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Teaching empathy through a stakeholder-focused engineering communications course

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Abstract

Civil and environmental engineers have the responsibility to not only design and build infrastructure critical to public health, safety, and commerce, but also the responsibility to effectively communicate with diverse stakeholders affected by or interested in our work. In 2019, the American Society of Civil Engineers (ASCE) updated the Civil Engineering Body of Knowledge (CEBOK) to, among other changes, update the communication skills needed by engineers entering practice and the competencies that a new engineer should develop as they progress through their professional career. In addition, this Third Edition of the CEBOK (CEBOK3) emphasizes that engineers should also develop an appreciation for effective communication and demonstrate key abilities related to the affective domain. With the importance of communication to future engineers' practice of civil engineering clearly defined, undergraduate curricula must adapt to meet this need. At the University of Delaware, the civil engineering curriculum included significant communication content prior to the issuance of the CEBOK3. However, the standard communication coursework of public speaking and technical writing left a gap in critical communication competencies needed for successful civil and environmental engineering practice. To address this gap, the civil engineering curriculum added a new course entitled *Communicating with Stakeholders in Engineering*. This course covers topics including communication theory, stakeholder identification, communicating through conflict, communication planning, implicit bias, public engagement principles, and more. The content was selected to fill the gaps in traditional communication classes taken by civil engineering students to expose students to tools and approaches to workplace communication and communication with public stakeholder groups. The topics covered in the course allow students to develop an understanding of and gain extensive practice with written and in-person communication skills. This practice is critical for the students to learn about themselves as communicators and about the audience they are communicating with. Engagement with the practice of communication at this level also requires an understanding of how humans communicate, needs that humans have, and professional obligations to society, all of which contribute to development of empathy in civil engineers. Spring 2021 represents only the third offering of the class, and the first as a required element of the civil engineering curriculum; therefore, it remains a work in progress. As a result of the COVID-19 pandemic, the course has also evolved from its original in-person format to a synchronous online delivery model. This paper describes course content, delivery, interactive activities, and student feedback to date, and in doing so offers a model for similar course development in other engineering curricula.

Introduction

In our relationships and in our workplaces, humans are constantly communicating. In the practice of civil and environmental engineering, where projects are designed and built for public use and benefit, engineers must be skilled at communicating with the array of diverse stakeholders that will be affected by their work. In 2019, the American Society of Civil Engineers (ASCE) published the Third Edition of the Civil Engineering Body of Knowledge (CEBOK3) [1]. The purpose of the newest edition was to update the competencies needed for

civil engineers entering and progressing in the practice of civil engineering disciplines. Within this Body of Knowledge, communication is identified as one of the professional outcomes necessary for successful civil engineering practice.

Of course, developing communication skills begins as early as K-12 education. Once students enter their collegiate course of study, academia, industry, and the students themselves must seek out and integrate communication study and practice into their engineering training [2]. Although effective communication is critical to the practice of civil engineering, it has been identified as a skill missing from engineering curricula in general [3]. Communication skills are not only necessary for the tasks of writing reports and giving presentations: effective interpersonal communication is an essential component of working in teams – a typical working environment for civil and environmental engineers – and is a characteristic of respected leaders in the field. In fact, a 2020 report from ASCE which examines the future of civil engineering education recommended the "elevation" of communication and other professional skills to a level of equal importance to technical skills [4].

A recent examination of employer demand for a variety of physical and cognitive competencies in the workplace found that communication is the top competency sought by employers in technical and professional fields, including engineering and related occupations [5]. The same study also found value – in terms of greater earning potential – in occupations where communications competencies were used "intensively".

Clearly, the civil and environmental engineers of today and tomorrow need communication skills to enter their profession and progress through higher levels of responsibility. Exemplar communicators connect with their audience – their peers, the employees that they manage, and external parties – in a meaningful way, using their technical knowledge and understanding of project stakeholders to develop messages and select communication formats that will help foster a sense of shared knowledge. This is akin to the development of empathetic understanding [6], or empathy, a skill that can and should be taught as part of an engineering education [7]. Although teaching empathy is not one of the stated goals of the class, the course objectives have the effect of doing just that.

