AC 2011-2571: APPLICATION OF CLASSICAL REALIST PHILOSOPHY PRINCIPLES TO ENGINEERING ETHICS

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Abstract

Modern and post-modern philosophical trends have influenced our society and culture in many ways. Tenets of individualism and relativism have led to viewing education as a commodity that is purchased and is valuable for eventual employment and obtaining a higher income. Aspects of personal development as well as the ability to "give back to society" through one's profession may be introduced in a course here and there or brought up by advisors or religious-based student clubs, but these are normally viewed as a secondary merit of education. Likewise, ethics education is often based on a utilitarian approach, namely – seeking the best possible outcome for the most people. However, this strategy does not address the need for making ethical decisions that impact individuals or conflicts in professional situations.

The principles of Aristotelian philosophy continue to resonate with people, even when they have been rejected by many of the philosophers of recent times. The ancients recognized the existence of reality outside ourselves that we must identify and evaluate through a combination of sense inputs and reasoning by our intellect. Specifically, engineering design is data driven, and thus an ethical system that is likewise data driven is both practical and meaningful. In addition, the classical realist principles point to the existence of a common human nature and help identify some common moral norms upon which we can base our ethical decisions. Indeed, Aristotelian philosophy also recognizes that the process of serving others and giving back to society through our professional work is a good and can lead to personal happiness and satisfaction in life.

A series of lectures and assignments have been developed to teach undergraduate students the principles of the classical realist philosophy as it relates to engineering ethics. Ethical approaches based on utilitarianism or philosophical skepticism are compared for validity with the principles of Aristotle's ethics. The paper will include a summary of the principal tenets of Aristotle's ethics as they apply for engineering cases, some comparison with the utilitarian approach, as well as both qualitative and quantitative assessment of student learning.

Background

The following material is presented in two 50-minute sessions of the one unit Process Safety and Ethics course that is required for all chemical and material engineering students at SJSU. SJSU is proud to claim it is the Metropolitan University of Silicon Valley and educates a very diverse student body. The only prerequisite for the course is CHEM 1B (2nd semester chemistry in a two semester sequence). It is nevertheless an upper division course because of the need for completion of all lower division requirements from the California Community College System. Six of the lectures are ethics, including one course introduction, the two Aristotle lectures, one

lecture on the Code of Engineering Ethics, one lecture on ethical reasoning applied to case studies and one class period for the ethics midterm. Given the brief time with the students, the purchase of a textbook seems unnecessary, and the concepts of Aristotle are presented as a foundation for the code of engineering ethics.

The learning objectives for the course related to engineering ethics are relatively low level on Bloom's scale. These include:

1. Restate the six fundamental canons of the NSPE Code in order to demonstrate knowledge of a code of engineering ethics.
2. Identify the ethical issues in an engineering case study.
3. Design a strategy to manage a situation where an employee/subordinate commits an ethics violation.
4. Identify all potential consequences of an ethical infraction.
5. Recognize the requirement of personal responsibility with regard to striving to be a well-prepared, technically competent engineer by the time of graduation.
6. Explain the foundations of the code of engineering ethics as stemming from the notion that all human beings share a common human nature and as such, it is necessary to respect the legitimate rights of all: to life, to good reputations, and other basic rights of human beings.

With the exception of objective (5) that is not assessed in the course, these objectives are assessed in one homework assignment that addresses the NSPE Code of Engineering Ethics, one paper that involves the analysis of a case study, and the midterm examination. To reinforce the presentation on Aristotle, a homework assignment is also given that asks short-answer questions covering themes from the two lectures. To gather the students' perspectives on the ethics portion of the course, an anonymous survey was taken and the results are presented in this paper.

Given that the students have completed their lower division general education prior to taking this course, the material is not completely new for all the students. Of 16 students enrolled this fall, only one completely agreed on the assessment survey with the statement that "The material was new for me – I had never learned about Aristotle's teachings before", while six partially agreed to the statement and three completely disagreed. Each semester there is at least one vocally empowered student in the class who maintains that all human actions are culturally driven and there is no basis whatever for ethics. While the students generally are inclined to agree with their peers before accepting what a weathered professor has to say, the students are very engaged with the material and many students continue to nod in agreement with the lectures as presented, despite the protestations of the vocal non-realist student in the room.

