

AC 2009-898: A MODEL FOR INTEGRATING ETHICS INTO AN ENGINEERING CURRICULUM

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Abstract

Ethics education is currently of major concern in higher education and in engineering in particular. There are many reasons for this, such as the seeming increase of cheating and plagiarism among students. Simultaneously, the level of trust in public and private institutions, in terms of the honesty and integrity of those in leadership, is dwindling. For engineers, whose occupation allows them potential for positive or negative societal impacts, it is critical that their decisions involve sound ethical judgment. Despite this obvious need, the amount of time given to ethics in an engineering curriculum is minimal. With all the knowledge and skills needed in engineering, it seems as if there is neither time nor space to teach ethics.

Consequently, the results are predictable. During a recent meeting of engineering students, the students were asked what kinds of ethical questions they encountered at work or in their studies. The majority indicated they had never encountered any ethical issues at all. When questioned further, it was clear that they considered ethics merely a “set of rules” – do’s and don’ts for specific situations. If they encounter no situation precisely described by these rules, then no ethical issue existed.

Ethics, however, is not a “set of rules”. Ethics is an inquiry into how to create a good life. Thus, ethics is a necessary part of every human decision.

How can we convey the importance of ethics to our students?

Our approach is based upon a problem involving communication skills. The ability to communicate effectively is fundamental and has also been deteriorating among undergraduates. In response, Drexel University instituted a Writing Intensive (WI) program, by which all undergraduates are required to take at least three WI classes for graduation. These classes are a standard part of their curricula but contain specific writing components. Specially trained student-tutors work with their fellows to ensure writing skills are being developed.

We propose a similar idea with ethics education.

The critical part of our program is a three-phase tutor-training program for upper division and graduate students. In Phase I, students are introduced to the major ethical philosophies by instructors playing the leading thinkers of those traditions. For example, an instructor might play Socrates or Confucius or Augustine or Kant, thus providing a more personal introduction to each philosophy. In Phase II, students are given a set of ethical issues and

asked to address those issues as these philosophers might have done. For each issue, a student would use one person's perspective, thinking as Aristotle about one issue and as Buddha about another. In Phase III, each student would write a paper for submission to a professional journal or conference.

Once trained, tutors would be assigned as ethics consultants to undergraduate engineering design teams. At Drexel, there are freshman and senior design projects. The tutors would work with those teams on matters of ethical concern. Eventually, we hope to expand this program to other disciplines within the curriculum.

Introduction

Recently, a student organization at my university, Drexel University in Philadelphia, sponsored a movie night. The movie was *The Island*, a 2005 film about a group of individuals who are maintained on an island as living spare body parts for the original individuals from whom they were derived. The film centers around selected individuals on the island who discover their actual purpose and identities and the conflicts this raises between the world of the island and the world outside. I (DLM) was asked to lead a discussion on the film and, sensing the opportunity for a broad consideration of ethical and moral issues, asked the mixed graduate and undergraduate audience the following question: Who has encountered an ethical issue of any kind either at work or on campus? To my stunned amazement, no hands when up. Not a single student indicated that they had encountered any ethical questions of any kind. When I pressed the matter – Drexel incorporates a co-operative education program in its engineering degree, so I knew students had been out in industry – one student spoke up and stated that he did not seek out any ethical situations at work since he felt that to do so would cost him his position. His attitude was mildly incredulous that the question could even be asked, indicating that it was unreasonable for anyone to expect them (the students) to take a stand contrary to that of their employer. Like Saul on the road to Damascus, this event changed my attitude towards the teaching of ethics and morality as part of engineering education. I had always known that more could be done to bring ethics into engineering education but I had no idea how little students understood about ethical behavior and worse, how little they seem to think about it.

This is hardly an isolated incident. Slobogen¹ reported one student interviewed as stating that ‘honor is a passé thing – no one really believes in it any more’. Thompson² reported that many students engaging in plagiarism do not consider such behavior as unethical and Zernike³ reported in the New York Time article student survey results indicating that 27% falsifying laboratory results happened ‘often or very often’, 41% engaged in plagiarism, 30% cheated on examinations and 60% collaborated on assignments when their instructor specifically indicated that they should work alone. In a recent presentation Harding and colleagues⁴ reported that up to 96% of students surveyed indicated they had cheated at some point in their academic careers. Honor does indeed seem to have become passé.

