

## Turning Belief Into Action: Aims of Teaching Engineering Ethics

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The aims of teaching Engineering Ethics to undergraduate engineering students are to add a vital component to their technical education: the understanding that being professional engineers requires not only technical expertise, but also insight into their social and professional roles. This means that students have to learn about their ethical obligations to society, their employers, and themselves. This paper discusses a teaching plan used at the University of Virginia School of Engineering and Applied Science to turn undergraduate engineering students into ethical practitioners of engineering.

The faculty of The Division of Technology, Culture, and Communication in the Engineering School teaches all undergraduate engineering students in a series of four courses designed to teach students to communicate clearly, both in writing and in speaking, about a variety of topics, including their own technical expertise. We also teach students engineering ethics from a half a semester to a semester and a half. While students are introduced to ethics in their first year, it is most heavily emphasized in their senior year when they take a two semester course, TCC 401, "Western Technology and Culture," and TCC 402, "The Engineer in Society." This senior course sequence includes the writing and presenting of a senior thesis which communicates a technical project to a diverse audience with a focus on the impacts a particular project might have on society, the area of expertise, industry, individuals, etc. This is a good starting point to get seniors to think about the ethical consequences of their work, as well as focus on the importance of ethical behavior in private and professional life.

By the time students are seniors, they have certainly developed a work ethic and their own moral codes. So the aim of teaching engineering ethics is **not** to teach them morals, but for them to learn to articulate and understand their own beliefs vis a vis an engineering code of ethics, and to learn what behavior our society expects of professional engineers when confronted with ethical dilemmas. The students first have to develop their analytical skills and use them to frame moral problems.

- *Develop analytical skills to recognize and frame moral problems:*

When I introduce engineering ethics to my students, I like to start out with a particular case and have the students analyze and discuss it on the first day. One case that has worked well is "Carter Racing" which is really the "Challenger" disaster, but the students do not know this. Inevitably, most of the students advise the car should race, which means that they have launched the Challenger. This is a shock to them and introduces the complexity of real life ethics cases. Immediately they learn that to make the decision whether to launch, for example, they need to

analyze in greater depth and that it helps to use some analytical tools.

To help them develop the needed analytical tools, I first present a general overview of the study of ethics and applied ethics, and ask them to learn some ethical theories, such as “duty ethics, rights ethics, virtue ethics,” and “utilitarianism.” We take a particular dilemma and try to solve it by using each philosophical approach to give the students an understanding of the theories, as well as think about what their own solution might be and why. Such an exercise not only helps in learning the differences between ethical theories, but also offers an intellectual framework for their own beliefs which they can then develop even further to include components of belief systems that compliment their moral values .

- *Understand “moral autonomy” and develop a strong sense of personal commitment to moral principles:*

Having to think about and articulate one’s own system of belief, also questioning why we would choose a particular course of action in solving a moral dilemma, inevitably brings up the question of “moral autonomy.” What is “moral autonomy” and how do we know that we have it? One way to engage students to think about this is to have them study Kohlberg and Gilligan’s theories of moral autonomy. While Kohlberg and Gilligan agree that there are three levels of moral autonomy, pre-conventional, conventional, and post-conventional, they differ in their view of the conventional and post-conventional levels of moral autonomy. This makes for a meaningful discussions on gender differences and what the students think it means to be “morally autonomous.” We usually agree on a combination of the two theories of moral autonomy, a combination that combines adherence to abstract principles of right and wrong, as well as Gilligan’s “ethics of caring.” Adding the “ethics of caring” adds a personal, human touch to moral autonomy. Since the University of Virginia has an honor system, students are not unfamiliar with what it means to have a personal commitment to principles of behavior. They have thought about what it means not to cheat on exams “on my honor as a student,” and it is not much of a stretch for them to commit to moral principles and “honor” as a person and a professional.

A commitment to moral principles, and being able to use frameworks of morality still does not make the students ethical practitioners of engineering. Their analytical skills are not yet sufficiently developed to arrive at satisfactory solutions to complex problems. When asked to “frame” a problem, they learn quickly to recognize what the central issues are; but when looking for alternative solutions to a given problem, they often lack imagination and stay with the most obvious and simplistic answers to various dilemmas. Because they just studied ethical theories, the theories most often dictate the answers to problems posed in class. When asked, “what would **you** do?”, finding an answer becomes more difficult for them because it is public, and they need to join personal beliefs with recognizable moral principles. The key to help the students analyze and find the solutions with the most utility is to introduce them to the concept of “moral imagination.”

