the Engineering Accreditation Commission/Accreditation Board for Engineering and Technology (EAC/ABET) sought to prepare students in the classroom prior to the start of their engineering careers and has required accredited engineering programs to demonstrate student learning in ethics since 2000. It has been demonstrated that engineering ethics education plays a significant role in the formation and reshaping of the engineer's ethics, and early training can allow students to develop ethical decision-making skills to identify ethical issues and conflicts, understand different perspectives, assess decisions and consequences, and revise plans, actions, and options as required [5]. In its most recent revision, EAC/ABET now requires that students must demonstrate "an ability to recognize ethical and professional responsibilities in engineering situations and make informed judgments, which must consider the impact of engineering solutions in global, economic, environmental, and societal contexts" [6]. This requirement aims to prepare the students for real-life ethical dilemmas. However, the multifaceted, complex nature of this outcome--requiring students to consider "global, economic, environmental, and societal" attention with ethical responsibilities--means that programs must carefully consider their interventions and assessment practices so as not to miss any element of the outcome [7] and possibly rethink their approaches to teaching ethics.

At the professional level, while ASCE first adopted a Code of Ethics in 1914, there have been many scenarios when codes resulted in systematic racism through conscious and unconscious bias. Recently, ASCE publicly stated that social justice is critical to the civil engineering profession. In 2017, ASCE added a new Canon 8 to address this acknowledgement, and in 2020, the ASCE Code of Ethics was revised to read that engineers should "acknowledge the diverse historical, social, and cultural needs of the community, and incorporate these considerations in their work" [8].

There are many examples over the past century of how civil infrastructure--transportation, safe drinking water, flood protection, and others, have negatively impacted communities, unintentionally, and sometimes, intentionally [9]. Examples include high-profile cases such as the Flint, MI water crisis, flooding from hurricanes Katrina (New Orleans, LA), Ida (New York, NY), and Harvey (Houston, TX), and the recently paused Houston highway expansion project--it is paused due to Civil Rights Act violations [9]. Other examples may not make national headlines, but are important to communities, nonetheless. For instance, author Mike McMeekin states how his hometown of Omaha, Nebraska has faced racial injustice and inequities of infrastructure spending systems [10]. Nebraska Department of Transportation has allocated $800 million over the next 20 years for Interstate highway infrastructure and, according to the author, Omaha's transportation funding needs far exceed current levels of funding [10]. The system for the distribution of federal and state transportation funds limit how those funds could be spent and does not require significant local input [10]. These and many more examples demonstrate the social impacts of infrastructure policy and the need for civil engineers to understand the ethical impacts of civil infrastructure.

Along with these examples, ASCE's updated Code of Ethics and EAC/ABET's updated outcomes demonstrate the critical need for civil engineering education to rise to the challenge of inspiring a new generation of civil engineers who understand their role in shifting from simply following the letter of the law to considering how the infrastructure affects all stakeholders and making appropriate adjustments such as designing beyond the code. Designing to the code does not necessarily obligate ethical considerations. Civil engineers must ensure that, in practice, infrastructure meets the needs of all communities affected by the infrastructure, not only users, or a subset of users, of the infrastructure. Public policy must change to reprioritize public infrastructure investments to create more equitable and prosperous communities. Civil engineering ethics education must also change to equip students to begin to address these issues.

1.2 Current approaches to addressing ethics

To meet these needs, current approaches to teaching ethics typically include threads through curricula and standalone courses. Programs have used these approaches as appropriate for their situations. Across-the-curriculum approaches can be beneficial for reinforcing and building on students' knowledge and experiences. However, reliance solely on a thread requires faculty coordination and buy-in, and sometimes results in not enough time being allocated to ethics in otherwise full courses [11]. Alternatively, stand-alone courses are often general and not discipline-specific and may do little to provide students with the tools and confidence they need to excel as engineers in our dynamic world [11].

Additionally, often co-curricular and extracurricular activities are considered the place where students learn and practice leadership, teaming, ethics, and other professional skills [12, 13], and for those who participate, these skills can be practiced. Yet, accessibility is limited to students who sign up and variability may exist from one organization to another. Engineering programs may have little control over the quality of these experiences such that they likely cannot rely on them to ensure student learning in this area.