If this is a common experience among educators, it is their responsibility to reverse this trend. The foundation of any free society is based upon the ethical behavior of the majority of its members. If the situation arises when that majority no longer operates in a morally appropriate manner, there are only two logical alternatives – anarchy or tyranny. Freedom simply cannot survive without a common set of basic values and an ethical system to which individual

community members can commit. One recognition of this is the ABET student learning outcome ‘an understanding of professional and ethical responsibility’. However, there is a world of difference between stating a student learning outcome and actually achieving it. In this paper, we propose a possible method by which this outcome could be attained

Definitions and Propositions

Defining ethics and morality as terms is always a difficult proposition since there is no consensus definition. However, it is important to have definitions all the same to ensure that when the terms are used, the context is readily understood. For the purposes of this paper, we will define morality as the determination of right and wrong behavior while ethics is the process by which morals are synthesized into a coherent system. Furthermore, we adopt three primary propositions:

1. Morality is intimately involved with everyday experiences;
2. Morality and Ethics can, and should be taught;
3. Moral reflection is an important daily occurrence – Socrates

The first proposition is in responses to students (and faculty, administrators, staff, etc.) who consider their daily activities to be outside the range of activities to which moral judgments should be applied. This is what allows students to excuse plagiarism – it is a common activity to which such esoteric philosophical musings as considerations of morality need not apply. Let us provide two examples to illustrate how such beliefs allow the justification of behavior which under other circumstances would never be tolerated.

Some years ago, one of the authors was visiting a local medical school where the daughter of a colleague worked in the graphics department. As the author stood watching, the young woman began to darken selected lines on a DNA gel prior to taking a photograph of the gel to be included in a manuscript for submission to a professional medical journal. The author was surprised and mentioned to the girl that this was ethically questionable, tantamount to scientific fraud. The young woman’s reply was instructive. No, it could not be fraud, she replied, because no one was changing the actual numbers or statistics – she was just making the pictures look better. When the author inquired further about how many research medical faculty made use of this ‘improvement’ technique for their gels, the answer was also quite enlightening. ‘All of them’ came the reply.

Upon reflection, we hope that the reader understands that this alteration of the gels was highly suspect ethically. Individuals use vision as their primary data collection devices and visual impressions can outweigh statistical analyses in a scientist’s mind as he or she reads a paper. A marginally statistically significant result becomes far more convincing in the light of clear differences ascertained through visual inspection of results, especially if the scientist reader is unaware that the results were selectively altered to produce just such a result.

A more prosaic result can be culled from the driving habits of American commuters. How many of you reading this paper have engaged in the practice of ‘tail-gating’, driving less than a 2 second distance of the vehicle in front of you at high speed? How many of you consider this an act of terrorism? Far fewer, we imagine, than have engaged in the practice itself.

However, consider the act and its repercussions. By tail-gating, you are attempting to inspire fear in the driver in front of you in order to obtain a behavioral change – they should either speed up or get out of your way. If they do not do this immediately, you continue to tail-gate as an act of intentional aggression. You threaten the lives of those in the vehicle in front of you – regardless of their age or gender. In fact, it is almost analogous to the action of a suicide bomber since you not only threaten the lives of those in front of you with a fiery and explosive death, you take the same risk with both your passengers and yourself. And the pay-off that justifies this heinous activity? You potentially gain between 1 and 1.5 seconds of time towards your destination.

I (DLM) have used this description to discuss daily applications of moral judgment and I recall one student's response. She was upset that her actions were being called into moral question. 'But what if the driver in front of you is really slow?', she asked. My response was to ask her if slow driving was a justification for murder. I hope that she will continue to think about this – many of my students have told me that these discussions have made them think more explicitly about the implications of their driving habits.

