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An Integrative Approach to Teaching Engineering Ethics

I. Introduction

A survey of recent literature in engineering ethics education displays two major trends – references to the ABET EC2000 accreditation criteria and approaches to satisfy it. The EC2000 requires for engineers to understand their impact in social contexts both locally and globally by knowing and embracing their ethical responsibility. Thus, recent engineering ethics education literature displays the dialogue surrounding its content and delivery.

Exploring arguments about the content of engineering ethics education surpass the limits of this paper, and others have engaged in such.[1] Thus, though arguable, I will assume that engineering ethics education should include the following: stimulate the moral imagination, recognize ethical issues, develop analytical skills, and promote ethical obligation and professional responsibility in each student.

The second prong of the dialogue considers pedagogical delivery whereby the content is related and the goals realized. A survey of recent literature displays four major strategies as educators endeavor to unpack the ABET criteria – micro-ethics, meta/macro-ethics, heuristics, and casuistry. However, these approaches entail a number of weaknesses that may thwart the overall purpose of engineering ethics education. Though not an exhaustive critique, this paper will briefly define and illustrate each approach followed by a brief criticism.

II. Problems With Current Approaches

<u>A. Micro-ethics</u>. Some also refer to this approach as a 'minimalist' approach. Very simply, this approach references a formulation of principles from a specific or general engineering profession whereby the engineering student applies the code to ethical dilemmas encountered. Whether referencing the *NSPE Code of Ethics for Engineers* generally or their professional society's code specifically (*e.g.*, Chemical, Electrical, Mechanical, etc.), the engineering student is told what his profession would (or should) do.

At least two weaknesses emerge from this approach. First, the engineering student will approach ethical dilemmas dependent upon the moral decisions of others. This weakness appears to deny their personal professional and ethical obligation and fails to promote their moral autonomy by examining moral beliefs as an individual and professional. Second, while the micro-ethic approach emphasizing professional moral codes helps to identify broad ethical responsibility as a professional, the approach obscures the complexity of moral dilemmas. For example, the *NSPE Code* requires professional engineers to "hold paramount the safety, health and welfare of the public." Yet, there is no clarification regarding who and what 'the public' entails, if health references public health populations or individuals, what degree risk undermines safety, and a host of other ambiguities.

<u>B. Macro/Meta-ethics</u>. This approach seeks to present classical ethical theories from the history of moral philosophy that the engineering student can reference when encountering moral

dilemmas. These approaches may choose perspectives to create polarities to display the divergence (e.g., deontological vs. teleological theories; distributive justice vs. libertarianism) or present various alternatives to deepen the student's ethical horizon by displaying the moral significance of duty, virtue, justice, liberty, and consequentialism.

However, this approach often results in engineering ethics education occurring in lower-division ethics classes taught by philosophy departments. Most of these classes often concentrate on classical ethics and may omit or obscure theoretical developments and more recent contributions. Very likely, a student may merely gain the theoretical abstraction of the moral principle that provides little assistance in resolving contemporary ethical dilemmas generally or for engineers specifically. Second, identifying which theories to include and omit becomes difficult. Furthermore, determining an adequate background of the ethical theory – whether ancient, scholastic, early modern, modern, late modern, contemporary – may entail outlining philosophical pre-requisites or obscuring the context.

C. Heuristics. This approach is the presentation of a procedure with simplified ethical dilemmas whereby a student applies a step-wise procedure to determine the ethical resolution[2]. First, the problem with this approach is its typical use of over-simplified ethical dilemmas that easily map to the heuristic. Yet, ethical dilemmas most often are complex. Often there are multiple layers of ethical dilemmas in real engineering cases that increase the complexity of the issue. Second, the heuristics often use moral language that is not developed or explicated. For example, the Weil's heuristic says that one initially should 'recognize and state the ethical problem.' Yet, this first step presupposes that identifying an ethical problem is clear and intuitive. There is no elaboration to explain what delineates an ethical problem.

D. Casuistry. This approach endeavors to present students with particular cases (actual or imagined) whereby students induce moral principles from paradigm cases that can be applied to cases of a similar sort. Again, two weaknesses can be highlighted. First, often this approach results in the exclusive consideration of high profile 'disaster' cases that involve engineering (e.g., Challenger Diaster). However, this approach may lead to students inferring that ethical dilemmas are limited to the catastrophic and divorced from the 'everyday' working of a professional engineer. Second, this approach assumes a moral consensus among those considering the case (*i.e.*, all will come to same conclusion even if propose different and even conflicting justifications). Yet in a pluralistic and global culture of conflicting values, this approach seems impractical in controversial cases and obscures the articulation of principles that may actually resolve the case or explain why case is viewed as paradigmatic.