Empathy involves taking the perspective of others or placing oneself in the role of someone else. Empathy developed through this "role-taking" can lead to more efficient communication [8]. In fact, stakeholder-focused communications employ two of the three aspects of empathy: perspective taking and empathetic concern [9], [10]. When communications are developed to focus on the content and delivery needs of the person receiving a message, this change in perspective sets the stage for more ethical communication and stakeholder involvement in decision-making [11]. The combination of positive attitudes toward communication and empathy is encouraged in the education of future physicians, to advance a model of patient centered care, and a similar focus on engagement and public welfare has also been recommended for educating engineers [10], [12], [13].

The course described in this paper is a new course developed specifically to fill gaps that currently exist between two required courses – technical writing, taught from an English department, and public speaking, taught from a communication department – in the University of Delaware civil engineering curriculum. The topics selected for this course have been identified for civil engineering students who will work with a range of stakeholders (clients, co-workers, municipal governments, regulators, community members, and more) likely to be interested in

their projects. Through these course topics, students build empathetic understanding through a stakeholder-focused approach to civil engineering communication. The course is a work in progress designed to give students more practice with the skills they need to communicate with a range of stakeholders, as well as touch on the affective domain, instilling in students an appreciation for the importance of effective communication in their field. This paper reports on evolving course design and observations from two full semesters of the course and adjustments made to accommodate online instruction (due to the COVID-19 pandemic) and a larger class size for an upcoming semester.

Course content and design

A new course, *Communicating with Stakeholders in Engineering*, is designed around a set of four learning objectives. By the end of the course, students should be able to:

1. Explain the importance of meaningful communication in civil and environmental engineering,
2. Demonstrate a working knowledge of different tools and methods of oral and written communication used by practicing civil and environmental engineers,
3. Assess engineering projects to identify stakeholders and appropriate methods of communication, and
4. Create a variety of communication products to support projects, engage stakeholders, and generally support sound decision-making.

The use of learning objectives is important – particularly in a non-quantitative engineering course – as they are an effective tool for communicating instructor expectations of students. Learning objectives are not only effective pedagogical practices based in literature [14], but they are also appreciated by students, as evidenced in student evaluations from this and other courses.

The learning objectives identified for this course do not exist in isolation, rather they are also responsive to student outcomes identified by ABET [15]:

3. An ability to communicate effectively with a range of audiences
4. 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
5. An ability to function effectively on a team whose members together provide leadership, create a collaborative and inclusive environment, establish goals, plan tasks, and meet objectives
7. An ability to acquire and apply new knowledge as needed, using appropriate learning strategies.

To achieve these objectives and outcomes, course topics have been arranged into thematic modules (Figure 1). The bottom of the figure represents foundational topics covered early in the semester; topics covered later are represented by boxes toward the top of the figure.

Figure 1. Themes used to organize course content.

Course organization has changed over the three years that the course has been offered; specific topics covered are shown in Table 1. These topics were selected to provide students with content related to stakeholder-focused communication, communication planning over the life cycle of a civil engineering project, the variety of tools available for communicating with stakeholders, and civil engineering-specific communication contexts.

Table 1. The evolution of course topics in *Communicating with Stakeholders in Engineering.* In year 3 of the course, the topics were reorganized new topics (bold) were added, and broad themes were identified.

Years 1 & 2	Year 3
Communication basics	<u>Theme: Foundations of effective communication</u>
History of environmental communication	Communication basics
Communication on current events	History of environmental communication
Communication theory	Communication theory
Elements of effective communication	Elements of effective communication
Public engagement principles	Active listening
Stakeholder identification	Public engagement principles
Implicit bias	Stakeholder identification
Verbal & non-verbal communication	
Narrative communication (storytelling)	<u>Theme: Factors influencing communication</u>
Ethics	Verbal & non-verbal communication
Conflict communication	**Workplace communication**
Crisis communication	Implicit bias
Communication planning	**Microaggressions**
Message mapping	**Zoom & remote work**
Risk communication	Ethics
Written tools	Crisis communication
Oral presentation formats	Conflict communication
Social media	Risk communication

