Online Ethics Center
FOR ENGINEERING AND SCIENCE

Phenomenological Approach to Engineering Ethics Pedagogy

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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 asks students to interview practicing engineers and asks them to reflect on their own values and what it means to be an ethical engineer.

Body

Exemplary features: Interaction with practicing engineers on ethics issues

Why it's exemplary: My program addresses two core problems in engineering ethics pedagogy: 21st century technologies raise daunting ethical questions that require strong engagement with ethics by engineers, yet engineering students don't care much about studying ethics. I developed a phenomenology-informed approach to ethics pedagogy in which students undertake research that investigates the question, What is it to be an ethical engineer? The coursework is interactive and emphasizes ethics in real-world, lived, everyday engineering practice. Students investigate their roles as engineering citizens from macro- and microethics perspectives and develop an affective engagement with study of ethical engineering practice. In other words, they begin to care about ethics and this helps maximize

their learning. Students demonstrate not only significantly improved ethical reasoning and decision-making skills but a deeper reflective understanding (versus rote knowledge) of their professional and ethical responsibilities. This approach is transferable to graduate students and is scalable and replicable.

Program description: I have learned that undergraduate engineering students who are nearing graduation are unprepared for and fearful of facing the myriad ethical challenges present in 21st century engineering practice. There is a critical gap between what students need and what we offer. While we educators are concerned with imparting ethical knowledge—codes, ethical theories, decision-making models applied to case studies—our students are concerned with understanding how they are going to fit into the world of engineering as ethically competent professionals when they make the leap from undergraduate student to practicing engineer. We must fill this gap if we expect our students to graduate with an understanding of their professional and ethical responsibilities. Based on my classroom work I've found that a phenomenological approach to engineering ethics education—where students are given the opportunity to investigate, encounter, consider, interpret, and understand the real, lived experience of what it is to be an ethical engineer—can help fill this gap.

Phenomenology is the study of human meaning from the standpoint of experience. It discloses the essences of human experiences to yield a better understanding of these experiences, to capture how it is to do or experience something and what that experience means to the persons experiencing and studying it. Importantly, phenomenology is grounded in the real, lived world of everyday human experience, not in abstract theory that seeks to explain how things are or should be. Phenomenology is particularly useful to study professional experience. Sadala and Adorno (2002), who used phenomenology to help nursing students understand the world of nursing on an isolation ward, found that this method is the most effective way for students to investigate the lived professional world because they acquire "experience in a situation where they relate to an already given world, which is out there, into which they are launched and which they will have necessarily to face" (287–288). Simply put, engineering ethics will be more meaningful to students if they study it in the context of everyday engineering work.

The two principal educational goals of my class are for students to (1) recognize the values embodied in the professional code of ethics for engineers and understand

how these values influence actual personal and professional ethical decision making, and (2) have an understanding of their professional and ethical responsibilities. Students achieve these goals by conducting qualitative phenomenological and interpretive research into the question “What is it to be an ethical engineer?” Phenomenology is not a standard approach used in engineering ethics education so there were no existing models to replicate for either pedagogical or assessment purposes. I had to design and test my own model for my one-credit, 3000-level, elective course, Ethics in Engineering Design.

Students undertake three core research activities: (1) They examine their own values and the values that inform professional codes and ethical theories. Though generally not made explicit, ethical engineering practice is inherently concerned with values and value judgments. Values—even for professionals in a technical practice—are fundamental, familiar, and everywhere. Students’ reflection on values brings deeper awareness of what is important to them, the priorities they choose, and how they make ethical decisions. (2) They interview practicing engineers about what it is to be an ethical engineer. These interviews are the single most influential activity undertaken by the students. The impact of this one-on-one experience cannot be reproduced in a textbook. This is where students gain a truer perspective on the ethical environment and issues they will face in practice and where many of the misconceptions about ethical engineering practice are debunked. Students routinely report that this is the activity they most dreaded but ultimately the one that was the most rewarding. (3) Students read a selection of writings presenting a broad range of perspectives on what it means to be an ethical engineer. Topics addressed include technology and the ethical engineer, sustainability and ethical engineering, roles of engineers in policy development, comparative global ethical practice and identity, and alternatives to traditional professional ethics deliberation. Students must ask how each article informs them about what it is to be an ethical engineer. It is important to review these articles each year, keep them relevant, and include a variety of perspectives. Students’ final research paper draws on all this work to interpretively understand and express the essences and meaning of what it is to be an ethical engineer. There are no “right” or “wrong” answers; each student’s work is personal and unique. Additionally, I meet twice with each student individually to monitor his/her progress and address questions/concerns. These meetings are instrumental in generating students’ affective engagement with the class.

