

Integration of First-Year English with Introduction to Engineering Design with an Emphasis on Questions of Ethics

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Abstract

Fundamental to engineering education, and mandated by ABET is that students engage with questions of ethics. Too often, however, this does not occur until late in the student's career. In the Foundation Coalition Freshman Integrated Program in Engineering at Arizona State University, we believe that concern for ethics must be integrated vertically into the curriculum beginning in the first year of the student's career. This can be successfully achieved if freshman English and engineering design are integrated, as we have been able to do. We introduce our students in their first semester to the ancient rhetors' concept of values and use that to explore specific engineering codes of ethics and decision-making tools employed in engineering. This foundation then allows students to critically analyze case histories and discover for themselves that ethical considerations are and must be part of the decision-making processes they employ, even when the tools they use cut out such considerations. This foundation allows us to then explore ethical considerations vertically throughout their careers as engineering students. Therefore, we urge educators to consider the possibility of developing integrated courses that allow students to connect the intellectual rhetorics of inquiry developed in freshman English classes with their engineering classes so that students can truly appreciate and comprehend the importance of ethics in their future professional lives.

Introduction

In the past several years, ethical concerns have become a central focus of the public and news media, creating a new awareness of the ethical implications of decisions we make in our professional and private lives. This awareness, in part, is due to the serious consequences of some decisions that have led to loss of life, not to mention loss of credibility. The public has witnessed disasters such as Chernobyl, Bhopal, the Challenger, and the more recent Firestone/Ford catastrophe. The profession has responded with training in ethics in as well as guidelines or codes of ethical conduct in many professions, such as the National Professional Society of Engineers (NSPE) Code of Ethics.

The recent mandate by ABET to make ethics fundamental in engineering education points to the understanding of educators that, inevitably, students will one day face ethical dilemmas as professional engineers. Engineering students must engage with questions of ethics early in their education so that ethical concepts become part their thinking and development. In the

Foundation Coalition Freshman Integrated Program in Engineering at Arizona State University (FIPE), we believe that ethics must be integrated vertically into the curriculum in the first year of the student's career. Therefore, with different assignments, we integrate ethics into our English and engineering classes. In the freshman English class, we introduce our students in their first semester to the ancient rhetors' concept of values to establish a foundation to explore specific engineering codes of ethics and decision-making tools employed in engineering. Then, by analyzing various engineering case histories, students discover for themselves that they must consider their own values in relation to the professional codes that attempt to regulate ethical behavior and decisions.

A Background: Ancient Rhetors' Concept of Ethics and Values

In ancient Athens and Rome, rhetors, statesmen and teachers who intended to affect community thinking, encouraged citizens to make decisions and resolve disputes with rhetoric to choose the best course of action. Today we often think of rhetoric as empty words or language used to distort the truth. However, for a rhetor such as Aristotle or Cicero, rhetoric was the power of finding the available arguments best suited to a given situation. With rhetoric, these ancients set out to persuade the audience to consider their beliefs by choice and not coercion and possibly to cooperate in achieving a shared goal. To direct citizens in their choices and decisions, Aristotle listed shared common values as goodness, justice, honor, and expediency and called on citizens to judge matters according to these values. Further, Aristotle promoted the usefulness of rhetoric to uphold truth and justice.¹

Because early rhetors understood that even ordinary citizens would face situations in which they must make judgments and decisions, they encouraged these citizens to weigh their values carefully and to base their judgments on internal codes of behavior. For example, Cicero urged rhetors to examine their "merits of worth or virtue of some kind, particularly generosity, sense of duty, justices, and good faith."² Quintilian asserted the "the whole conduct of life is based on the desire of doing ourselves that which we approve in others."³ Translator James J. Murphy points out that Quintilian's focus was for rhetoric to be "merely a tool of the broadly educated citizen who is capable of analysis, reflection, and then powerful action in public affairs."⁴ The clear implication of these early rhetors is that citizens need a strong moral sense if they are to improve society.