Years 1 & 2	Year 3
Assessing effectiveness Case studies of communication on civil & environmental engineering projects Guest speakers: • US EPA communications coordinator • Consulting engineer • University career services	<u>Theme: Organizing and assessing your message</u> Communication planning Message mapping Narrative communication (storytelling) Assessing effectiveness <u>Theme: Written communication formats</u> Written products and readability Brochures/frequently asked questions/fact sheets **Posters** & presentation slides **Web pages** Social media <u>Theme: Oral communication formats</u> Oral presentation formats Effective oral presentations **Overcoming nerves** <u>Theme: Case studies & guest speakers</u> Stories from the Field (recorded guest speakers) • Consulting engineers (civil & environmental) • Engineering firm president • University career services Case studies (project-specific communication materials) • Water, wastewater, stormwater, site remediation, solid waste

Figure 2 shows the relationships between content covered in the new course and content covered in the two existing communications classes in the undergraduate civil engineering curriculum. While some of the topics in the new course appropriately reinforce concepts covered in the existing communications courses, new topics, additional depth, and an engineering-specific perspective make this a distinct educational offering.

Course content in years 1 and 2 was delivered primarily in-person; in year 3, the course was delivered online in a primarily synchronous format. In all years and formats, interactive activities have been a centerpiece of the class, providing real-time, small-group, low-stakes practice opportunities. The variety of delivery mechanisms helps to engage students as well as showcase a variety of communication products.