Notably absent from this curriculum is the traditional case study ubiquitously used to teach engineering students how to apply ethics knowledge. A serious but unheeded charge against the case study is that it creates a myth of the engineer as the "individual actor who, alone, must make the ethical decision between 'personal sacrifice' or doing nothing" (Conlon and Zandvoort 2011, p. 220). My own students express this fear but report that their research interviews usually reveal the myth is unfounded and not representative of actual engineering practice. A better approach to case studies is needed, especially when engineering problems with ethical implications cannot be solved by science alone. My students consider, for example, how ethical engineers could use rhetorical deliberation to reveal otherwise unconsidered options in these cases.

On completion, my students are affectively engaged in their work and demonstrate improved ethical reasoning skills and understanding of their professional and ethical responsibilities.

Assessment information: I assessed student learning outcomes for 3 years using both quantitative and qualitative methods. Quantitatively, I used the Defining Issues Test-2 (DIT-2), a measure of ethical reasoning skills frequently used in engineering ethics education research. It is a multiple choice test with five nonengineering-specific scenarios presenting various ethical dilemmas. My students took the test in week 1 and after week 14. In 2011 mean N2 test scores increased 23.40% (from 28.59 to 35.28); in 2013 scores increased 26.62% (from 26.82 to 33.96); and in 2014 scores increased 38.38% (from 34.08 to 47.16). These scores compare to (1) those from an NSF-funded study of ethical skills of undergraduate engineering students ("SEED" study), where mean N2 scores for Michigan Tech students and those from 17 other institutions were 29.7 and 32.4 respectively, and (2) the DIT-2 national norms for college seniors in all majors and graduate students in all majors of 36.04 and 41.33 respectively. My students usually started the course with mean test scores lower than their peers, but their scores improved significantly each year to exceed those of their engineering peers and to approximate their nonengineering peers. In 2014 their post-test scores exceeded not only their engineering and nonengineering peers but also national norms for graduate students. This increase may be attributable in part to the individual meetings I added to the curriculum in 2014. These meetings promote student affective engagement, a known contributor to improved student learning outcomes. Thus, the combination of a

phenomenological approach to ethics education and attention to affective engagement enables students in this one-credit course to significantly improve their ethical reasoning skills. Although the student numbers are small (20, 20, 13), the annual improvement in results is consistent.

These students are not self-selected for their commitment to ethics. Annual surveys show that nearly all take this class because they need one credit to graduate, not because of the ethics content. I used a qualitative philosophical hermeneutic approach (which looks for evidence of understanding) to assess whether my students expressed an understanding of their professional and ethical responsibility in their final essays and found that each student has a personal view of what it is to be an ethical engineer. They are more confident about facing ethical problems because they understand that experienced people are available as resources and that ethical decisions needn't be career-ending. They appreciate and understand the complex nature of ethical decision making and that it often involves tradeoffs in values, not tidy win-win solutions. They remain ambivalent about the relationship between technology and being an ethical engineer, but they do understand that engineering practice and ethical decision making occur in and are relevant to broader social contexts beyond the laboratory. These students will be less surprised by the ethical problems they encounter in practice and better prepared than most of their peers to deliberate them. These findings were reviewed and affirmed by a panel of practicing engineers.

Additional resources:

1. Conlon E, Zandvoort H. 2011. Broadening ethics teaching in engineering: Beyond the individualistic approach. Science and Engineering Ethics 17(2):217–232.
2. Sadala MLA, Adorno RF. 2002. Phenomenology as a method to investigate the experience lived: A perspective from Husserl and Merleau-Ponty's thought. Journal of Advanced Nursing 37(3):282–293.
3. Teaching Engineering Ethics: A Phenomenological Approach: http://ieeexplore.ieee.org/document/7128813/
4. A phenomenological approach to teaching engineering ethics: http://ieeexplore.ieee.org/xpl/login.jsp?tp=&arnumber=6893434&url=http%3A%2F%2Fi

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