1.3 Proposed approach

The approach proposed herein leverages a Civil Engineering (CE) Codes and Regulations course to teach discipline specific ethics related content in a way that gives time for true consideration as a standalone course, but also complements a thread through the curriculum because it is not solely an ethics course. We posit that a Codes and Regulations course is an ideal course to exploit for the purpose of embedding ethics because it is already focused on ethical civil engineering practice by teaching students the codes and regulations pertaining to civil engineering practice. By expanding the scope of codes and regulations from teaching students what codes are and how to design to them to teaching students how to influence and improve codes and regulations to create more equitable civil infrastructure, ethical considerations are more in line with the EAC/ABET criteria requiring students explore the "global, economic, environmental, and societal" [6] impacts of their decisions.

The goal of this endeavor is for students to experience ethics in all facets of design–from concept to realization–and in the small and large decisions. The intended outcome is to develop more well-rounded and resourceful students. In this approach, the intent is for students to view ethics as baked into constraints of their work as civil engineers like other codes and regulations. They examine the impact of good and not-so-good decisions and learn to describe their ability to positively influence codes for a more equitable and sustainable world. Our full-course format allows time for students to practice and apply the learning outcomes. Since the course is also a co-requisite of the first term of the senior Capstone Design course, students are, at the same time, experiencing civil design from the conception of design. This setup allows students to make connections across classes and directly put into practice the skills they're learning.

In our intervention, we developed learning objectives to allow ethics to be infused into codes and regulations. In doing so, we expanded the definition of codes and regulations to include Codes of Ethics and expected "codes" of professional conduct for students' career success. To build credibility, we leveraged guest speakers from a variety of backgrounds to instruct students and provide real-world perspectives. In addition, these interactions allowed for networking for students and faculty, and, for some alumni, reconnection to the university.

2. Background

As EAC/ABET accreditation requires ethics to be included in engineering programs, and universities have developed techniques to fulfill the requirement. Some engineering programs are integrating ethics learning objectives into existing technical courses, while others have chosen to teach specific courses or modules related to this topic [14-16]. Benefits of the standalone approach include time to do a deep dive into topics and continuity across the course [11]. Texas A&M University, Virginia Polytechnic Institute, Iowa State University, and Delft University of Technology in the Netherlands, among others, implement standalone ethics courses in their curriculum [11]. At Delft, the stand-alone courses on ethics and engineering have received positive feedback from 60-100% students [18]. The University of Nevada, Reno teaches a module entitled, “Who Wants to Be an Ethical Engineer?” [17]. However, at some universities, since the course was separate from students’ other technical courses where engineering design or discipline-related content was taught, it was perceived as unnecessary or circumferential by students [11].

Other programs such as United States Military Academy [18], Padnos School of Engineering [16], University of California, Berkeley [17], Illinois Institute of Technology [19], Colorado School of Mines [19], Utah Valley University [19], and Rose-Hulman Institute of Technology [20] have threads of ethics woven throughout their engineering curricula. An important benefit of this approach is the modeling that occurs: faculty across a program or university are being seen as involved in teaching ethics which may elevate the importance of ethics and keep it from being viewed as peripheral to students’ curricula [11]. One of the biggest implementation challenges faced by universities using this approach is coordination among faculty. Breakdown in coordination can lead to overlapping or missing content within the thread [11].

2.1 Ethics in the Civil Engineering program at Rose-Hulman

Ethics can and should be touched upon throughout the curriculum. At Rose-Hulman Institute of Technology, a Civil Engineering ethics thread was first implemented for a freshmen cohort in 2015-16 [20]. Students are taught to identify their set of personal values in year 1, and by year 4 they are expected to analyze no-win ethical dilemmas. Table 1 provides a brief description of the ethics thread purpose and placement in the civil and environmental engineering curriculum [20]. While some instruction is included in the early years, there is a gap in ethics instruction that the CE Codes and Regulations course can fill for upperclassmen, as noted in the final column of Table 1. Since our CE Codes and Regulations course is a co-requisite course for Capstone Design, students can see direct application of embedding ethics in early steps in the design process such as for concept development, stakeholder involvement, and feasibility analysis.