Review of relevant literature

Literature germane to what is presented in this article includes papers describing the relevance of ethical theory in engineering education. Two reviews on approaches to teaching engineering ethics can be found[1, 2].

One of the major obstacles to including ethical theory in the class is that engineering faculty teaching the course may not feel competent to cover philosophical theory [3]. To overcome this challenge, some universities borrow a faculty member from the humanities to teach the ethics theory [4]. Once the theory is cursorily introduced in the beginning of the course, the engineering faculty normally move into analysis of case studies. Reider suggests that students are then forced to make decisions in the case studies based on *intuition* because of the scant level of theory that was covered [5].

As described in the reviews and confirmed in some of the more current articles, the most common approach to introducing ethical theory in ethics courses has been reported to include three principal foundations. These three include the *deontological* approach, namely, following rules and performing one's duty; the utilitarian approach, which judges the ethical nature of an act by its consequences; and the *virtue ethics* approach, which is most closely identified with Aristotelianism [6] Virtue ethics takes its bearings, not from whether an act conforms to certain rules or leads to favorable consequences, but rather from how a human being ought to live in order to really flourish as a human being, to reach authentic happiness.

In a spirit of open-mindedness, the modern and well-educated university professor may feel compelled to present a variety of options for students to choose from in making ethical decisions, including those listed above [7]. In my experience, presenting such a variety of ethical approaches, without spending adequate time explaining their advantages and disadvantages, leads engineering students to a kind of relativism, rather than to a growth in personal responsibility. For this reason, in the approach discussed below, only an Aristotelian approach is covered and presented in such a way as to lay the foundation for the code of engineering ethics. By presenting the *why* of the code, an attempt is made to foster a better understanding and therefore, more ownership of the code of ethics.

Can 100 minutes of Aristotle be life changing?

The material presented to the students is taken from one book by Daniel J. Sullivan entitled, *An Introduction to Philosophy*. [8] Philosophy (etymologically: love of wisdom) attempts to answer the great questions of man's existence: "Why am I here?" "Do I have a purpose?" "Why is there suffering?" "Is there life after death and do I have to worry about it?" "Do I somehow have control over my own destiny?" Although these questions don't seem to have immediate relevancy to engineering ethics, the ethical person does not make ethical decisions only "at work." Without a deeper foundation for an ethical life as a whole, an engineer is not likely to

carry out his or her work in an ethical manner. In addition, upon deeper examination, Aristotle's answers to these questions can be a motivating force in one's professional life, as well as in life outside of work. These questions, presented to the students, engage their attention as does much of the presentation of this material. The following section mainly comprises a summary of the principles of Aristotle, as developed for the students. In support of the selection of Aristotle as a presenting a philosophical thesis that is meaningful for professional ethics, Alasdair MacIntyre, a prominent contemporary moral philosopher, related his observations of discussions with school teachers, trade union organizers, small business owners and other workers:

> "When such students read Plato or Kant or Mill, they took them to be fascinating and ingenious spinners of interesting theories, with much to be said for and much against them. When, however, they read Aristotle, many of them at once understood him as extending enquiries that were already their own, as presenting them with a conception of practical activity that both illuminated the forms of their own activity, by identifying and exposing its limitations, and provided a way of posing further questions about practice. They had already asked themselves: "What ends am I pursuing, as a family member, in the work place, as member of this or that organization?" Aristotle gave them the resources for asking "But what is it all for? What is my end qua human being?" And Aristotle's reflections on the human qualities needed to achieve worthwhile ends, on the virtues, coincided with and deepened their own reflections. [...] The only other thinker to whom such workers responded in a similar way was Marx. He too had asked their questions." [9]

Aristotle (384-322 BC) was a student of Plato (427-347 BC), and he studied at Plato's Academy. Aristotle identified two principles of things: that which makes a thing what it is, which he called the *form* of a thing. For example, a tree *is a tree*. It could be said that it has *treeness*, which other things do not have. Such identifications also belong to other bodies - a man has *manness* and this manness does not exist by itself but only as a constitutive principle of a human being. And at the same time that there is a *form* or *essence – manness* – still individual *men* exist. Form alone does not explain the actually existing thing. The *matter*, which we learn in physics to be "a substance which has mass and occupies space" is the second principle which is a "principle of limitation", a principle which limits *form*, restricts it to an individual, in a fixed time and place.