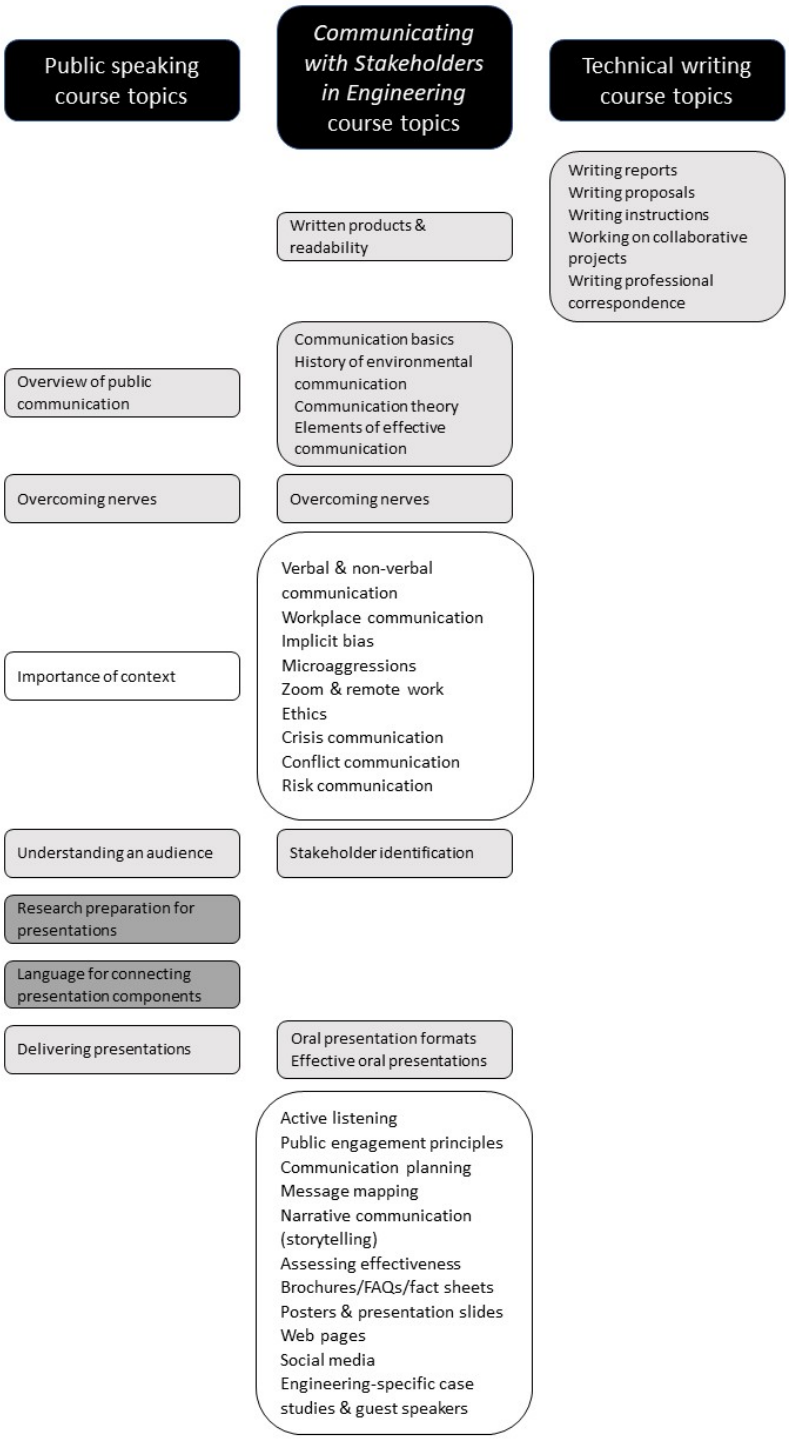

Figure 2. Comparison of topics covered in the three required communication courses in the University of Delaware civil engineering curriculum. Lighter shading indicates a topic covered in the new course and one of the existing courses. Darker shading indicates a topic covered in an existing class that is not covered in the new course. No shading indicates a set of topics addressed solely in the new course.

Actual and plausible civil and environmental engineering scenarios, communication materials, and assignments are used to infuse content specific to the field throughout the course. For example, scenarios requiring communication of changes in local traffic patterns and remediation of nearby Superfund sites are used for the semester project and homework assignments. In-class discussions evaluate the intended audience for communication materials produced by the Delaware Department of Transportation (DelDOT) and the Delaware Department of Natural Resources and Environmental Control (DNREC). Online discussions require students to seek out communication materials – brochures, fact sheets, and social media posts – from civil engineering firms or related to civil or environmental engineering projects and discuss what made them particularly effective (or not effective) using principles discussed in class.

To allow students to practice communication skills as much as possible, both formative and summative assessments are used. Assessments are summarized in Table 2.

Table 2. Assessments used in the course.

Years 1 & 2	Year 3
Grading scheme	
Traditional (0-100%); no revisions or resubmissions	Modified specifications- and points-based grading scale, based on achievement of learning objectives; limited revision and resubmission permitted
Formative assessments	
Homework assignments (7) - traditional Engagement* activities	Homework assignments (8) – shorter assignments, each with a specified learning objective Engagement* activities
Summative assessments	
Quizzes (4) Group project Class presentation	Exams (2) Semester project with individual and group elements Class presentation
Assignment weighting	
Homework: 25% Quizzes: 40% (4 at 10% each) Project: 20% Class presentation: 5% Engagement* activities: 10%	Homework: 64/180 points (36%) Exams: 32/180 points (18%) Project: 40/180 points (22%) Class presentation: 12/180 points (7%) Engagement* activities: 32/180 points (18%) *(Percentages do not add to 100% due to rounding.)*

**Engagement: lost & found assignments and online discussions*

In addition to traditional assessment methods (homework assignments, exams or quizzes), additional small-stakes engagement activities are used. The goal of engagement activities is just that: to engage students more deeply in the course content. In the third year of the course, engagement activities evolved to accommodate the online class format by providing thought-provoking prompts for graded online discussions. For example, students are asked about their observations of effective communicators and communications as well as given scenarios in which they are asked to propose a method of communicating with stakeholders in different situations. The highest marks for these discussions are reserved for integrative responses connecting multiple course concepts or concept from other courses or experiences outside the classroom. Engagement assignments also increased in value to contribute a greater portion of the

overall course grade. “Lost and found” engagement assignments have been used since the inception of the course; these assignments require students to reflect on course material to identify one topic from a lecture or module which left them feeling lost and one topic that they found interesting. These assignments receive individualized responses to guide “lost” students to additional resources to clarify concepts or correct misunderstandings. The instructor also gains insight into topics of more significant student interest.

