Online Ethics Center
FOR ENGINEERING AND SCIENCE

Ethics and Engineering for Safety

Author(s)

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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 describes a semester-long course that looks at safety ethics and how to build and operate safer systems.

Body

Exemplary features: Connects ethics learning with engineering practice; requires consideration of difficult problems that lack clear right and wrong answers; prepares students for business-related ethics issues.

Why it's exemplary: It connects students' ethics learning to engineering practice and also addresses macroethics (the broader ethical and social issues involving individual engineers and societal decisions about technology). Almost no other universities teach how to engineer for safety and integrate this education into helping students determine the responsibilities of engineers in general and themselves in particular in safeguarding human life while creating new technological artifacts. Ethics is not taught as a separate topic but as part of their responsibilities in engineering safer systems.

Program description: Over 400 graduate and undergraduate students have taken the semester-long class. I started it (25 years ago) as part of a software engineering class where students were asked to consider various ethical dilemmas that a

software engineer might face and to decide how they would personally handle them. Students were first asked to create answers for themselves alone and later a class discussion was held to compare and discuss the alternatives. About 18 years ago I moved to the aerospace engineering department and the activity became a semester-long class that both considers engineering ethics related to safety and teaches how to build and operate safer systems.

The class starts with reading about risk in modern society, answering questions such as “How safe is safe enough?,” and considering specific problematic ethical cases such as the Ford Pinto. Students are first given an assignment to answer questions about their own and general ethical standards and responsibility for safety in engineering, the ethics of risk-benefit analysis, and what level of risk should be “acceptable.” The questions do not have a right or wrong answer but instead involve personal beliefs such as who has responsibility for safety (individual engineers? management? stockholders? government regulators?), various alternatives for controlling safety (government regulation, the legal and court systems), the incommensurability principle vs. cost-benefit analysis, what should be the role of the courts and legal system, and individual responsibility. Then the students discuss their answers in small groups (the class has gotten too large to have full class discussions) and report to the entire class on their discussions. Sometimes I organize a class debate with different people arguing the various sides of an issue. Students also read about the consequences of failures of engineering responsibility in loss of life, including a paper I wrote 30 years ago on the Therac 25 accidents, which has been reprinted in over 20 engineering ethics books, used in engineering ethics education, and even translated into Braille and sound recordings for the blind. The rest of the class is spent learning safety engineering and applying it to accident investigation and accident prevention. Students have a semester project on a real system (last semester it included power grids, automobile autonomy, the Iceland Blood Bank, air transportation systems, drones, manufacturing robots, and medical devices). In the projects, the students apply both engineering and ethical principles to the design, oversight (regulation, for example), and operation of the system. I try to take examples from the newspaper throughout the semester (unfortunately, it is not hard to find them) and we discuss them and also have occasional guest lecturers who happen to be in town. The course was originally a graduate class, but in the last two years I have taught an undergraduate version.

Assessment information: Assessment is done through written assignments, class discussions, tests, and the semester-long project. Class evaluations by the students

are always quite high. Although the class satisfies no requirements and is a pure elective, it grows each year and this year had over 50 students. The students come from every department of the School of Engineering and students outside my department find out about it mostly through word of mouth.

Rights

Use of Materials on the OEC

Resource Type

Educational Activity Description

Parent Collection

NAE Exemplars in Engineering Ethics Education

Topics

Risk
Safety

Discipline(s)

Computer Sciences
Computer, Math, and Physical Sciences
Engineering
Teaching Ethics in STEM