Table 1: Ethics in CE Required Courses

Academic Level	Learning Objectives [22]	Course	Form of Ethics Intervention
Freshmen	· Identify set of personal values · Compare and identify differences of their values with peers' values · Interpret role of their values in interactions with peers	Graphical Information Systems	**Instruction** and assignment
		Engineering Statics	**Instruction** and assignment
Sophomores	· Explain purpose and paraphrase ASCE Code of Ethics · Evaluate ethical dilemmas using the ASCE Code of Ethics	Dynamics	Assignment
		Sustainable Civil Engineering Design	**Instruction** and review of ASCE Code of Ethics
Juniors	· Describe a formal process for ethical decision making · Apply the process to recommend resolution to a win/no-win ethical dilemma	Structural Mechanics I	Ethical Dilemma Assignment
		Construction Engineering	Ethical Dilemma Assignment
		Environmental Engineering	Ethical Dilemma Assignment
Seniors	· Evaluate no-win/no-win ethical dilemma · Analyze cases with multiple conflicting ethical principles · Describe role of ethics in capstone design project	Capstone Design Sequence (year-long)	Ethical Dilemma Assignment Required discussion in students' capstone design report

2.2 CE Codes and Regulations Course at Rose-Hulman

At Rose-Hulman Institute of Technology, the CE Codes and Regulations course was initially included in the undergraduate curriculum to complement technical courses by teaching code awareness and execution. Historically, students were introduced to major building codes, the Americans with Disabilities Act, zoning regulations, construction techniques, indoor air quality and moisture problems, environmental regulations, wind loading, seismic design category, fire rating, and site development including feasibility and environmental site assessment. The original course objectives were for students to demonstrate proficiency in the following areas:

- Building and other CE codes to provide guidance for code-compliant design of civil engineering systems,
- National and local environmental regulations, and
- Codes and regulations for land development.

Since proficiency in some of these areas was critical for students' capstone design projects, this course was offered alongside the first term of the capstone sequence. Students learned, through lecture, about these topics and completed assignments consisting of solving problems or preparing reports to practice using the codes and regulations.

Over time, faculty recognized that some of these topics were focused subfields in civil engineering that could be more appropriately taught in the suitable design courses themselves or in the applicable technical portion of the capstone design sequence when necessary. Additionally, faculty identified the need to provide instruction about equitable civil infrastructure design: it is not enough for civil engineers to simply be obedient and follow codes, but rather they need to expect to collaborate with a variety of even non-traditional stakeholders to consider going beyond the letter of the law of codes, or to improve codes and regulations. In addition, over the years, engineering codes themselves have changed to reflect changes in our culture, law, and technology. It is our belief that civil engineers need to not only know how to keep up with these changes but should be ready to lead these changes.

In our redesign, our aims were to highlight the importance of an engineer's ability--and perhaps duty--to influence codes and regulations, and to make ethics more concrete and tangible for students by leveraging their exposure to practicing engineers. The redesigned course teaches a baseline of expectations for ethical civil engineering practice, especially in relation to civil engineering codes and regulations, and in turn, allows students to explore how engineers can influence codes and regulations to create new best practices. Using the ASCE Code of Ethics, students explore the ethical need for community engagement, equity in infrastructure, excellent communication and relationship skills, engagement in public policy, and basic literacy in legal issues related to civil engineering. With this instruction, our goal is for our students to go into the workplace with the skills and confidence to participate as an ethical professional and pursue equitable civil infrastructure solutions. Students need the opportunity to learn what equitable civil infrastructure looks like, the skills and considerations needed to achieve equitable designs, and their responsibility as a future civil engineer to engage with the public in ethical design practices and implementation.

The redesigned CE Codes and Regulations course maintained co-requisite status with the first term of Capstone Design. As before, the course was a four-credit course that met for 50 min, four times per week. The course learning objectives used to guide the course redesign were

- Describe how codes and regulations are used to provide compliant design of civil engineering systems,
- Explain the importance and interaction of national and local regulations,
- Explain basic principles related to public policies and legal issues in civil engineering, and how engineers can impact public policy, and
- Describe the impact of professional issues and civil engineering on culture and social issues.