With a deeper analysis, *being* can be divided into the *potential* (what a thing can become) and the *actual*, the completely real (fullness of being, actual existence of a thing). For example, if students study and learn their subjects, they can become engineers, although they are not yet engineers. There are some who don't have the potential to become engineers, but potential alone is not sufficient. A physical example relevant to Aristotle's time would be: *the statue of Hermes is in the block of wood.* The full reality of any being is what it actually is plus its potential ways of being. What is a potential way of being? A carpenter is one who can build even when he is

not actually building. A person with her eyes closed is capable of seeing and is therefore different from a blind person, even though neither is *actually seeing* in the moment.

An important concept for engineers is the mystery of *change*. Engineers are keen to model this phenomenon with a differential equation. Change is defined as the movement from what something is to what something could be, or in other words, the actualization of a potential. Change is neither potency nor act but something in between. Things in the world are undergoing constant change: Gas prices, people… the statue of Hermes just carved has already changed through decay. Although when we look at the world we see everything constantly in change, there are aspects of the world that don't change. The laws of nature - gravity, electrostatic force, conservation of energy and matter, don't change. Human nature is unchanging; although people are different and people change, the nature of humanity does not change, as can be clearly discerned from reflection: the same Homer from 200 BC is still appreciated today; we are still moved by beauty; people still have religions. It can be said that although we have a very diverse numerator, we all share a common denominator – that of being a human person. While this claim is not uncontroversial among philosophers, it is a matter of common sense, which students almost always can recognize. Perhaps the diverse nature of the student body is an enabling factor to the students' acceptance of our common nature, as we daily come face to face with both our cultural differences and our fundamental similarities.

Because there are aspects of things that *don't* change, it is possible to *know things.* In essence, the nature of things and the laws of change are unchanging. Further, we come to *know* through *senses and intellect.* Both senses and intellect as means of knowing things are necessary to really understand the world. The senses recognize the changing aspects of things while reason connects us with the stable, unchanging aspects of things. Once one is taught what a triangle is, if one then sees - Δ - one knows that it is a triangle. Likewise, if one sees the sun early in the day, one knows it is morning, and at the same time, it is time to begin the new day.

Furthermore, it is possible, with the light of the intellect, to penetrate deeper and deeper into the panorama of change and reality. This process includes the scientific method, which everyone accepts as a valid means of understanding reality in new ways. Examples of deeper aspects of things include quantity and individuality, as well as purpose. Not only does the scientific method enable us to understand the reality of things around us, it can be applied to a deeper understanding of human nature. These sciences include anthropology and psychology. If there were no commonality to humans, these fields of study would have no purpose or validity. For Aristotle, the nature of man himself was a crucially important question. And Aristotle is by no means alone in holding that human beings are different from other animals because of intellect and free will.

Aristotle interpreted man's actions as *free.* Specifically, man has a free will and is able to choose in contradiction to what he knows is good. For this reason, it is necessary to reflect on what makes an action good or bad. What is freedom? We are not free to *break* the laws of thermodynamics; no matter how hard students may try, it is not an option. The same can be said of all laws of nature. On the other hand, we are free with regards to the moral law (e.g. we can choose whether or not to drive at a safe speed). Aristotle recognized that man is *rational*, and *responsible*. It is up to us both to discover what is really good, and to choose to do it.

This view of freedom was shared through the Middle Ages, into the Renaissance period, and in the Enlightenment, though thinkers in these various periods have differed in some respects about what kinds of acts are actually good for us. More recently, in post-modern philosophy, it has been brought into question. Some consider man as just an animal with superior intellect, but like animals, without control over the instinctive drives. In effect, we are slaves of our senses, driven by cultural influences that are beyond our ability to manage. Other post-modern philosophers despair of our being able to use our freedom in any meaningful way, because they think it is impossible to discern how one choice would be better than another.