The semester project for the course is integrative, requiring a stakeholder analysis, creation of a message map [16], and production of several written and in-person communication materials – targeted to specific audiences using information organized in the message map – to support a mock public engagement for a local, notional engineering project. Over the lifetime of the course, possible project topics have included: implementation of a city-wide rain barrel program; road closures resulting in permanent changes to traffic patterns; linking pedestrians with public transit; and a new curbside composting program. Semester projects bring together the thematic building blocks of the class and require project teams to produce a related, discipline-specific set of communication materials. This simulates the process an engineering project team may follow to perform outreach to key stakeholder groups in the time leading up to project implementation. With anchor points within the class content, the project provides a clear connection between our course and what may be expected of the students upon entry into civil or environmental engineering practice. In the most recent year of the course, groups were assigned based on student interests and skills – as assessed in a brief survey – and group assignments were prefaced by the instructor clearly explaining the purpose, value, and practicality of group projects [17]. Initial group meetings occurred during class time, and each group was provided with a discussion guide to facilitate their first interactions. Although group membership was assigned, groups could choose their own project topic. Additionally, due dates for project deliverables were staggered throughout the second half of the semester to avoid the temptation to postpone the work to the end of the semester.

In the third year of offering the course, a point-based grading system, an adaptation of specifications grading, was adopted to provide student certainty and to facilitate grading the greater number of assignments from a larger class [18]. Specifications are linked to learning objectives for each assessment, and students are provided detailed rubrics. In the event a student does not achieve a learning objective on an assignment, or in cases where students meet the learning objective, but want to achieve an exemplary score, students have five opportunities throughout the semester to revise assignments. This encourages students to use assignment feedback to improve their communication products; the process of revision and editing is, in itself, a communication skill. The third year of the course also brought a shift in weighting for assignments: notably, more emphasis was placed on homework assignments (+ 11%) and engagement activities (+ 8%), and less emphasis was placed on exams (-12%). This gave students many structured, low-stakes opportunities to apply communication skills and concepts.

Course observations and feedback to date

A summary of students completing the course (or enrolled in the course, for the semester in progress) is presented in Table 3.

Table 3. Student enrollment in the course. Numbers represent end of the semester enrollment for years 1 and 2 and the beginning of semester enrollment for year 3.

Year 1	Year 2	Year 3
Number of students		
4	9	56
Majors		
Civil engineering: 2 Environmental engineering: 2	Civil engineering: 7 Environmental engineering: 1 Mechanical engineering: 1	Civil engineering: 52 Environmental engineering: 1 Mechanical engineering: 2 Biomedical engineering: 1

The two completed semesters of this course have included a small number of students, so observation opportunities to date are limited. However, feedback from course evaluations and instructor observations consistently indicate:

- Most students appreciate the civil and environmental engineering case studies and the practical aspects of the class; some students request even more of this content
- Organization and pacing are critical to allow opportunities for adequate communication practice without overwhelming students
- Multiple types of assessments (formative and summative) are welcomed by the students
- Different content delivery formats (video, reading, interactive activities) support learning outcomes and retain student engagement

In addition, course impact may be related to the instructor's ability to model empathy and effective communication in their teaching style. When teaching a communications course, an instructor's own communication skills will undoubtedly be scrutinized. Student course evaluations pose questions related to instructor communication skills and audience focus: over two completed semesters (n = 12 responses) course evaluations indicate that students found the instructor was able to communicate concepts well (average 4.8/5; SD 0.4), engaged the class (average 5/5; SD 0), and showed respect for all students in the class (average 5/5; SD 0).

Conclusions

The act of taking the perspective of a project stakeholder when developing communication materials for civil engineering projects is an act of empathy. Awareness of stakeholder concerns and the ability to communicate in a way that incorporates those concerns is a central component of transportation projects, water resources management, site remediation, solid waste management, and other civil and environmental engineering projects. Though this paper presents a course that is a work in progress, the limited course observations to date support the utility of the course to impact both the cognitive and affective domains with respect to engineering communication. Several recent changes, for example, the conversion to specifications grading and addition of new course topics, have yet to be evaluated. While empathy is not directly measured, and the ultimate impact – engineers able to communicate effectively with a range of stakeholders – cannot yet be quantified, the program will remain in contact with graduates, employers, and departmental advisors to ascertain the impact of this additional communications coursework. Other civil and environmental engineering programs considering tailored communications content for their curricula may find inspiration in this model.

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