This brings us to the second point – morality and ethics can and should be taught. In the current pluralistic American society, there is a natural and reasonable reluctance to teach specific aspects of moral behavior. Unless one accepts that there are universal moral principles applicable to all ethical systems, the teaching of one set of principles will necessarily place others at a cognitive disadvantage. Who is to choose which set of principles is correct and which are not? This seems to be a bit too great a philosophical burden to place upon the engineering faculty. If your college or university is affiliated with a religion or specific religious or philosophical point of view, then that can justify instruction in ethical approaches associated with that point of view. Institutions who try and serve a very diverse student population do not have that luxury and may feel inhibited from any significant instruction in ethical thinking. Later on in this paper, we will show a method we believe will teach ethical thinking without enforcing a specific set of beliefs. However, for now it is enough to state that we can no longer afford to avoid the problem altogether. We are witnesses to results of that educational oversight and those results do not bode well for the future.

Finally, our third proposition is that moral reflection should be undertaken on a daily basis. In a sense, this reflects a more general physiological principle 'use it or lose it'. While this terminology lacks the punch of the word *homeostasis*, the associated activities are as fundamental to organisms as those related to the more familiar internal maintenance systems. Most of you are familiar with the observation that lack of physical exercise makes physical activity more difficult while a consistent level of exercise seems to have the opposite effect. Such physical manifestations of the use it or lose it principle are significant problems for manned space flight, involving bone loss, muscle atrophy and changes in vestibular function to name a few. Given that mental activity flows from brain activity and brains are physiological systems subject to the same principles, it should not be surprising that the mental exercise of thinking and reflecting promotes future mental activity⁵. Moral exercise is just as important as physical exercise in maintaining a productive member of any society.

Teaching Ethics and Morality

In teaching, while there are many ways to present ethics and ethical content to students, perhaps the most important distinction that can be made—and has been made since Plato and Aristotle—is that between *diegesis* and *mimesis*. *Diegesis* is to tell—to tell the story, to tell the truth, to tell the class the relevant information, but *mimesis* is to show. It means to show the audience what happened, to show the judge the truth, and to show the class how to embody or to perform the relevant ethical actions.

Much money and time in education is spent on the telling of ethics, the re-hashing of over-used scenarios and case studies, and the listing of codes of ethics. None of these approaches actually engages the student in the process of acting (or behaving) ethically. Whereas *mimesis*, the demand that the student copy and thus enact the ethical practice of someone, requires the student to literally go through the motions of acting ethically. It is, in a sense, a kind of rehearsal for a possible future event: the need to make a decision regarding the ethics of an event or a policy. Whether we are talking of a medieval or a modern morality play, a dancer practicing and practicing again the steps shown by the choreographer, or the student surgeon practicing on a cadaver the same moves shown by the instructor, we are talking about education by means of *mimesis*, wherein the subject to be learned is presented by a living and practicing human being (the choreographer, the surgeon) and the student's actual apprehension of this learning is revealed in the success of their imitation of their teacher.

Ethics—not as a topic of comparative or historical study—but as an intelligent, living, and evolving human practice cannot be taught by rote or by representation. It cannot be told. It must be shown—it must be a lived experience. To act ethically is a kind of practice; it is not a kind of knowledge. A person can know every point of their discipline's or industry's codes and still not put them into practice. To be able to put ethics into practice can only be learned by watching how someone else does it. And this is why *mimesis*—or learning via imitation—is the only way for a student to “get a feel” for ethics.

However, to “understand” the practice of ethics, and its importance and its difficulties, can only be learned, not by imitation, but by being the person being imitated—by becoming the role model, the paragon, the teacher. By teaching, and observing the outcomes of their teaching, students can increase their confidence in and autonomy about making their own ethical decisions. A sense of confidence and autonomy are the first steps on the road to taking ethical responsibility for something, and it is this avoidance of personal responsibility and its concomitant refusal to make difficult decisions that gets so many people into the kinds of scandals we see today. More importantly, to be able to say without embarrassment, “I don't know, but I do know where we might find some ideas,” is liberating to both student and teacher as well as to anyone faced with an ethical dilemma who feels they simply do not have enough information at hand.

Role-Playing as an Educational Tool

The term “role playing” was originally coined in the 1920s by Jacob L. Moreno, a Viennese psychiatrist who believed that his psychologically disturbed patients improved more

from exploring their problems “by acting them out “ than by talking about them. Moreno first tested out his ideas by forming the “*Theatre of Spontaneity Acting Company*” in 1921 and two years later publishing his theories in a book of the same name. Subsequently, *role playing* became popular in business and educational institutions as an experiential learning approach. Role playing methods are situated in the context of popular drama related learning approaches such as psychodrama and sociodrama.. An individual, for example, employs guided dramatic action to examine problems or issues (psychodrama) or a group does the same (sociodrama). Using experiential methods, such as sociometry, role theory, and group dynamics, drama facilitates insight, personal growth, and integration on cognitive, affective, and behavioral levels. It clarifies issues, increases physical and emotional well-being, enhances learning and develops new skills.