However, the rationality and free will of man set him apart. Man is conscious of his own existence, capable of self-reflection. Man can co-create beauty in art, writing, and music. Humans can educate their children in refinement, virtues, character, etc. Humans can know God, and pass on a heritage to future generations through technology and education. Humans can employ humor as an aid to forge through life's difficulties. We have the capacity to recognize what is good; and we have the concomitant responsibility to make good choices.

In contrast, with regard to all other animals, we cannot speak of "ought" or duty in the sense of freely achieving a potential. A mother teaches her children, "You *ought* to study. You *ought* to clean your room." A clergyman can teach, "You *ought* to pray..." In essence, man can knowingly and freely co-operate in the full realization of what his nature ought to be. When we say, "The turkey *ought* to be done by now," we are expressing what is in the nature of the turkey, but not under the control of the turkey. In contrast, when we say "The student *ought* to study for the midterm," we are saying not only what is in the nature of the student, but what is under the power of the student to do. On the other hand, we can also choose erroneously and perversely. Students often appear suspicious at the word "perversely," but an obvious example is those who use drugs to an extreme and ruin their health and empty their bank accounts instead of studying and preparing themselves to give back to the community that nurtured them. For many the example hits home, as they likely know friends from high school that chose that route to their own destruction.

Aristotle developed a sophisticated treatise on ethics. *Ethics* comes from *Ethos* (Greek), which means a *pattern of conduct*. Ethics is the study that is concerned with the authentic happiness of

human life. Alternatively, it is the study of what humans ought to be by reason of what they are. Aristotle determined that humans *should* aim at whatever will fulfill their nature. What does that mean – to fulfill their nature? To give students an inkling of an answer, it is enough to reconsider the notion that we can leave a legacy to future generations through our work, through raising a family and giving back to the community. To be able to do so, this discussion focuses on the need for students to study and become the best possible engineer they can within the realm of their limitations. What is the measure of one's success in this endeavor? While the answer to this question is deeply personal, it lies in what Aristotle deemed man's ultimate good.

Aristotle called man's ultimate good *eudaimonia,* which is often translated as "flourishing" or "happiness." Normally, we say we are happy when we are fulfilled or satisfied. Happiness is a *state of being* that is achieved through a lifetime of making good choices. People strive for happiness but sometimes they are confused about what will make them happy. People strive for different *goods* with the goal of being happy. Money, fame, knowledge, health, and pleasure are examples of the sorts of good things that some people seek after for the sake of obtaining happiness. Aristotle argued that *full* happiness must be complete, lacking nothing: such that once we have it, there is nothing else we could desire. If some of our desires remain frustrated, then happiness is partial.

However, part of being rational is knowing which desires are worth pursuing, and which should be moderated or renounced. Every choice we make excludes some possibilities. Marriage excludes freedom from responsibilities – and a young man can only choose one wife, he cannot have them all. Drunkenness may bring a brief delight, but one who is habitually drunk excludes good health from one's possibilities, not to mention the hangovers. Given the need to make exclusions, the wise man tries different things and orders the goods. For example, food is good, exercise is good, knowledge is good – but each in due measure, appropriate to human nature and to one's concrete needs and possibilities.

Aristotle spoke great wisdom in identifying the different values of things. For example, the principal value of some things is that they lead to the possession of other things which are more valuable. *Money* is only valuable because it can be exchanged for other things. Money can therefore never be an end in itself – man cannot find happiness in an endless struggle to get more and more of it. Another *means* is exercise – exercise is only a means to good health and will lead to frustration if sought for its own sake. Aristotle also recognized that bodily pleasure is only a fleeting consequence of certain actions such as eating, having sex, enjoying a beautiful landscape, etc. Because of its temporary nature, pleasure cannot serve as our ultimate goal.

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If man is to lead a good life, he must know how to moderate his desires, and how to put goods in their right order, not choosing means as ends or ends as means. Happiness is thus a kind of optimization problem. We can be wrong about what will make us happy; we can choose (we are

free to choose!) some things that we think will bring happiness but the end result may be disappointing. A student may choose to party instead of study for an exam, or a teen girl decides to have sex with her boyfriend and winds up feeling used and objectified. Life can teach us how to make difficult but prudent choices that will enable us to achieve our goals.