The ancients also recognized that values and moral judgment were not to be compartmentalized and employed only in certain situations but, rather, were to be a part of one's thinking, development, and character. Quintilian, for example, was convinced that a person could not be a good orator unless he was a good man, and he asserted that the two are inseparable.⁵ His emphasis on the "good man speaking well" was the foundation for training in both speaking and character building in public schools in his day. This combination of technical and ethical training in ancient times played a significant role in helping citizens determine rightness and justice in situations of dispute and promoted Aristotle's view of rhetoric as "the faculty of seeing in any situation the available means of persuasion."⁶

The modern study of the early rhetors is not a mere antiquarian exercise but is rather a significant review that provides contemporary students with decision-making strategies that lead to better choices and judgments. However, it is important to point out that these rhetoricians did not promote their own personal beliefs of morality; rather, they called on their students to make their own moral judgments based on the a shared standard of virtue with shared public values. They believed that with this direction, orators would make decisions that promoted the interests of the public good.

Making Connections between Values and Decisions

The conflicts arising from poor ethical decisions such as the recent Firestone/Ford tragedy reflect the need today for engineering students to squarely face questions of ethical behaviors and attitudes as they consider what is best for their companies and, even more importantly, what is best for society. The costs of unethical actions may be high: the loss of personal or company reputation, litigation, and, most importantly, loss of life. Societies such as the National Society for Professional Engineers (NSPE) provide guidance for ethical behavior in the forms of specific codes of conduct, which try to aid members of the profession to behave in an ethical and competent manner. The fundamental canons of NSPE Code of Ethics are representative of the major components in most engineering codes of conducts. These canons call for the engineer

- to hold paramount the safety, health, and welfare of the public,
- to perform services only in their areas of competence,
- to be objective and truthful,
- to be loyal to employers or clients,
- to avoid deceptive acts, and
- to be honorable, responsible, ethical, and lawful.⁷

Inherent in these principles are the shared public virtues of goodness, justice, honor, and expediency that Aristotle recognized. Also acknowledged today, these shared values encourage engineers to work with similar standards. However, just as Cicero and Quintilian recognized, behavior and attitudes cannot be a directive if individuals do not connect these virtues to their internal codes of ethics. What individual engineers value has a direct bearing on the decisions they make, whether they be decisions for the public good or for personal interests, and dilemmas arise because of these conflicting desires. Engineers might wrestle with their own values when they are asked to perform tasks that they think are dishonest or not in the public's best interest. Further, legal liability often supersedes moral responsibility, making decisions even more difficult.

When we ask engineering students to consider the values that drive their own individual decisions, behavior, and attitudes, we ensure that these prospective engineers understand that ethical considerations must not be divorced from their lives as students or as professionals. Engineer and author Samuel C. Florman recognizes this with his disquieting question to those in the profession: "To what avail are noble intentions, and even exemplary legislation, if we lack the strength of will to turn words into reality?"⁸ Engineers who are asked to examine their own personal values will find it much less disconcerting to make decisions and take stronger stands about ethical issues when they see the connection between legislated codes of conduct and behavior, such as the NSPE Code of Ethics, and their own values. Further, these prospective

engineers, who might one day be owners, managers, and supervisors of engineering companies, need to recognize that decisions and choices they make in their administrative roles directly affect other lives than their own. These future engineers must struggle with conflicting desires of financial growth, enhanced reputation, social progress, and employee satisfaction in their choices of projects for their companies.

Making ethical decisions is difficult for anyone in our present face-paced, competitive world; however, the stakes are sometimes even higher for those in the engineering profession because of the tremendous effects on human life. Therefore, before these engineers are embroiled in tough choices and decisions in their professional lives, we must encourage them to discover the values that drive their decisions and how these relate to the professional codes that legislate their behavior and actions. Paul Dombrowski, Chair of the Ethics Committee of the Association of Teachers of Technical Writing, calls for professionals to clarify their own values before the time comes for making decisions. However, Dombrowski does not suggest an absolutist stance with one course of action, nor does he suggest a relativist stance in which there are equally valid and ethical actions that leave no basis or grounds for decisions. Instead, he asserts, "Since ethics involves decision and action, we assume that you will do something in a given case; [however,] you cannot do everything and cannot do nothing. What we ask of you is that you try to make clear to yourself as best you can, and express and explain to others, what that something is."⁹

Application: Assignments That Make Connections

To help engineering students understand how codes of behavior such as the NSPE code can help them in the professional lives, we ask first-semester students in the FIPE program to connect their own values to the NSPE Code. In the third assignment of the first semester we require students to take on the role of a presenter in the student division of the Institute of Electrical and Electronics Engineers, Inc. (IEEE). In this simulated rhetorical situation, students write to an audience of fellow students, professional engineers, and educators in the engineering field at an IEEE convention that is focused specifically on ethics in engineering. In this assignment, students research an engineering product that failed to explain what values lay at the heart of a decision that was made in the case history. To discover this, we ask students to consider the values of engineers and how these values might differ from other people in the organization in which the engineers work. Further, we ask students to examine how the engineers' values might be affected by the NSPE Code of Ethics by exploring how and why this product failed suggesting which engineering ethics were ignored or adhered to in the case history.