III. Necessary Integration

Thus, this paper seeks to present an alternative approach to engineering ethics education that integrates the above approaches, presented as three interwoven cores – foundations, guidelines, and applications. The key to the integration is to present each of the components while maintaining continuity. Connections must be intentional and explicit or students may fail to embrace their moral development and responsibility as engineers, while additionally being encouraged to deepen and expand their moral imagination.

<u>A. Foundations: Identify Moral Issues</u>. First, students must be able to identify ethical issues and dilemmas. To gain this skill, we must present broad moral principles and foundations -- meta-ethics – as a moral starting point. This presentation may be the most difficult part of the approach being presented, but necessary. With many students congregated around either the extreme of ethical relativism or dogmatic absolutism, we must provide diverse ethical foundations that delineate ethical domains and issues. Furthermore, meta-ethical principles are needed to enable students to understand and learn to negotiate values in a pluralistic social context. I suggest choosing at least three or four different major moral perspectives (*e.g.,* ethics of duty, utility, virtue, justice, liberty, paternalism, religion, natural law, or others). Each meta-ethic's theoretical core is briefly explained through lecture and readings from classic, contemporary, or secondary sources. Emphasis is upon brevity and the theoretical core.

The limits of this paper constrain the amount of explanation that can be presented; however, some illustration may provide more clarity and the endnotes contain some suggested resources to possibly implement. Duty ethics articulate one's obligation by emphasizing universality and respect for others irrespective of personal consequences or desires. Formulations of Immanuel Kant's categorical imperative could be used as an example: Act always in a way that you would will your action to be a universal law; or, always respect others by never using them as a means to something else. These formulations guide students to infer various duties like telling the truth and being charitable.[3] Utilitarian ethics present morality as doing the most good for the most people and minimizing the bad by analyzing the consequences of different courses of action. J.S. Mill's utility defines the good as maximizing happiness (*i.e.*, associated with the higher faculties of humanity over mere bodily pleasure) for the most people; one considers the consequences of actions or rules to ensure the good is maximized.[4] Virtue Ethics emphasizes character traits (*e.g*., honesty, generosity, stewardship, fidelity, wisdom, just, compassion, etc.) instead of individual actions. Virtues are cultivated through moral education and habit.[5]

To further promote integration and deepen the foundation core, professional codes of ethics should be presented after the meta/macro-ethics. First, the aforementioned major moral foundations will be displayed in the codes. Students can be directed to *NSPE Code* or their particular society's code to see how the codes further explicate the moral foundations stated. For example, the 'Fundamental Canons' of the *NSPE Code* display all of the above moral frameworks. Second, this integration provides an evaluative component to see if students can 'see' the moral theoretical frameworks and infer whether the justification would be consequential, deontological, virtue, or some combination. Third, the ethical codes connect theory to their profession generally and specifically. This connection promotes relevance and applicability to the engineering student's confrontation with moral philosophy. Fourth, the student is exposed to theoretical depth and diversity initially when connections are presented between the meta-ethic and micro-ethic through the vocabularies and reflections on the variety of moral justifications that may or may not lead to the same conclusion.

<u>B. Guidelines: Presentation of a modified heuristic</u>. To further promote engineering ethics education, students must be aided by ethical guidelines. The concept of 'guidelines' is used intentionally (instead of 'heuristic') to gravitate away from a regimented, piece-meal, procedure that guarantees ethical dilemma resolution. Guidelines are 'suggestions for approach' that imply flexibility, diversity, complexity; they can be modified, interwoven, or combined. These

guidelines help students approach ethical dilemmas that the foundation core enables them to identify. I suggest the following guidelines: identify the moral issues, relate morally relevant facts, consider alternative options in light moral frameworks, and present a personal decision. General guiding questions are provided to stimulate moral imagination, emphasize clarity by identifying ambiguities, increase moral awareness and sensitivity, promote ethical analysis, and encourage personal moral responsibility.

B1. *Identifying the Moral Issues*. Is there something wrong personally, interpersonally, or socially? Is there conflict that could be damaging to people? Animals? Environment? To institutions? Does the issue go deeper than legal or institutional concerns? Is there a clear distinction between the moral and legal nature of the issue? What does it do to people as persons who have dignity, rights, and hopes for a better life together? Are there conflicts of interests, justifications, duties, rights, virtues?

B2. *Morally Relevant Facts.* What individuals or groups have an important stake in the outcome? What is at stake for each? Do some have a greater stake because they have a special need or because we have special obligations to them? Are there other important indirect stakeholders in addition to those directly involved? Have all the relevant persons and groups been consulted and is there a need to do so? Is there any information that is morally relevant but unavailable? Do 'interested' parties skew available data?