Why can't material things such as money or electronic games and gadgets, or passing pleasures bring us lasting happiness and fulfill our nature? Aristotle's explanation is that man's ultimate good must stem from his nature, and it cannot fulfill man to seek principally that which is less than himself. External things have a nature that is inferior to man himself, and therefore, cannot satisfy completely. At this point in the discussion, we can consider different options for how to find satisfaction in life. This discussion is relevant, when every advertisement is recommending some thing or set of things that will satisfy our desires. Interestingly, recent medical research has shown that doing good to others is a source of happiness as measured by the degree of absence of health problems, both physical and mental, and longevity. [10]

For Aristotle, the happy life in so far as it is possible to man is spent in the undeviating contemplation of truth. This may not sound terribly convincing to the younger generation which is active and fun loving. But they will agree that boredom is bad, and engineering students are easily attuned to the fact that they desire to be challenged to learn and develop themselves. Learning is truly good, and to use one's learning to help another is an even greater good. Since the intellect is our highest power, our greatest fulfillment must involve its exercise. This concept is completely in line with the students' desires to solve problems and work at their expertise, though of course, Aristotle recommends a kind of contemplation of truth that goes beyond problem-solving.

At this point in the lecture, we must embark upon a sticky subject, namely, *moral relativism*, that is "what is right for one person may be wrong for another." The moral relativist would argue that we can never judge the actions of others. Either our culture or environment has programmed us to make a given decision and we were not truly free, or else our inner conscience has determined that action to be morally good and therefore it simply is so. If the class is asked whether they agree with this moral relativism, inevitably they all or mostly all concur. It is possible to deconvolute this theory with a few humorous examples, as pointed out in Sullivan's book[8]. Specifically, even people who claim there is no right or wrong live as though this were not true: a man safely assumes his wife will not whimsically put arsenic in his food; he assumes his friends will not cheat at cards; he assumes his employer will not steal his salary; or if someone accuses him of beating his wife, he is not likely to say "well, it doesn't matter either way." How can a moral relativist accept a code of ethics? There can be no standard upon which to agree. Following these arguments, the students can be found to be in a state of confusion. Perhaps they will agree to a code of ethics because everyone who wants to practice as an engineer agrees to it. Ethics, however, is not something that can only apply to one aspect of life.

We want to graduate ethical persons from our program. While their personal decisions are not part of our purview as educators, it is incongruent that we can accept that students are only following the code of ethics because we told them to, or the professional society forces them to if they want to keep their job. Such motives are surely not enough to sustain ethical behavior over the long haul; if I only behave well to keep you from firing me, what is to keep me from behaving badly when I am confident that you will not catch me?

After this discussion of moral relativism, the notion of moral standards is presented. To judge rightly of human actions, we have to know what human nature is and its place in the scheme of things. Because reality is an ordered whole, and human nature is the same in all people, the standards of morality should be the same for all people. In essence, morality exists because human nature exists. The moral code is written in our nature – traditionally called "natural law." What is natural law with regard to human nature? This natural law is the given order of nature to which man must conform himself and which he knows by reason; that is, man's individual reason tells him how to harmonize his individual choices so as to reach the authentic fulfillment of his nature, genuine happiness or flourishing. Man's freedom is not a blind freedom – with his reason he can discern the overall order of things to which he should conform himself in order to live a good human life. Each human being has the responsibility to put himself, through his free actions, in conformity with what reason tells him is his true end.

What are some specific points of this natural law? Children should obey their parents, or alternatively, we should all respect legitimate authority. It is wrong to kill, including to kill a person's reputation through slander or defamation; it is wrong to commit adultery, because it is wrong to disregard or inflict harm upon our own or others' commitments – especially when another person (the participant's spouse) is harmed by our actions; it is wrong to steal including to unfairly take away opportunities for wealth from others (conflict of interest), it is wrong to tell lies including to misrepresent one's skills to obtain a position. Why are these specific points identified? It is clear that the basis for this list is that it is necessary to treat others as one would want to be treated, and the reason for that is because we are all humans and share a common human nature.

Because man *can* know what will lead him to a good end, he *should* choose those things that will lead him there. Indeed, this is the way to happiness because it cooperates with our nature. In short, morality is not just a set of rules, a collection of *dos and don'ts* imposed on us from the outside, but rather a way of life that corresponds to our nature. Morality fulfills the possibilities of our nature. Virtues are habits that correspond to our nature and lead us to fulfill our nature.

