Integrating Ethics in Engineering Education Utilizing a Psychological Model

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Introduction

As the engineering profession has become progressively more complex, ethics has become an increasingly important issue. Engineers must sometimes make significant decisions that are often based upon what appears to be what they believe to be morally correct and what appears to be best for their employers or themselves. Engineering education, however, does not always sufficiently prepare students for the ethical conflicts that face them when they join the workforce. Consequently, engineering educators have been challenged with the difficult task of preparing professionals who are technically competent and ethically aware, one of the first steps in ethics education.¹

The need to integrate ethics into an engineering curriculum is well documented. The Accreditation Board for Engineering and Technology (ABET) has incorporated “an understanding of professional and ethical responsibility” as part of the general criteria for evaluating undergraduate engineering curriculum.² The ASEE website also states that “because engineering has a large and growing impact on society, engineers must be equipped by their education to fulfill their ethical obligations to the public at large, to their profession, and to their clients and employers.”³ This has led to great diversity in how institutions approach the task of teaching ethics to undergraduate engineering students.⁴,⁵,⁶ Some curriculums require general ethics courses from philosophical or religious perspectives; others integrate ethics in existing engineering courses. While there is a standard focus and content for engineering courses (e.g., thermodynamics and hydrology) there is no standard curriculum for an engineering ethics course and it is often quite difficult for engineering educators who are focused on course content.

The purpose of this paper and presentation is to propose a method that is pedagogically based on Kohlberg’s stage theory of moral development⁷ that can implement the integration of ethics in engineering education and to provide a model with specific examples that may be used as a guide within the curriculum of those educators committed to integrating ethics in engineering education. Kohlberg’s theory has produced a great deal of empirical research on student’s moral development and demonstrates that people progress in their moral reasoning, which is the basis for ethical behavior, through a series of stages. These stages are germane to understanding the professional moral development of engineers.⁸ Because most engineering faculty are unaware of the theory and/or how to implement it into an engineering course or curriculum, this paper and presentation will briefly discuss the theory in general and focus on steps to facilitate the integration of the theory in the classroom.
Kohlberg’s Theory of Moral Development

Lawrence Kohlberg, who began his career as a developmental psychologist at Harvard University, developed his stages of moral development through research studies that he conducted. Grounded in Jean Piaget’s research on cognitive and moral development, Kohlberg’s theory demonstrated that these kinds of development occur in a progressive fashion. That is, people progress in their moral reasoning through a series of identifiable and hierarchical stages that can be generally classified into three levels. He maintains that these stages are not the products of socialization or maturation but emerge from one’s own thinking about moral problems. The stage changes specifically occur as a result of role-taking opportunities that give individuals the opportunity to consider other viewpoints and perspectives. Furthermore the stages are qualitatively different ways of thinking, are structured wholes (general patterns of thought), progress in an invariant sequence (no skipping of stages), and are cross-cultural universals (the same in all cultures).

Kohlberg developed his theory by using a series of hypothetical dilemmas. Individuals could respond to the dilemmas with “yes” or “no.” Kohlberg, however, was not interested in the response but in the reason given for the decision. After classifying the various responses he was able to create his stage definitions and a scoring system for his theory. Kohlberg created three levels, each of which contains two stages. The levels provide clarity to the stages.

Kohlberg’s Level 1, labeled “Preconventional,” is a level of moral thinking at which people behave according to their own desires and needs. In Stage 1 (“Obedience and Punishment”) the individual strives to avoid punishment by being obedient. In Stage 2 (“Individualism, Instrumentalism, and Exchange”) the individual promotes his/her self-interests by making deals. Level II, labeled “Conventional” is a level that reflects moral thinking generally found in one’s society, group, and family. Stage 3 (“Mutual Interpersonal Expectations, Relationships, and Conformity”) is differentiated by the concern that people should live up the expectations of community and family. That is to say, that individuals should be “good” in order to gain the approval of others. Stage 4 (“Social System and Conscience Maintenance”) is characterized by the individual’s concern with law and order for the good of society as a whole. Level III, labeled “Postconventional,” is a level that reflects moral thinking generally found in society at large and has an age requirement of late 20s. Stage 5 (“Social Contract and Individual Rights”) recognizes principles and values that emphasize basic rights and the democratic process. Stage 6 (“Universal Ethical Principles”), a stage that most adults never attain, is based upon respect for universal principles and the demands of individual conscience.

A Model and Its Implementation

Reimer, Paolitto and Hersh proposed a general model for educators that may be used as a guide for engineering educators committed to integrating ethics in engineering education. The model stimulates a specific process, but doesn’t necessarily create specialists in the subject area.
of ethics. The key to the model lies in the faculty role. It is imperative that they first reexamine their teaching role by helping students to experience cognitive conflict and take a social perspective. This may be accomplished in the following fashion.

1. Know where your students are developmentally: The faculty should understand or attempt to understand the different developmental characteristics/stages present in their students. This is especially important since the average age of students in higher education has increased significantly and within any given engineering classroom one can have students in most of the stages. This can be accomplished in a variety of ways.

Moral reasoning can be assessed with an instrument, the Defining Issue Test (DIT)\(^\text{12}\) that measures how people reason morally about social problems. It is a multiple-choice, objective, and self-administered test derived from Kohlberg’s theory. It has been extensively tested and is reliable (Cronbach’s alpha in the upper .70s/low .80s with test/retest about the same). It consists of vignettes followed by multiple-choice questions addressing recommended action and prioritization of items. Many campus-testing centers have access to the DIT and will administer it, reporting the results and scores to the individuals. Students are usually quite willing to share their results with the faculty and fellow classmates.