Role playing was modeled after theater and includes many terminological counterparts. The protagonists are the participants who improvise their actions within a situation normally simulated about them. It is their life or abilities, their roles that are being examined or tested. The auxiliary egos are anyone else who performs to place the protagonists within the situation. The audience is any onlooker who may provide feedback. The stage is wherever the practice is performed or perhaps fictionally set. The director is the expert who guides the exercise, this can be a therapist, instructor, trainer, coach, or, within role-playing games, a game master.

Many students who have participated in role playing have expressed that immersion in the topic, established through role playing, provides insight into real issues that they have faced and allows them to work through these issues in a meaningful way, thus providing them with a unique learning experience. The social interaction in role playing leading to a character’s immersion in the role and its context, support the features of Vygotsky’s social development theory⁶. Vygotsky focused on the connections between people and the sociocultural context in which they act and interact. According to Vygotsky, humans use tools that they develop from a culture, such as speech and writing, to mediate their social environments. Initially children develop these tools to serve solely as social functions, ways to communicate needs. Vygotsky believed that the internalization of these tools leads to higher thinking skills. Many schools have traditionally held a transmissionist or instructionist model in which a teacher or lecturer ‘transmits’ information to students. In contrast, Vygotsky’s theory promotes learning contexts in which students play an active role in learning. Roles of the teacher and student are therefore shifted, as a teacher should collaborate with his or her students in order to help facilitate meaningful construction in students. Learning therefore becomes a reciprocal experience for the students and the teacher.

The psychological aspects of role playing are critical and must be managed and planned by the director of the role playing enactment. To this end, there are several “production techniques” that have developed over the years, role reversal, soliloquy, mirror techniques⁷. According to Paul Torrance⁸, role playing attempts to help understand and resolve conflicts for which there are no obvious, logical solutions. “Altered states of consciousness”⁹ are deliberately created in role playing enactment. Both are regarded as important tools for effective problem solving. The goal of a role playing enactment is to facilitate the kinds of thinking which will encourage the likelihood of creative breakthroughs. The issue is- in what ways might we best reach that goal?

Torrance believed that creativity has its roots in conflict and the unconscious forces motivating and energizing the creative solution. Role playing deliberately uses conflict for learning and growth. Because heightened states of awareness seem so important in facilitating creative breakthroughs, the role playing production techniques are structured to encourage their production. These techniques deliberately encourage conflict so that a problem may be viewed in a new way.

Role Playing as a Pedagogy

Role playing can be incorporated in any number of learning situations. For example, it can be used to deepen the analysis of a work of fiction, to illustrate case studies and scenarios, and to learn more intimately about different historical time periods. By directly immersing themselves in a situation, the performers come to appreciate the complex experiences of the characters they are portraying. This is a very hands-on form of pedagogy; it is quite unlike listening to a teacher giving information or watching a documentary, both of which situate learners at some distance from the material.

Bloom¹⁰ contends that there are six developmental levels pertaining to the acquisition of knowledge and of intellectual analysis and skills: knowledge, comprehension, application, analysis, synthesis, and evaluation. Role playing involves a collaborative application of what has been learned; it also requires students to synthesize aspects of the topic in the creative process of formulating the virtual play itself. Furthermore, when analyzing the play after its presentation, students reach a better understanding of the topic. For example, they have the opportunity to identify any fallacies in the characters' assumptions, as well as distinguish between facts and inferences

Online Role Playing

Tisha Bender advocates online role playing as an engaging educational tool that promotes sustained learning¹¹. An experienced teacher in both traditional and online classrooms, Bender has found that role playing connects students to the course material—and to each other—more intimately and successfully than a traditional lecture can. She provides technical tips for establishing an online “theater,” describes three role-playing assignment models, and evaluates those models according to Bloom’s taxonomy. Bender also reports student reactions to role-playing exercises and suggests concrete criteria for grading individual performances.