The word "ethics" is not explicitly stated in the course learning objectives, by design. In this course, students are not studying big ethical dilemmas and determining the best course of action for the engineer to take to solve a problem. This course seeks to teach ethical civil engineering by embedding ethics into all facets of civil engineering design, and in particular, the early stages of design where community engagement is essential. It is critical that civil engineers recognize their responsibility as servants of the public to positively impact public policy. It is critical that civil engineers examine designs from others' perspectives by seeking and integrating input from all stakeholders.

These learning objectives were achieved by creating learning objectives around seven modules in the course (Table 2). We developed these modules and learning objectives by seeking input from faculty members in our civil engineering department, especially the Capstone Design instructors, and conversing with alumni and employers of our students. Each module consisted of 4-8 class meetings. These learning objectives guided us in finding guest speakers to demonstrate and provide examples of our objectives, as well as to teach objectives we did not possess expertise in such as the processes for changing existing civil engineering codes. To identify speakers, we reached out to alumni and professional friends. Sometimes these discussions led to new connections and networking opportunities for our department, faculty, and students.

The ability to reliably conduct virtual presentations as a result of the COVID-19 Pandemic allowed for professionals across the country, and even the world, to share their expertise with the students in our class. Four of the 18 speakers were female; eight were not engineers by training though these non-engineers worked closely with civil engineers. We purposely enlisted these non-engineers because of their perspectives as non-engineers, and because of their training in city planning, environmental science or law. In each module, we leveraged at least one guest speaker (Table 3).

The course was a near even mix of lectures by instructors (55%) and presentations by guest speakers (45%). On days when the instructors taught, students completed pre-class activities such as watching a video, listening to a podcast, or reading a case study related to the topic at hand. In-class, students put the cases in context through discussion and some traditional lecture. On days when guest speakers presented, they provided instruction for some topics, but primarily reinforced topics by sharing pertinent expert experience through case studies and discussion.

Table 2: Learning objectives and modules developed and deployed in CE Codes and Regulations (* indicates where content complemented Capstone Design)

Module	Learning Objectives
Module 1: Interactions of codes and regulations: Explore processes and changes in structural engineering codes	· Describe how codes and regs are used to provide compliant design of civil engineering systems. · Explain the differences and similarities between a code, regulation. · Explain how codes, regulations and certifications or rating systems work together. · Explain what an engineer's obligation is (or standard of practice) when there is no governing code or regulation. · Describe positive and negative outcomes of designing to a higher standard than what is required by code/regulation. · Describe typical processes allowed by code/regulation to deviate from the code/regulation. · Describe and explain the engineer's role in the code/regulation writing and adoption process and the engineer's role.
Module 2*: Site assessment and feasibility: Study the importance and process of Environmental Site Assessment	· Describe at least two examples of harm (economically, environmentally, health) as a result of historical land use · Describe the purpose of and basic processes of CERCLA · Describe the purpose and importance of a Phase 1 Environmental Site Assessment · Describe and give examples of the four main components a Phase 1 Environmental Site Assessment · Prepare a site assessment and feasibility study report for senior design sites
Module 3*: Community engagement: Examine infrastructure and ethical dilemmas from equity in infrastructure and humanitarian engineering lenses	· Describe the impact of civil engineering on culture and society, and give an example of how civil engineers can most effectively improve quality of life for all stakeholders · Explain one example of a well-intentioned but failed development project, and a successful development project · Develop a plan for involving community needs/wants in senior design projects · Examine no-win/no-win ethical decisions

Table 2: Learning objectives and modules developed and deployed in CE Codes and Regulations, continued (* indicates where content complemented Capstone Design)