If the DIT is not available there are a variety of real and hypothetical ethical dilemmas online (e.g., Kohlberg Dilemmas found at http://www.haverford.edu/psych/ddavis/p109g/kohlberg.dilemmas.html) that can be used. These provide the dilemmas and questions to which students would respond and from the responses, one could approximate their moral stages. This may be completed as a take-home or in-class assignment. Faculty can also approximate moral stages by the students’ analysis of short web-based cases studies or daily newspaper articles that address dilemmas that face engineers.

2. Facilitate moral growth: Faculty must understand and create cognitive conflict to challenge the perspective-taking abilities of students. This will promote moral growth. The use of dialogues and role-playing activities may facilitate this. Discussion is a key element. It can be promoted in-class through real and hypothetical questions posed as information is presented or through questions from the reading assignments. In addition, faculty can use online discussion boards to prod students to discuss these dilemmas. Assigned readings such as “Would you sell a computer to Hitler?”\(^\text{13}\) also work well as a basis for discussion and having students play different roles, such as the owner or CEO of an engineering company, an employee, etc.

3. Develop awareness of moral issues: Faculty should develop the students’ awareness of moral issues by providing a variety of ethical dilemmas (hypothetical and real). In addition, there must be frequent opportunities for discussion of ethical issues in the classroom and online. Newspapers, journals, and cartoons provide a plethora of material that can be brought into any engineering course.
4. Develop questioning strategies: Faculty should develop questioning strategies starting with the introduction of open-ended discussions and going on to in-depth techniques. This may be facilitated by highlighting moral issues, asking questions, introducing more complicated circumstances, using personal and naturalistic examples, alternating real and hypothetical moral problems, and refining probing questions. Given that most engineering educators are also involved in real-world activities (e.g., consulting work, advisory positions in engineering firms, etc.), they have at hand an enormous amount of knowledge that can be directed into questions to promote higher-level thinking. In fact, by providing students with simple to complex questions regarding individual dilemmas, readings, and cartoons, the faculty creates a non-threatening atmosphere for perspective taking. This may also be enhanced by requiring students to respond on the discussion boards to fellow classmate’s posting by critiquing them, questioning them, and providing suggestions and alternatives.

5. Create a good class atmosphere: The class atmosphere is critical for good discussions that will promote moral growth. A conducive environment may be created by planning the physical arrangement of the classroom, organizing effective groupings, modeling acceptance, fostering listening and communication, and encouraging student-to-student interaction. From the first meeting with the students, the faculty must create a setting in which it is safe and acceptable to discuss sensitive issues and to disagree with one another. Positioning the standards and expectations of respect in the beginning of the term fosters good discussion, both in the classroom and online. Many courses include group projects or group activities; faculty should think about the arrangement of the room as well as the individual group participants. By manipulating group membership to include students who are in several different Kohlberg stages, the faculty can create effective group dynamics that, in turn, would stimulate growth.

Requiring follow-up discussion among students on-line promotes communication and encourages student-to-student interaction. It is also important that the faculty responds to each individual student privately, preferable via email, regarding the posting(s)/discussion. It is here that the faculty may continue to question the student with more complicated questions that would promote cognitive and moral growth. It is important to note, that in order to be successful, the faculty must reward the student, even minimally, for participating in the online discussions with the assignment of points that will be used in the determination of the final course grade. It is beneficial, too, after the online assignment is completed to spend a few minutes in the classroom to talk about the postings and discussion in general.

6. Anticipate difficulties: It’s a given that there will be difficulties. These may manifest themselves in terms of peer pressure, problems in examining authority roles, effects of cognitive conflict in students, limitations of verbal abilities, and acceptance of occasional failures. In effect, this means that faculty must shift from the position of “sage on the stage” to “guide on the side.” In so doing, the faculty will have a better understanding of the group dynamics within the classroom and would be better positioned to address the difficulties.

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Additional Tools

There are additional tools available to help implement this model. These include but are not limited to the abundance of case studies that contain real and hypothetical examples of dilemmas faced by engineers and which are available on the web. Examples of web-based case studies include, but are not limited to: The Online Ethics Center for Engineering and Science at Case Western University (http://onlineethics.org/); Texas A&M University (http://ethics.tamu.edu/Nsfcases/); Environmental and Sustainable Development Cases (http://www4.ncsu.edu/~jherkert/envsdcases.html); National Institute for Engineering Ethics (http://www.niee.org/cases/index.htm); Computing Cases (http://computingcases.org); Texas Tech University (http://www.coe.ttu.edu/ethics/ethics.htm); and University of Virginia (http://reorant.tcc.virginia.edu/ethics/index.htm).

Conclusion

Engineering education does not sufficiently prepare students for ethical conflicts facing them when they join the workforce. Engineering educators must assume a leadership role in preparing undergraduate engineering students for success upon graduation. The preparation goes beyond the technical skills within the programs. Preparation for success must include a respect for the laws and standards determined to govern behavior, the ability to engage in decision-making and moral reasoning (especially when conflicts in values and interests are involved), and the moral motivation and self-control to engage in ethical behavior.  

An extremely difficult challenge presented to engineering faculty is the integration of ethics in today’s crowded engineering curriculum. While the profession is concerned with the importance of ethics in engineering, there is a lack of training in this area. This may be resolved by educating engineering educators in the ethical arena by providing faculty training in the areas of Kohlberg’s theory and Reimer’s model as well as in the utilization of existing material in multiple courses. Engineering faculty will better prepare students for the professional as well as ethical responsibilities facing them upon graduate by incorporating this pedagogy in multiple existing content area courses throughout the degree program.

References


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