Online role playing engages students intimately and creatively in the learning process. It provides them with opportunities to think and learn in a more dynamic, interactive fashion than in the traditional lecture-style format, and it allows them to discover imaginative connections between their personal experiences and the course material. Students also develop presentational skills as they share these connections with their classmates and audience. As such, online role playing asks students to do something with the course material beyond simply memorizing it; it encourages them to identify with characters in specific situations and thus achieve a more meaningful understanding of the topic at hand. Moreover, the power of role playing often leads students to a sustained and passionate interest in the subject matter itself, which surely achieves one of our primary goals as educators.

Our Model for Ethics Education

The model for ethics education in engineering being proposed here is based upon another model created to deal with a similar general issue – the ability of engineering students to engage in high quality written communication. Drexel University’s approach to this was to require all programs have their students participate in at least three Writing Intensive (WI) courses as a condition of graduation.

The Writing Intensive Model

Writing intensive courses have several key components. Multiple writing assignments are built into each WI course with the proviso that each assignment go through multiple drafts. Students work with specially trained tutors who review each draft and work with students to improve their writing as the students proceed from draft to draft. Thus, unlike a term or research paper which may have at most two drafts and often only one, these writing assignments are reviewed and revised several times to ensure that lessons about effective communication are thoroughly learned. By selecting courses in a developmentally appropriate manner, students’ progress in communication skills can be tracked over their academic careers. This provides for timely intervention should adequate progress not be observed. In addition, the WI program requires that one of the three designated WI courses be in a course outside of the student’s major, ensuring that students’ writing experiences are not excessively focused upon only one format or style.

Background

Drexel University is strongly committed to co-operative education and this naturally leads to a five year undergraduate program: freshmen; sophomore; pre-junior; junior and senior years. Six month co-operative education experiences typically occur in the sophomore, pre-junior and junior years alternating with six months on campus attending classes. The School of Biomedical Engineering, Science and Health Systems, where we plan to pilot this ethics program, is a separate academic unit from the College of Engineering but collaborates closely with the College on academic matters.

The Ethics Intensive Approach

There are a number of classes involving design and project-based learning into which an *Ethics Intensive* (EI) component could be integrated. The initial possibilities include Freshman Seminar; Freshman and Sophomore Engineering Design, Principles of Biomedical Engineering I and II (where pre-junior students work in teams on projects in the School’s concentration areas: biomaterials and tissue engineering; biomedical devices and imaging; biomedical informatics; biomechanics and human performance engineering; and neuroengineering), Junior Design Seminar and Senior Design. Following the WI model, and to ensure the broadest possible incorporation of ethics into the students’ world views, we hope to require an EI component integrated into a non-major course as well.

What would constitute a potential EI assignment? As described above, many current approaches to ethics education have students examine case studies or specific issues that have been determined in advance by participating faculty to have an ‘ethical’ or moral dimension.

This unfortunately reinforces the notion that ethics is an esoteric discipline with limited everyday and real world relevance. In addition, such approaches tacitly assume that students already have a significant and well-considered ethical framework from which to analyze the case study being considered. However, since the development of such an ethical framework is the whole point of the educational exercise, this approach ‘places the cart before the horse’ and is not likely to be very effective.

Role-playing can be used in ethics education but the application must be carefully considered. Students placed in a position of acting out a role must have some understanding of the role beyond their own interpretation of it. For example, suppose a student were assigned to play the role of a blind individual offered a chance to see if only the individual would participate in a crime. One can pretend to have been blind and discuss the ramifications of the decision-making process but that does not have the same impact as it would if the student were required to wear a blindfold for a day. The latter case provides a context beyond the student’s everyday experience from which new perspectives can be drawn.

How can we approach that kind of experience in our undergraduate education? We are currently reviewing a number of options for specific EI experiences, including the possibility of an initial service learning co-op experience. Another possibility is to have students assigned a specific philosopher or religious leader as the role from which the student analyzes an ethical case study. This is different from the standard approach in that the student will have to learn enough about the philosopher/religious leader to understand how to apply that leader’s perspectives to the ethical questions. This can be further refined so that students might have to play two roles simultaneously – role-playing the philosopher who is role-playing an individual caught in an ethical dilemma. By choosing a mix of commonplace and discipline-specific situations, students will be forced to think at multiple levels about the role and relevance of ethical systems in their lives.