Justice

Among the virtues, justice holds a special place in any discussion of professional ethics. Justice is the virtue which makes us render to each his due, whether other individuals or the community. There are two principal types of justice, distributive justice and commutative justice. Distributive justice refers to the fair distribution of commonly held goods. An example of an infraction would be to give education only to people of a certain skin color. Distributive justice also refers to common tasks and burdens – for example, taxes should be fairly demanded, civic offices should be open to all, and military duties can be expected for securing safety. Of local interest in California is the CHP 1199 foundation that allows people to pay a fee to enter a club run by the California Highway Patrol. The membership is prominently displayed on the license plate of the car and (unofficially) exempts the owners of the vehicles from being pulled over for speeding. This is a clear infraction of distributive justice because it exempts people from obeying commonly held traffic laws. Other kinds of exemptions may be appropriate, such as the case of a juvenile delinquent who may be treated differently from an adult criminal. This example of proportionate justice is reasonable because it can be assumed that an adult should be responsible and know better than to commit the crime.

Commutative justice (justice of exchange) deals with equality in the exchange of goods. The exchange of goods should be on a roughly equal basis to the extent possible. An example of an infraction would be doing civic favors for family members, or for a teacher to give all the girls A's and all the boys B's, or to drive a hard bargain to take advantage of another's misfortune or ignorance, such as performing a sterilization on someone in exchange for a free meal, or to get someone drunk before doing business with them, or to cheat another person because of their ignorance of the true value of what he is exchanging.

Individual (distributive) justice should come ahead of commutative justice. For example, if there is unfair distribution of goods and opportunities to start with, then insisting on commutative justice only aggravates the injustice. A case in point would be in the time of serfs who struggled to eke out a meager existence and then they were charged taxes on top of it. The taxes are fair for those who can pay from their excess but should not come from one's subsistence.

Social justice issues

As mentioned above, we depend, at least materially, on the physical heritage of the community. We continue to drive on the roads, work in buildings, live in cities that were built before. We also continue to communicate with others using established manners and customs, and thrive with all of the accumulated wisdom and skills learned from previous generations. In the society, special interests must be subordinated to the common good - one man's freedom cannot be exercised at the expense of another's basic rights.

A society is any union of persons which aims, under some recognized authority, at a common end. The unity of a society is a *moral* unity, with the common purpose of the group providing the bond for the group to hold together. Societies are either *natural*, with the family as a basic unit followed by the town, state, and nation, or *contractual*, such as student organizations, company, religious associations, etc. Authority is necessary to protect both the common good and the basic rights of individuals. The civil community is not more important than the people which make it up, unlike in totalitarianism where the individuals are completely absorbed for the good of the whole. The good of the community is important and it is legitimate that the citizens can be asked to make personal sacrifices of their time, wealth, labor and even their lives if necessary for its sake. However, society cannot ask citizens to do what goes against their conscience. According to Aristotle, an unjust law is no law.

The family is where children are cared for both physically and in a moral sense – to fulfill our basic need for love and companionship and education. An infant can die for lack of affection as well as lack of physical care. Parents have a duty toward children as children have a duty towards their parents.

For the philosophers who hold that man is rational and free and therefore social by nature, the foundation of right and duty is in the natural law. We can recognize what we *ought* to do and realize our destiny. We likewise have a legitimate claim on those goods that we need to carry out our duties – they are our right! In other words, rights and duties *flow* from our nature, and thus are inalienable rights, for example, life, liberty, the pursuit of happiness. Alternative theories, such as the contract theories of Hobbes and Rousseau, root the rights of man in the state. They held that the individual surrenders his basic freedom as a condition to having a peaceful life in society; the state is the foundation of rights and duties and can specify and change them at will. In the *totalitarian state* there is no such thing as an unjust law. If the state withdraws freedom it is just tough luck. A duty today may be a crime tomorrow. The result of these justice systems, as history has shown, is that the laws become arbitrary as opposed to what is rooted in human nature, and in the face of apathy and doubt, the ruthless take over "right" = "might".