Module	**Learning Objectives**
Module 4*: Communication: Learn skills to improve emotional intelligence, difficult conversations, and common dysfunctions of teams for working with a variety of professionals	· Describe how to leverage your strengths for engaging in difficult conversations · Describe key elements in identifying difficult conversations · Give two examples of how to navigate difficult conversations · Explain emotional intelligence and how to apply them to improve client and peer relationships · Discuss common ways teams can break down and ways to guard against dysfunction
Module 5: Public policy: Examine opportunities for engineers to engage with policy including through public sector work	· Explain differences between elected, appointed, and merit-based public officials and differences in motivations and interactions · Describe the bidding process · Explain how an engineer can leverage collaborations with a variety of stakeholders to achieve win-win outcomes · Give at least two examples of how to build consensus among stakeholders to progress projects · Describe ways that engineers can impact public policy
Module 6: CE-relevant environmental regulations: Explore including erosion and sediment control	· Explain the four main different frameworks used in drafting environmental regulations, and justify classification of an example regulation in each category · Describe the main processes of CE-relevant environmental regulations: NEPA, CERCLA, CAA, CWA, SDWA, ESA · Describe the purpose of <state> Rule 5 under the Clean Water Act · Give examples of good and bad erosion control · Create a Stormwater Pollution Prevention Plan for a senior design conceptual plan
Module 7: Legal aspects: Examine the basics of ownership and contracts, and serving as expert witness	· Describe the basic principles of ownership including sole proprietorship, partnership and corporation · Describe the three basic requirements of contracts and analyze sample contracts · Explain common consulting fee structures and contract processes · Give examples of the need for robust contracts and documentation of all communications

To practice the skills they were learning, students completed assignments for all modules. The students prepared a report for five of the seven modules (Table 3). To allow students to get questions answered in real time, at least one class meeting per module was devoted to in-class work time on course assignments. Students completed assignments in their capstone design teams, and three of the reports submitted in CE Codes and Regulations contained content to be used in their capstone design reports or to benefit their capstone design team experiences.

Table 3: Speaker arrangement and aligned assignments for each course module

Module	Topic	Speakers	Assignments
1	Interactions of codes and regulations	3 external virtual	Speaker reflections
2	Site assessment and feasibility	1 external in-person	Prepare site assessment and feasibility study for capstone project, Speaker reflections
3	Community engagement	3 external virtual, 1 internal in-person	Evaluate ethical dilemmas, Speaker reflections
4	Communication	2 external in-person, 3 internal in-person	Evaluate difficult team dynamic situations, Speaker reflections
5	Public policy	2 external in-person	Speaker reflections
6	Environmental regulations	1 external in-person	Prepare stormwater pollution prevention plan, Speaker reflections
7	Legal aspects	1 external in-person; 1 external virtual	Create case statement for consulting company, Speaker reflections

Specifically, students prepared a feasibility and site assessment assignment for their desk study–review of site-specific information available online or via references–for their capstone project as they began to explore their site at the beginning of their capstone experience. Students prepared an erosion and sediment control plan for a site to be used as a framework for the plan they would prepare after they established their designs. Students examined difficult conversation scenarios and developed ideas to resolve conflicts that would inevitably arise while working in their capstone design teams.

Other assignments required students to use their new skills to evaluate cases introduced by speakers or instructors. For every guest speaker, whether internal or external, students prepared a summary of the speaker's presentation and reflected on how what they learned related to their capstone design project or team and/or their future careers. These reflections were due two days after each speaker's presentation to keep students from falling behind.

3. Methods

3.1 Research question

In our research, we set out to assess the impact of the redesigned CE Codes and Regulations course on students' learning related to ethics for the practicing civil engineer. This study aimed to answer the following research question:

Can professional, civil engineering-focused ethical instruction scaffolded in a Codes and Regulations course impact students' preparation to be successful, ethically-minded civil engineering practitioners?

3.2 Participants, data collection, and analysis

At Rose-Hulman Institute of Technology, the CE Codes and Regulations course, CE450, was historically offered in the fall term of the senior year. It was designed to work in tandem with the first term of a year-long Capstone Design course. As such, only seniors also co-enrolled in Capstone Design are annually enrolled in CE Codes and Regulations. In the 2021-22 academic year, 21 seniors (seven female, 14 male) were enrolled in the course; 16 total students responded to the survey.

Through an approved IRB protocol, participants participated in a post-course, retrospective gains survey. The survey was intended to allow us to learn if students had prior exposure to the ethics and codes and regulations topics, and the degree of impact of the course instruction on their confidence in and ability to engage positively in a variety of professional areas including difficult conversations, public policy, starting a consulting firm, etc. (Table 4).

Averages and standard deviation values of the data were determined for the Likert scale questions. Students' perceptions related to prior exposure in particular areas were compared to students' perceptions of their gains in desired outcomes of the course. The open-response question responses were analyzed manually and organized by the type of response to understand the breadth of prior experience.