The assignment of EI experiences will have to be developmentally appropriate as well. It is not just knowledge and skills in a major or discipline that advance over the course of an undergraduate career – ethical thinking and moral judgment grow as well. To foster this growth, more simple and everyday examples should be introduced early in freshman year and gradually made more difficult and combined with discipline-specific questions as students approach graduation. The final questions should be related to the students’ own engineering designs and research and thus be self-generated.

Tutor Training

Our experience with WI courses has revealed a clear correlation between the quality of the tutor and any improvements observed in undergraduates’ written communication. Poor tutors not only decrease the chances that undergraduates with whom they work will improve writing skills, they can actually negatively impact writing. In other words, a poor tutor can be worse than none at all. Tragic as such circumstances are when considering writing skills, the implications for ethics education are far worse. The right tutors are, therefore, absolutely critical

Our tutor training program will be divided into three parts covering most of three quarters (Drexel University uses the quarter system). The first part will allow the students to see “ethics

in action” as they observe various philosophers and other thinkers confront contemporary ethical issues in biomedical engineering. What would Plato have thought about stem-cell research, or Aristotle? What would the Buddha’s views have been about human cloning, or Immanuel Kant’s? Such questions can only be answered by asking the philosophers themselves or, since they are dead, by asking the next best thing: scholars who specialize in the thought of a particular philosopher or thinker.

One well-known example of this approach to understanding contemporary issues can be found in the works of Peter Kreeft, professor of philosophy at Boston College, whose 1982 book *Beyond Heaven and Hell: A Dialog Somewhere Beyond Death with John F. Kennedy, C.S. Lewis, and Aldous Huxley*¹² and his 1983 book *The Unaborted Socrates: A Dramatic Debate on the Issues Surround Abortion*¹³ both endeavor to set contemporary ethical and moral issues before great minds with different perspectives on these issues. Think of such teaching and discussion as an opportunity for students to participate in, and even direct, an episode of Steve Allen’s PBS show *Meeting of Minds*, where the students will be asked to challenge a particular mind during each class session, so that each class will be an immersion into the mind of that philosopher or thinker. Also, this sets a context for possibilities of thought, for one could ask Nietzsche what he thinks of *in vitro fertilization* once it has been explained to him. However, one could not ask him what he thinks of Jean-Paul Sartre’s views on IVF, since Nietzsche died before Sartre was born. In order to undertake this type of mimetic teaching, we would invite specialists and scholars like Kreeft, who is an Aquinas scholar; C. Steven Evans, a Kierkegaard scholar at Baylor University; Georgia poet and Rumi translator, Coleman Barks; or Kant scholar Allen Wood of Stanford University, to face the questions of the undergraduate engineering students and answer them as the philosopher or thinker in question.

The second part of the training involves role-playing. In this case, students will be assigned a different major philosopher and/or religious thinker to personify while investigating numerous different case studies – both everyday and discipline-specific. Students will be required to analyze each situation from two perspectives – first, as the thinker they have been assigned to emulate and second, according to their own personal views. Each week, the case study and the thinker assigned to each student will change.

The third part of the training involves both on-the-job aspects and further development of the student trainee’s own ethical system. The trainee will be required to investigate and analyze an issue of his or own choice and submit an abstract or presentation proposal to a professional journal in ethics or to a conference. The on-the-job aspect will involve the trainees acting as ethics consultants to senior design teams. Each senior design team is required to analyze the ethical implications of their product or process design and the trainee/tutor will engage the students on those teams in generating the best possible analysis. The student design teams will then rate the trainee/consultants on their impact. This allows for the faculty to review the performance of each trainee/tutor in a more controlled situation with more mature students before assigning them to lower division undergraduates.

We plan to initiate training using graduate students as potential tutors due to their relative maturity and the intensity of the training process. Later, if circumstances justify it, we may

incorporate a cascade mentoring design, with upper division students mentoring lower division students as part of their own EI experiences.