Utilitarianism

It is worth taking a special note of utilitarianism because many of the texts on engineering ethics base ethical reasoning on utilitarian principles. It is also a common ingredient in current philosophical trends and public discussion of moral matters.

The etymology of “utilitarianism” includes, "uti," that is to take advantage of, to use, and "utilis," or useful. The emphasis is on the usefulness of human activity. The utilitarianism taught in engineering ethics education is more accurately described as seeking the best possible outcome

for the most people. A fundamental problem with the utilitarian analysis of a situation is that it makes man into a means for others. It cannot be overlooked that people have an intrinsic equality regardless of how "useful" they are. We see this notion being supported in the modern laws for the disabled. One modern philosopher who was a resolute opponent of utilitarianism was Kant. He maintained that a person cannot be treated merely as "the means" to the end of another person, because they are equal in nature; they must both share the end in mind. A utilitarian analysis of a situation can lead to the abuse of the rights of certain individuals, for the sake of a supposedly greater good for the majority. In contrast, the Aristotelian emphasis on the common good tells us that it is part of our own good to contribute to the authentic good of all, without violating the rights of any. Thus, utilitarianism does not adequately address the need for making ethical decisions that impact individuals or conflicts in professional situations.

Survey results

Sixteen students were surveyed following the course in Fall of 2010 regarding the material in the ethics portion of the course. As a baseline, the students were asked to respond to the following question regarding their general ethical behavior: "I believe I always make ethical decisions and follow those decisions in my behavior." To this question, three completely agreed and 12 partially agreed. Two questions were asked to probe how the material was motivating to them to make ethical decisions. To the question, "The material motivated me to strive to be ethical in my professional decisions," Five completely agreed and eight partially agreed, with the remaining students responding "neutral." Likewise, to the question, "The material motivated me to strive to be ethical in my personal decisions," four completely agreed and eight partially agreed with four neutral. As an overall summary to the outcome, the students were asked, "The course material helped me in my quest of being an ethical person," to which five completely agreed and seven partially agreed, while one partially disagreed and three were neutral. It can be extrapolated from the above results that for most of the students, the material was perceived to be helpful to them in both their personal and professional ethical decisions.

Finally, the students were asked to respond to, "The material helped me to understand the foundations of the NSPE Code of Ethics." While understanding where the code comes from does not mean they will follow it, at the same time, it would be difficult to follow a set of mandates that are just pulled out of a hat… To this question, 14 completely agreed, one partially agreed and one response was "neutral." To aid the students to understand the connection between the Aristotelian principles and the code, a homework assignment was given asking them to identify connections between a short list of what was covered, including the points about natural law, as well as distributive and commutative justice. The solution to this homework shows that each and every line of the code relates directly to the ancient ethical principles.

In terms of measuring the learning outcomes, it is difficult to determine whether the students have truly embraced ethics. We can expose them to principles but it is their free choice to put

them into practice. Thus, it could be argued that it is not realistic to try to measure ethical behavior in our students beyond a survey. The learning outcomes are specifically designed to be measurable, even if they do not project to actual ethical practice on the part of the students. For example, students are required to write the six fundamental canons of the NSPE Code of Ethics on the midterm from memory. The performance criterion is to correctly scribe the six canons although mistakes are allowed if they don't change the meaning of the canon. The evaluation of a case study is part of a paper assignment. The performance criterion is to identify correctly all of the ethical infractions described in the paper by comparison with the NSPE code. In the same paper they are asked to describe a strategy for dealing with the infractions if they were to assume to role of the supervisor of the perpetrator. Questions on the midterm probe the students understanding of the consequences of ethical infractions as well as the need for personal responsibility in their own educational preparation as engineers.

Summary

Lectures on Ethics for Engineers were developed from the material in a brief text by Sullivan [8]. The lectures are available for use at the following url: http://www.engr.sjsu.edu/~ckomives/Courses/Safety%20and%20Ethics/ethics%20lecture%20notes/ The principle goal of the lectures is to help the students understand why ethical behavior is important for them as human persons and to motivate them to be ethical by showing them logical arguments about how such behavior it can lead to their happiness and fulfillment. Survey results confirm that the students grasped the foundations of the NSPE Code of Engineering Ethics based on the lectures about Aristotelian philosophy.

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