To complement survey data, course evaluation responses were analyzed, and key elements were identified and summarized CE Codes and Regulations course, it was encouraging that students' learning was measurable for key course outcomes, including student's recognition of the importance of topics that they hadn't realized were important for civil engineers to master. As we reflect on our experience, we provide some expectations and lessons learned to aid others in implementing modules to embed ethics into existing courses such as a Codes and Regulations course to encourage holistic student learning.

5.1 Expectations for time and resources

Any course redesign is an investment of time. We conversed with faculty and alumni to discuss possible learning objectives and course topics and modules. With the modules identified, we met with over 20 potential speakers and spent approximately 50 hours in discussions with speakers alone. The high overhead for a hybrid traditional and seminar class was increased because the co-instructors truly co-taught each class. Coordination, debriefing, and recalibrating is not trivial for any co-taught class, but especially for the first teaching of a class with such a high number of guest speakers embedded into the course instruction.

However, the ability, ease, and comfort of virtual meetings as a result of the COVID-19 Pandemic made this task simpler than it could have been and made it possible for students to learn from experts across the nation and world; we had an alumna located in Germany speak to the class. However, the benefits of this access and technology come with the risk of confusing students about how the class was meeting on any given day. Thus, it is imperative that instructors increase class organization and practice consistent communication through a variety of means: through the course management system, in class, and via email.

5.2 Lessons learned

After learning from the prior student feedback, for future teachings we plan to tighten up the focus of the course and expand the areas where the largest improvements in students' learning occurred, such as in legal aspects and public policy. We wish to expand the assignments and cases students consider in these modules.

As we consider student feedback, we plan to decrease the number of speakers we invite and transform some of the content that was taught by speakers into instructor-led lecture/discussions/activities. We aim to have one--no more than two--guest speakers per week. In addition, while we met at least once with speakers prior to the course to share learning objectives and trade outlines or presentations, some speakers strayed from our expectations. We suggest instructors provide detailed direction for the speakers, going so far as to create detailed outlines after initial conversations and to schedule at least one additional follow up conversation. This would, of course, increase the time investment for both the instructors and the speakers. We believe, however, that a shared vision would allow for better use of speakers' time and class time, yielding more satisfaction for students and faculty. All information shared by guest speakers was valuable and translatable to students' work or future careers. However, in future teachings, we need to help the speakers help the students see the connections. Following speaker presentations, we suggest that instructors emphasize the intended theme and takeaways. This may include directing debriefing to help students reinforce connections.

In addition, to champion social justice and diversification brought to the classroom, we seek to bring a more diverse set of speakers to the classroom. Doing so will challenge us to look farther beyond our alumni pool. This challenge is indicative of the changes needed in the civil engineering profession, and the importance of which we wish to model.

5.3 Implementation strategy

In needing to teach ethics, we propose an approach that seeks to teach ethics from a discipline-specific framework within the scaffolding of a CE Codes and Regulations course. While this setup works for us as a co-requisite for Capstone Design, it would be possible to insert modules piecewise throughout technical or other courses where it would be appropriate. While ethics can be taught as a thread through a curriculum, or as a standalone class, or both, the intervention described herein should be complementary to any style.

6. Conclusions

Based on our assessment and student evaluations, students found value in our ethical instruction as scaffolded in a CE Codes and Regulations course. Students perceived that the ethics-embedded learning objectives positively impacted their ability to be prepared for, and their confidence in, being civil engineering practitioners. Our findings indicate that students' abilities to participate in policy-making, serve society by starting a civil consulting firm, and work efficiently with others on teams demonstrates achievement of our two ethically-focused course learning objectives: (1) explain basic principles related to public policies and legal issues in civil engineering, and how engineers can impact public policy, and (2) describe the impact of professional issues and civil engineering on culture and social issues. The redesign of the CE Codes and Regulations course allowed students to learn, including in areas they didn't even know were important for civil engineers. We look forward to continuing to improve the course to provide a learning environment for students to develop critical knowledge and behaviors vital for their success as ethical civil engineers.

Civil engineering education must provide opportunities for a new generation of civil engineers to acquire and practice skills to lead changes to codes and regulations and ethics cultures to encourage communities to flourish. Civil engineering infrastructure lasts lifetimes, as do our educational investments. Like our students have noted, ethics skills are broader and more important than initially thought.

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