Online Ethics Center
FOR ENGINEERING AND SCIENCE

Ethics as Philosophical History for Engineers

Author(s)

Daniel Biezad

Description

This activity is considered an NAE Exemplar in Engineering Ethics Education and was included in a 2016 report with other exemplary activities. This approach asks students to look at historical and mathematics- and physics-based dilemmas that tie back to modern day ethical challenges in math, physics, and engineering.

Abstract

Exemplary features: Unique topical focus on historical and mathematics- and physics-based dilemmas that tie back to modern day ethical challenges in math, physics, and engineering; micro-insertion technique

Why it's exemplary: The requirement to provide ethics education in the engineering curriculum is being met in the Aerospace Engineering Department at the California Polytechnic State University, San Luis Obispo, by an unconventional approach that is intended to have a lasting impact on engineering graduates throughout their working career. Instead of relying solely on exposing students to a particular code of ethics, or on primarily reviewing engineering case studies of

ethical situations, a topical history of philosophy and mathematics is presented in intermittent bursts of weekly storytelling that last 5 to 10 minutes with the intent of showing the evolution of ethics from antiquity to the present day. Surveys before and after the class showed that the engineering students appreciated and benefited from the historical mathematical and philosophical focus on ethics, and that they fully appreciated the significant ethical challenges they will encounter. Comments labelled this approach as both interesting and unique.

Program description: The primary goal of this effort is to complement and enhance exposure to and information about engineering ethics with philosophical history in a way that generates lasting internalized student concern about engineering ethical behavior; that is, in a manner that facilitates the development of what traditionally has been called a conscience, an inner feeling or voice viewed as acting as a guide for the rightness or wrongness of one's decisions and actions. This is done by focusing on philosophical and mathematical topics familiar to the student and relating them to the evolution of our shared morality. The topics must have two primary characteristics. First, their history must expose a positive and interesting relationship between a particular philosophy in a given era and the accompanying development of mathematics; for example, the relationship between the philosophy of Pythagoras and rational numbers in ancient Greek culture. Second, a chosen topic must be a link in the historical evolution of the ethical code that became widely accepted in Western culture after the Enlightenment; for example, the evolving concept of the number zero or of mathematical limits in parallel with the evolving primacy of scientific reasoning.

True stories and interesting cultural situations are used to highlight how prevailing norms of morality have evolved episodically in Western culture. The stories include the origins of cultural moral codes in the Axial Age; how Greek culture changed them; how they evolved into the ethics of the Enlightenment through the mathematics and philosophies of Galileo, Newton, Leibniz, and Spinoza; and finally, how today they precariously stand as ethical standards based on reason alone, presenting a serious challenge when viewed through the work of Immanuel Kant and John Locke. The intent is to illustrate a few historical highlights with which students can immediately identify; to show how difficult it has often been in the past to maintain ethical integrity; and to emphasize the serious ethical challenges that will confront students in the uncertain future. The weekly presentations cover the following ten topics and morals: (1) The irrational rationalism of Pythagoras

(570–495 BCE) emphasizing the moral code of geometric harmony and proportion; (2) Zeno's Paradox and the Negation of Zero (450 BCE) with the moral code of absolute logic and perfection; (3) The female philosopher Hypatia (400 BCE) with the moral code of rationalism and pre-Enlightenment astronomy; (4) Ethics in the Dark Ages (1050–1100 CE) with the morality of religious dogma and certainty; (5) Famous women Isabella, Joan of Arc, and Catherine of Sienna (1200–1300 CE) with the morality of religious dogma and revelation; (6) The end of Byzantium and crisis in the West (1400–1600 CE) with the morality of religious dogma and Machiavellianism; (7) Cartesian mathematics and philosophy (1600–1650 CE) with "I think, therefore, I am" reasoning; (8) The calculus (Newton and Leibniz) and philosophers Spinoza, Locke, and 19th century Germans (1650–1850 CE) with Enlightenment morality under uncertainty and limits; (9) Ethical dilemmas and examples (1850–1950 CE) with the morality of secular humanism and relativist ethics; and (10) Ethics in crisis: high school shootings (current day) with morality tainted by nihilism and alienation.

The ethical challenge concludes with case studies and a general awareness of a crisis in ethics that can be stated as the following question: How can we foster and provide meaning and purpose for all individuals, no matter their talent, motivation, or status, given an increasingly materialist worldview and the individual's shrinking importance within it; that is, given an ethical worldview based on reason alone? This is the modern ethical conundrum, the moral challenge that confronts the current and probably the next generation. If the supremacy of reason—both in science and in the conduct of human affairs—is a necessary condition for a moral and ethical society in the modern world, it remains an insufficient one. In addition to a code of ethics that puts this necessary condition into words, a healthy democratic republic must also allow and promote a diverse array of belief producing individuals who are motivated to strive for excellence in all areas of life; who reject absolutisms or fanatic ideologies that lead to violence; who both accept and heed their profession's code of ethics in principle and in practice; and, just as importantly, who accept some degree of uncertainty as a fact of life and as a reality of their faith. This internal acceptance of ethical standards implants within oneself what has traditionally been called the conscience, the essence of personal integrity.

There remains the danger of overconfidence. Specifically, if one cannot allow a level of ignorance to exist in one's own views, however slight, and thereby accept the uncertainty advocated by Richard Feynman as a precondition for progress, one may

abandon the difficulty of striving for virtue and either seek what is most appealing materially or succumb to what is most powerful ideologically. The caution urged by G.K. Chesterton during any search for an ethics based on reason alone should be taken to heart: “Wherever the people do not believe in something beyond the world, they will worship the world. But, above all, they will worship the strongest thing in the world.”

Assessment information: Assessment of the team project is done by the clients and by the professor. We also collect individual essays in the first week about ethical issues in software design and compare them with essays done in the last week.

Additional resources:

> Ethics as Philosophical History for Engineers (paper accepted at ASEE conference in Seattle, June 10, 2015): https://peer.asee.org/ethics-education-as-philosophical-history-for-engineers

Rights

Use of Materials on the OEC

Resource Type

Educational Activity Description

Parent Collection

NAE Exemplars in Engineering Ethics Education

Topics

Pedagogical Approaches

Discipline(s)

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