We prepare students for this assignment by asking them to work through a series of readings and written exercises. These exercises, which rhetors would call heuristics, form a set of systematic questions designed to generate ideas about this topic. We begin with work on what values they hold as individuals and we compare that to values they hold as Americans, using the ancient rhetors' definition of values as honor, justice, goodness, and expediency. Then, we ask students to consider if their values differ from our values as teachers and whether they think values have changed over time. These activities are outlined below:

Group Activity #1:

1. Make a list of values that you hold and be ready to report out.
2. Next, write down the values that you think influence our program. Consider the values of professors of the program as well as those of our sponsor, National Science Foundation.
3. Report out. (15 minutes).

Group Activity #2:

1. Write a list of the values that you think engineers as a group might hold. Then discuss the following possible scenario and answer the questions.
 - You work for a small engineering firm that is struggling to compete with the larger, more established engineering firms. Your supervisor has assigned you the job of preparing a proposal for a large company. You know that this company will award its contract to a firm with sufficient experience. The owner of your company has told you to “pad” the proposal, misleading the large company into thinking that your company has more experience with developing this product than it actually has. He has even asked you to exaggerate the number of engineers employed. You know that to go against what you’ve been told to do goes against your value system. What are some consequences of following your boss’ demands? What could possibly result from not doing what he’s asked you to do?. Report out. (10 minutes)

Reflective Journal Entry:

Identify the values that individuals in your team have and speculate how these values affect the performance of your team (don’t name specific names).

Heuristics:

After these initial exercises, the students read about the NSPE code in their engineering textbook, *Engineering by Design* by G.Voland and complete the following heuristics:¹⁰

1. Skim through the case histories in *Engineering by Design* and based on this, make a list of possible case histories you could use for this assignment. Then add to your list by searching for ethical dilemmas in engineering on the Internet and asking your engineering professor to add to your list. (We keep an ongoing list on one of the large whiteboards in the classroom and ask all the teachers in the FIPE program to add to this).
2. Narrow your list to three possible cases and find at least two sources for each case beyond the Voland textbook that would help you with this assignment. Print each source. You will have a total of 6 sources. Reread the assignment sheet to remind yourself of the goals and constraints for this assignment. Write a paragraph explaining which topic you have chosen to pursue for this assignment and why. Explain why you have discarded your other two topics.
3. Now find at least four more sources. Of these, three should be articles from either print or e-journals. Summarize each of your six sources (two from Heuristic 2) you have now gathered that deal with your case. Then write a paragraph in which you discuss the differences you have found in your sources.

4. Read through the NSPE Code of Ethics for Engineers and the notes you made in class about their underlying values. What values were not adhered to or were overlooked in your case history? What evidence do you have that would prove these values were not adhered to or were overlooked? What other values affected your case history? What evidence do you have to prove that these were the dominant values?
5. List the events and decisions in your case history, noting where your sources differ as to what happened. Now write a narrative based on this in your own words describing the case history.

After the students have completed these heuristics, they are ready to write their article. The goals for this assignment correlate to some of the goals and objectives we set for the semester: writing to a specific audience with a specific purpose, conducting research to find a balanced group of sources, and making connections between engineering and English. Therefore, to write a successful paper, students must demonstrate an understanding of the code of ethics and the values upon which those are based and how those ethics are affected by others' values. Further, students must write a narrative of the events of the products' failure as well as an analysis of connections between the values held by those who developed and produced the product and the NSPE Code of Ethics. To effectively inform the audience who may not be familiar with the code or the product, students must explain the code in their own words and provide sufficient background of the case history, considering ways to make the paper as vivid and interesting as possible.

We have found that for this assignment to be successful, we must provide sufficient background for students, and so we examine the classical rhetoricians' concepts of values with Aristotle's view of shared public virtues of goodness, justice, honor, and expedience. We connect these values with the underlying principles in the fundamental canons of the NSPE Code of Ethics. Then, to discover their own values and what drives their own decisions, we spend class time working through several scenarios to see how what they value as students drives decisions in their personal lives.