Teaching Ethical Thinking versus Specific ‘Do’s and Don’t’s’

College students are often still experimenting with different systems of ethical belief, values and moral standards.^{14, 15} Present education in ethics does not seem up to the task of preparing students for the ethical and moral dilemmas they will encounter as professionals.¹⁵⁻¹⁷ Evidence has shown that people who engage in unethical behavior as students continue to do so as employees¹⁸ generating significant costs for the employer and community at large^{14,18}. Ethics courses which focus on teaching a set of rules do not seem to have the intended impact. Students do not necessarily incorporate these rules, but rely instead on a pre-existing but largely unexamined set of beliefs.^{20,21} Thus, there is a need to promote critical thinking, self-reflection and the ability to analyze situations from multiple points of view.²⁰ We believe the proposed approach will do just that putting students in positions where they are required to analyze multiple different situations from multiple points of view. The goal is not to present a specific set of ethical or moral principles – it is to create a moral and ethical individual.

Assessment and Evaluation

To assess a program and evaluate that program’s effectiveness, you must have clear goal and objectives. The goal we stated was the creation of an ethical and moral individual. How does one measure that? In fact, moral development scales do exist and have been used for just this purpose for many years.

The surveys – the Defining Issues Test (DIT)²² and the Moral Judgment Test (MJT)²³ – are based upon Kohlberg’s²⁴ six stage scheme for moral development. Kohlberg’s approach divides moral development into 3 levels with two stages in each level. The three levels are Pre-Conventional; Conventional and Post-Conventional. The pre-conventional stage is characterized by an orientation to self and the rewards and punishment associated with one’s own behavior. This is the realm of the child who is dependent upon adults and must act in accordance to their wishes in most circumstances. A threat of punishment or promise of reward is the primary motivator for behavior. In the conventional stage, the rewards and punishments have become more complex and involve other individuals. Behavior is modified according to peer expectations. At the more advanced stage in this level, obedience to society at large becomes an issue and right behavior, doing one’s duty and obeying the law can become synonymous. Finally, at the post-conventional stage, a person actually analyzes the consequences of behavior and reflects on moral choices. At the most advanced stage, individuals weight the results of behavioral choices on the basis of consciously chosen values and principles. The two tests – the DIT and MJT – are designed to measure a person’s progress through these stages and are thus good instruments for assessing the impact of ethics education. A comparison of the two can be discussed by Ishida.²⁵ Other approaches, such as the use of Perry’s model of cognitive development²⁶ can be modified to assess ethical development as well.¹⁵ The point is that established measures exist to assess ethical development and can be used for the approach proposed here or for others.

The key to this, of course, is to monitor the development of an ethical sense. The assessment cannot be done once in the curriculum – it must be repeated at different times in the curriculum in order to determine how each student is progressing. In fact, there is really no difference between developing a mathematical sense and a moral sense – each relies on a series of developmentally appropriate experiences to achieve the expected level of performance. You would not expect a student to handle multiple non-linear differential equations before learning basic calculus. There is no reason to expect that students can handle complex ethical dilemmas when they have no training in evaluating more simple situations. Thus, when designing an ethics intensive program, it is critical to map the various experiences into the curriculum in developmentally appropriate ways and incorporate multiple assessments into the design to ensure that the expected progress is being made.

The tutor training is somewhat unique in this regard because it is compressed into an intensive three-quarter sequence. This provides for the possibility of verifying to some extent the efficacy of the training by selecting a matched control group of students who are not undergoing training. Both groups of students would complete the DIT and MJT twice, the tutors before and after training and the control students at the same times but without the training. In this way, one can determine how the training is influencing the ethical development of the tutors and make appropriate adjustments.

Conclusion

In his famous work, *On Liberty*, John Stuart Mill articulated the reasons for free reflection.²⁷ These were: 1. The common belief may be wrong; 2. The common belief may be only partially true; 3. Without challenge, even true beliefs may become simple prejudice; and 4. The meaning of the belief may be lost and simply practiced by habit or ritual. As engineering educators, we have a responsibility for developing innovative, reflective and thinking engineers. As a profession, engineering has a staggering potential for creating beneficial or harmful effects on humanity and life in general. The only method for tipping the balance in favor of beneficial effects is through the development of ethical and moral engineers. We have proposed one method for accomplishing the task here based on the methodology of role playing and implementing continuous assessment throughout the curriculum and hope that many others will be forthcoming.

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