B3. *Alternative Options.* Which option will produce the most good and do the least harm? Which option respects the rights and dignity of all stakeholders? Even if not everyone gets all they want, will everyone still be treated fairly/justly? Which option would promote the common social good and help all participate more fully in the goods we share as a society, as a community, as a company, as a family? Which option would enable the deepening or development of those virtues or character traits that we value as individuals? as a profession? as a society? Which option promotes particular duties of a profession, society, individual?

B4. *Personal Decision.* Considering the various options and perspectives, which of the options is the right thing to do? What are strengths in your decision that are absent in others? How does your position avoid weaknesses encountered in other options? What makes something a strength and weakness? How coherent and consistent is your option? Are there possible objections to your view? If so, what are they and can you answer them? What moral theory(ies) may ground your view in approaching the particular case?

Essentially, the guidelines are a flexible model that students begin to think about when applying the theoretical to the actual. For clarification, some intentionally over-simplified cases may be used to show applicability. However, the real test is the last component of this integrative approach – Application.

C. Application: Apply to Various Case Studies (from disaster to everyday). There are true crucial points that I wish to highlight. First, we must avoid "…fixating on dramatic cases of whistle-blowing or idealized cases of moral conflict,…[and] pay attention to the complexities of engineering practice that shape decisions on a daily basis."[6] Diane Vaughan heralds this exhortation by exemplifying the kind of analysis that avoids simplistic answers that send us searching for the evil one capable of risking killing seven astronauts or thousands of people for the sake of a profit-motive.[7] Rather, Vaughan argues for a kind of analysis that endeavors to see how someone like me ends up in a situation where a decision that puts many at risk seems like a reasonable course of action. Thus, we should avoid cases, or minimally too many cases, that consist of a decision at a crucial moment with only a few options – one or two of which are morally acceptable. Rather, cases should be more open-ended to allow students to think creatively about the moral decision-making process, promote personal and professional moral accountability, and reasonably map to contemporary engineering practice. In other words, the student could see himself encountering the same kind of dilemma and must consider what he ethically would do.

Second, we must not only consider the kind of case presented but how the cases are presented. As aforementioned in weaknesses with casuistry and heuristics, cases should not be solely presented in over-simplified ways so as to hinder meaningful exploration of the ethical complexity and depth of issues and potential resolutions. To foster moral and analytical development, some simplified cases may be used. Yet, these should always lead to cases considerations that display moral depth and complexity.

To illustrate, consider the Bhopal disaster. A degree of familiarity with the case is assumed; Stephen Unger's brief summary provides most of the information needed and has a good discussion of the ethical issues involved.[8] Typically, students concern themselves with the question of who is at fault in the disaster. This immediate tendency needs to be quickly utilized and then re-directed. First, highlighting the duties, consequences, and injustices displayed upon multiple levels (individual, corporate, national, and international) should easily come from the students' fault-finding. Additionally, one should point to various statements of professional codes to display clear moral violations.

However, to deepen the moral imagination, the concern should be shifted toward what can be learned so as to prevent such events from happening again. This shift can display the degree of effectiveness of different levels of institutional safety procedures and agencies, consider possible arbitration solutions among competing claims, and utilize a 'reverse engineering' thought process to highlight multiple points of moral obligation and violation. One way to make this shift could be to assume that Union Carbide's claim that the disaster was the result of sabotage was correct. Thus, students are forced to consider the guidelines with respect to the plant sitting, security, safety system redundancy, and system failure responses.

The case also offers the opportunity to display a number of social and political elements that are morally relevant (*e.g.*, tendency to see non-American or non-European engineers as inferior, so as to highlight cultural prejudices that may be associated with some moral conclusions). Bhopal provides an opportunity to discuss coercion vs. autonomy between more developed vs. less developed countries. This case highlights the differences in a population's willingness to take risks and how this willingness is affected by their economic status, and the pressures faced by individuals when the corporation or institution which employs them is having economic difficulties. Bhopal presents this issue of economic coercion and the obvious counter-argument that in these cases people are freely choosing avenues which allow them to overcome their economic disadvantage. Again, the meta- and micro- ethical foundations along with the guidelines applied to this particular case should aid the instructor in accomplishing the goals relayed in the introduction.

IV. Conclusion

This paper has sought to display some of the weaknesses of current pedagogical approaches to teaching engineering ethics and to present an approach that integrates the strategies into an intertwined core of foundations, guidelines, and applications. This pedagogical approach is practically applicable in multiple engineering ethics education formats (*e.g.*, stand-alone course, integration into classes by engineering faculty with possible support from another department, or engineering ethics module or workshop). The integration fosters malleability for both student and instructor by allowing and even promoting multiple discussion avenues, degrees of moral depth, and opportunities for various cases specific to context of presentation. Finally, the approach seeks to meet students 'where they are' by recognizing tendency for dogma or relativism and promote moral depth through imagination, analysis, and practicality.

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