- *Foster “Moral Imagination” in Engineering Students:*

When I ask my students what makes them “do the right thing,” as some of them like to say, the answer I get most often is “my conscience,” or “when I am personally involved or know the people affected by the dilemma.” So when discussing possible solutions to ethical dilemmas, I ask them to put themselves, members of their family and friends into the situation. This puts an

element of caring into finding a solution. By “imagining” themselves or important others in a dilemma, they can then take the next step and “imagine” possible solutions. As mentioned earlier, engineering students have been trained in convergent thinking, focusing on a specific problem and its details. “Moral imagination” requires some divergent thinking; the students need to be able to step away from the problem, view it in a larger context, and then do some free association thinking to come up with a variety of solutions. The “moral” part of the “imagination” refers to being able to associate each possible answer with moral beliefs, not just self-interest.

We use a combination of studying hypothetical and real life cases, historic events, and classical literature to foster the students' ability to use their moral imagination. I like to use some of the classic literature, for example Shelley's Frankenstein, to encourage student's divergent thinking and engage them in lively discussions of what Dr. Frankenstein might have done differently to avoid the tragedy that followed when he planned the creation of the monster. Since all of us like stories and feel much less inhibited in suggesting possible solutions when discussing fiction, the students let their imagination roam freely and get a real sense of what it means to exercise moral imagination. Every solution they suggest is discussed in detail, including the moral principles associated with that solution. This encourages imaginative thinking and also drives home the point that every solution or action taken has long and short range consequences to more than just one person. Taking action in solving moral dilemmas should never be a knee-jerk “reaction,” but requires developing the habit of first framing the problem, then giving careful consideration to alternative solutions and questioning the moral principle behind each possible course of action. Once we have settled on the best answer to the problem, we take action.

- *Turn Belief Into Action:*

Taking action in accordance with personal and professional moral principles, requires that the students understand that professional and personal behavior are integrated. Every year I hear some students say that there is a strict division between professional and private life and that one does not affect the other. They make this kind of comment because often they have not thought out the implications of such a statement. They are merely thinking of protecting their privacy and assume that “personal and professional behavior” means having a “separate professional and separate private life.” It does not take long to convince them that someone who lies habitually to his family and friends will eventually do the same to his colleagues at work, or that a person who only thinks of herself will do so at work as well. These are more extreme examples to convince them that personal and professional behavior are integrated and that to make a commitment to live by moral values means both in our private and professional life.

I believe that most engineering students aspire to be first rate professionals, and when they accept that adhering to moral principles is a part of the image of professional engineers, they are more open to discussion of such principles and how these principles are reflected in their actions. We discuss not only actions one might take when faced with moral dilemmas, but also general behavior on the job which might help later in solving problems.

For example, recruiters from companies when interviewing senior engineering students,

often ask about their ability to work in interdisciplinary teams. What the recruiter is really asking is if the student is able to listen to and tolerate divergent points of view, and if she has good communication skills which enable her to work with people of different backgrounds who sometimes or often disagree in their approach to framing and solving problems. To be able to work in interdisciplinary teams also requires that a person can take a stand on an issue and resist falling into “group think.” Thus effective team work requires learning to be morally autonomous, using moral imagination, as well as thinking analytically, and then communicate persuasively; all this is necessary for a successful professional career.

The aims of teaching Engineering Ethics then are to help students understand what it means to be and how to become ethical practitioners of engineering. To act ethically on the job requires an integrated belief system, accepting personal responsibility for our actions in both our personal and professional life. As ethical practitioners we have to be reflective, develop moral autonomy, use our analytical skills and moral imagination in framing and solving problems. If we refer to such a framework for professional and personal behavior and decision-making, we develop the habit to act on the basis of moral principles. Our engineering students learn to see themselves as people and professionals in the center of a technological society with moral responsibilities and obligations to themselves and to society.

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