Only when they have this background are students ready to research a specific case history and discover for themselves how values lead to good or poor decisions. For instance, some students chose to write about the case history of the Ford Pinto, an engineering disaster in which ethics played a significant role. Students discovered that decision-makers valued expediency (in this case time and money) more than they valued the public's safety. These and other case histories helped students to make connections and understand that values drive our decisions. They also discovered that although ethics are legislated by certain codes, the values of those involved may drive the decisions made, so that self-interest may supersede safety.

Assessment

Of course, this assignment does present teachers with a dilemma when we assess the work. How do we assess a student who clearly does not share the same values we hold? Do we grade down a response because the student does not conclude that Company X failed to uphold the NSPE code of ethics as we would have concluded? Are we in danger of trying to legislate values

through our grading system? Clearly, as teachers, we must be cognizant that these dilemmas might arise.

As English teachers, we must often have students write about topics we ourselves feel strongly. We could avoid these topics because of our own biases – an honest response, and, perhaps, better than pretending that as teachers we take neutral stands and have no biases. We could also insist that students must draw the “politically correct” conclusions that we might draw. However, these responses do not challenge students to think critically or to make connections to ethical decisions they must make as individuals, students, and future engineers. Instead, we believe that our best approach is to remind our students of their own roles as rhetors. Therefore, we evaluate students’ work by the reasonableness of what they argue and the evidence they present, and our judgements are facilitated by working closely with the engineering professor.

Demonstrating Outcomes

How do we demonstrate to ABET that this assignment helps our students achieve the appropriate outcome? At the end of the first semester, we ask students to write a reflective letter in which they consider how concepts they have learned in engineering and English integrate with each other and how they might apply to life beyond that of an engineering student in the university. We encourage them to reflect not only on the subject of values and ethics, but also connect these concepts to working in teams. This final assignment gives us a written record of how the students have internalized these concepts. Then when the engineering professor sets more complex design projects in the second semester, he is able to ask students to address values and ethical considerations in their designs.

Conclusion

Throughout our professional and private lives as professionals, we must all continually face situations in which we must question the right course of action. In some situations, our judgment may not be as quick or sure because of the serious consequences that might occur as a result of our decisions. Other complex situations may threaten to violate our own personal values of rightness, justice, or honesty. Often, we do not have the time to allay our qualms but are forced to act decisively and quickly. Engineers, in particular, are required to make immediate decisions that could jeopardize the success of the company or, more importantly, the safety and welfare of the public. Therefore, prospective engineers must be taught early on to consider the ethical bases of their own decisions and the decisions of others. Including ethics in our instruction might not ensure an easy process of decision-making, but it will lead students to less impulsive and unconsidered judgments that have might have far-reaching effects on society.

Bibliography

- 1 Crowley, Sharon & Hawhee Dawn, *Ancient Rhetorics for Contemporary Students*. Allyn & Bacon, Boston: (1999): p. 85.
- 2 Cicero, *On the Parts of Orator*, translated by H. Rackham. Loeb Classical Library, Cambridge, Harvard UP: (1982) p. 28.
- 3 Quintilian, *On the Teaching of Speaking and Writing Translations from Books One, Two, and Ten of the Institutio Oratoria*, translated by James J. Murphy. Carbondale, Southern Illinois UP: (1987), p. 28.

- 4 Quintilian, *On the Teaching of Speaking and Writing Translations from Books One, Two, and Ten of the Institutio Oratoria*, translated by James J. Murphy. Carbondale, Southern Illinois UP: (1987), p. xxvii.
- 5 Quintilian, *On the Teaching of Speaking and Writing Translations from Books One, Two, and Ten of the Institutio Oratoria*, translated by James J. Murphy. Carbondale, Southern Illinois UP: (1987), p. 19.
- 6 Murphy, James J, *A Synoptic History of Classical Rhetoric*. Davis, Hermagoras: (1983) p. 23.
- 7 Voland, Gerald, *Engineering by Design*. Addison Wesley, Reading, MA: (1999), p. 511.
- 8 Florman, Samuel, *The Introspective Engineer*. St. Martins, New York: (1996) p. 162.
- 9 Dombrowski, Paul. *Ethics in Technical Communication*. Allyn & Bacon, Boston: (2000) p. xi.
- ¹⁰ Voland, Gerald, *Engineering by Design*. Addison Wesley, Reading, MA: (1999).

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