



Online Ethics Center
FOR ENGINEERING AND SCIENCE

Multiyear Engineering Ethics Case Study Approach

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Description

This activity is considered an NAE Exemplar in Engineering Ethics Education and was included in a 2016 [report](#) with other exemplary activities. This activity involves an interactive approach where students discuss and think about ethical cases while they are involved in a co-op position. The case study discussion draws heavily on the real-life experiences the students gain through their co-op.

Body

Exemplary features: Integration with co-op activities; ethics embedded in a multiyear required engineering program; use of real-world cases; strong evidence of success based on evaluation of learning

Why it's exemplary: This program is exemplary because (1) It spans multiple years, from the students' second year (before their first cooperative education work experience) to their fourth year (before their third co-op work experience). (2) It is interactive, driven almost entirely by case studies. Students wrestle with ethical concepts as if they were the engineers facing each dilemma, learning strategies to recognize and weigh competing interests, identify their own biases, and anticipate the consequences of proposed courses of action. (3) It connects to engineering

practice. Lectures and discussions are led by faculty members who have many years of practicing civil engineering experience. The case study discussions during the students' fourth year draw heavily on their knowledge of actual industry practice from their co-op experiences.

Program description: Our ethics education program is required for all civil engineering undergraduate students. The department typically graduates 80 to 100 civil engineering students per year. Although student demographics change over time, this past spring semester our undergraduate population numbered 468 students, of which 34% were women and 18% international students. The two faculty who developed this activity have over 15 years of consulting engineering experience, and thus bring considerable professional and personal insights to this program. Through their professional contacts, they are able to draw on the case studies and perspectives of current practicing engineers, including many of the program's alumni and co-op employers, who understand the program and its goals. This allows these practitioner partners to shape their contributions to the program.

The goal of our ethics education program is to ensure that students develop responsible professional behavior for their engineering careers and are prepared to recognize when situations may require ethical assessment. They practice navigating the often tense and uncertain human climate surrounding ethical dilemmas and learn that, with honesty and creativity, solutions can be developed that uphold the health, safety, and welfare of the public and the environment, the honor of the profession, responsibilities to firm and client, and their own careers. One of its student learning outcomes of the Accreditation Board for Engineering and Technology (ABET) is "an understanding of professional and ethical responsibility." As an ABET-accredited program, our program strives to meet this outcome via our innovative case-based approach.

- A procession of case studies is presented, discussed, and in some cases used for written assignments. This gets the students talking about the issues and builds their capacity and confidence in identifying early-stage ethical conflicts and determining an appropriate response and future course of action.
- Cases are selected by the instructor to facilitate evaluation of different parts of the Codes of Ethics of both the American Society of Civil Engineers and the National Society of Professional Engineers. The selection of cases allows students to wrestle with sometimes conflicting requirements in the codes. Some cases have clean outcomes, others don't. The ones without definitive

“answers” help students understand the often ambiguous nature of ethics dilemmas, an understanding that informs their personal ethic, analysis and prioritizing of inputs, and consideration of outcomes of alternative courses of action. The process also reinforces their engineering technical problem-solving skills and process and teaches them that creativity often leads to better outcomes, while obvious answers often have hidden drawbacks.

- Students are often frustrated by the lack of truly “right” answers like those in the majority of their other engineering classes. Over time, they come to appreciate the ambiguity of the situations studied and the importance of thoughtful, creative thinking with full consideration of outcomes.
- Co-op employment provides a deep apprenticeship experience for our students. Some will encounter ethical dilemmas on the job, while for others the case study method provides a virtual apprenticeship experience. The students wrestle with situations in the relative safety of the classroom, while interacting with their peers (who have all had different co-op experiences) and with their instructor, who has worked in the field as a civil engineer.
- The ethics concepts are revisited multiple times in two courses (in years 2 and 4 of the degree program), reinforcing the students’ ethics exposure and learning. Their understanding and appreciation of the concepts mature, resulting in greater retention of the fundamentals as well as a higher level of reflection as they progress from the first to the second course.

Assessment information: The success of our program is assessed based on the students’ anonymous evaluations of the junior-year course and their scores on an independent test. The teaching evaluation numerical scores are well above average, and associated comments are positive and support our assertion that the students can adapt to ambiguity, benefit from the case study framework, and form linkages between the classroom activities, co-op work experiences, and their future careers. In the past three years, the numerical score for the course evaluation question “The in-class discussions and activities helped me to learn” averaged 4.55/5.00 for the junior-year course, compared to 4.13 and 4.15 average scores for all civil engineering courses and all university courses, respectively. The junior-year course in our ethics program has a significantly higher rating for this and other metrics.

In addition to the numerical metrics, the following comments are typical of end-of-semester course evaluations:

- “The course provided us a great opportunity to have a better understanding of our careers in the future. It is more like a training class than a lecture, which is really good for engineering students.”
- “The case study approach was very useful and brought to light how many different ways problems can be viewed.”
- “Probably one of the most useful classes I’ve taken. I feel like I actually have a resource to go to and useful lessons learned that I can apply to real life.”
- “The discussions were all good, thought provoking, and kept the class involved. The group activities were fun and made the classwork relevant. Important information on how to handle problems in the workplace.”
- “This class was very helpful and informative in regards to how to best handle and go about dealing with future problems and ethical decisions we will encounter later in our careers. The case studies and examples were particularly helpful. Overall this was a very effective and positive class.”

For the second method of evaluation, we consider the Fundamentals of Engineering (FE) examination, which is the first stage assessment for an engineer’s certification as a licensed Professional Engineer. The FE exam includes several questions on the combined topic of ethics and business practices, and a separate score in this topic is provided as part of the institutional reporting. While no examination can accurately measure an engineer’s capacity for ethical behavior in confronting real-world problems, historic data from this section of the FE exam provide an independent assessment of our students’ aptitude for thinking through ethical dilemmas and applying rules of professional conduct. During the period from October 2005 to October 2013 (until the recent change to a computer-based examination), 400 Northeastern University civil engineering majors took the FE exam (about half of the students who graduated during this time period) and scored 1.6% higher than the national average. On the Ethics and Professional Practice section, however, our students scored 4.7% higher than the national average.

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Resource Type

Educational Activity Description

Parent Collection

NAE Exemplars in Engineering Ethics Education

Topics

Case Study Method

Ethical Decision-Making

Pedagogical Approaches

Discipline(s)

Engineering

Teaching Ethics in STEM