Engineering culture and the ethical development of undergraduate students

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Abstract*: The Survey of Engineering Ethical Development is a holistic assessment of the curricular and co-curricular experiences of engineering undergraduates that lead to improved ethical development. This project will collect data from 4,000 undergraduates at 20 universities in the United States. We present a qualitative analysis of the cultural summaries from the first 10 of these site visits. In particular we consider how students, faculty, and administrators view ethics education within the context of the engineering academic culture. Students, faculty, and administrators viewed ethics instruction as an important aspect of engineering education, though they also highlighted numerous barriers to its implementation. Furthermore, each group of participants commented on the apparent disconnect between the emphasis placed on academic ethics and that placed on professional ethics. Based on these findings, we make a number of recommendations to overcome the integration of ethics in engineering curricula and to better unify academic and professional ethics.*

Introduction and Context

The ABET standards require that students have "an understanding of professional and ethical responsibility" (Engineering Accreditation Commission, 2007). While this standard is certainly positive, it is largely interpreted by colleges of engineer in a minimalist way. The resulting focus for many engineering curricula is on the acquisition of ethical knowledge (e.g. professional codes, descriptions of ethical theories, etc.) with little attention given to the developmental aspects of ethical reasoning, identity formation, and behavior.

The need to incorporate the goal of ethical development into engineering professional preparation is evidenced by *The Engineer of 2020* report (National Academy of Engineering, 2004). The report concluded that future engineers would need to "possess a working framework upon which high ethical standards and a strong sense of professionalism can be developed." Here a "framework" is envisioned as something more than simple knowledge. Rather, it is a collection of the moral empathy, reasoning, identity, and integrity needed to recognize and address ethical dilemmas completely.

Research Question

The Survey of Engineering Ethical Development (SEED) is a National Science Foundation funded research project being conducted by the E^3 Team (Exploring Ethical decision-making in Engineering, http://www.engin.umich.edu/research/e3/index.html). The primary goals of the Survey of Engineering Ethical Development (SEED) project are to further educational reform efforts by identifying the curricular and co-curricular experiences that most positively influence the ethical development of engineering undergraduates and to shed light on how participants in engineering education view ethical development. Ultimately, the SEED project will result in the development of an online survey tool that will gather data from 4,000 engineering undergraduate students from across the United States.

To accomplish this goal it was imperative that the attitudes and beliefs of educators, leaders, and learners be explored as they pertain to ethical development. Therefore, the first phase of the project was to conduct a series of focus groups and interviews with engineering undergraduates, faculty, and administrators, which lead to our research question for this paper: *How do engineering undergraduates, faculty members, and administrators view ethical development and ethics education within the context of the engineering academic culture?*

Theoretical Framework

The theoretical framework of the SEED project is depicted in Figure 1. The SEED project is holistic in the sense that a) the outcome of interest is seen as a developmental and fluid construct, and b) we consider a broad array of factors that influence this outcome. The outcome variable of ethical development is comprised of three constructs: knowledge of ethics, ethical reasoning, and ethical behavior. Knowledge of ethics is a student's familiarity with professional codes of conduct and, to a limited degree, the engineer's role in ethical dilemmas. Ethical reasoning is a student's ability to apply reason and identify the right decision when faced with a moral dilemma in a professional context. Ethical behavior is the extent to which the student takes action that is consistent with her identification of the right decision.

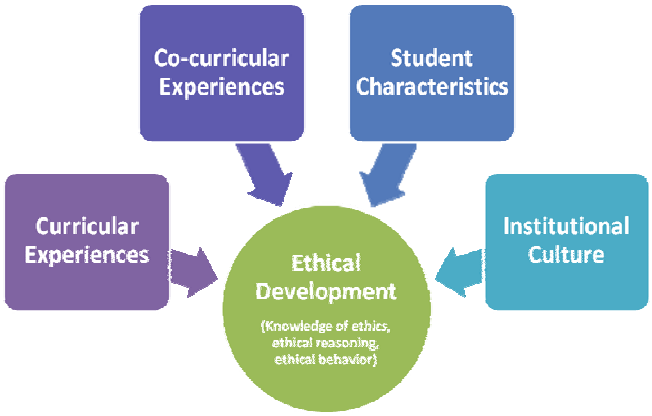

Figure 1: The conceptual structure of the SEED project

Curricular experiences are defined as those within a formal academic program that are intentionally provided by the institution with the goal of affecting students' ethical development. Co-curricular experiences are defined as those outside of the formal curriculum that may or may not be intended to influence students' ethical development. Student characteristics are those individual qualities or traits that have been shown to be related to students' moral reasoning and ethical development. Institutional culture is the collection of shared knowledge, values, practices, symbols, traditions, social norms, and ideals that are unique to a certain institution.

Methodology

Twenty institutions agreed to participate in the SEED project, representing a diversity of institutions geographically, demographically, and culturally. This paper presents data from the first 10 partner institution site visits conducted during 2007-2008. Among these schools are institutions from four types as classified by the Carnegie Foundation for the Advancement of Teaching (Carnegie Foundation, 2009): three Research Universities – Very High (RU-VH), four Research Universities – High (RU-H), one Master's University – Large (MA-L), and two Bachelor's/Specialty Institutions (BAS). During each site visit we conducted focus groups with engineering students and faculty members and personal interviews with academic and student affairs administrators in order to gain the perspectives of leaders, educators, and learners on the determinants of ethical development.

The data reported here are a result of focus groups with 66 students and 59 faculty members and interviews with 20 administrators. We employed a random recruitment process for the students and asked the on-campus liaison to select faculty members either involved in ethics education or with knowledge of how ethics is included within the curriculum. The interviewees were chosen based on their knowledge of student life and/or ethics instruction within the engineering program. We tracked the participants' demographics characteristics through a brief anonymous survey. Except for the student focus groups having a higher proportion of female students, focus group demographics roughly mirrored those of engineering students and faculty nationwide (Gibbons, 2007).

The primary purpose of the focus groups and interviews was to fully capture all dimensions of the domains depicted in Figure 1. For the student focus groups, we separated the domains into two protocols. The first included questions about curricular and co-curricular experiences that might promote or detract from ethical development, and the second incorporated questions on how students approach ethical decision-making generally. Both protocols included identical probes related to institutional culture and student characteristics. The faculty and administrator protocols were similar to the first student protocol but were adjusted to fit the participant's role, i.e. more questions about co-curricular activities for student affairs professionals and more questions about curricular activities for faculty and academic affairs administrators.

From the site visits we coded three types of transcript data: 1) the types of activities affecting ethical development, 2) the manner in which those activities were conducted, and 3) cultural aspects of the institution. A more detailed discussion of this analysis can be found in Sutkus, Carpenter, Finelli & Harding (2009) and Holsapple, Finelli, Carpenter & Harding (2009). Here we present on the cultural aspects of the institutions; however, it is important to note that this analysis is based upon the first ten partner visits only. Participants' comments that appeared to reveal a prevalent theme were coded for the theme, institution type, and the specific participant's status (e.g. student, faculty or administrator).

Findings and Conclusions

Analysis of the cultural summaries from each institution revealed two dominant themes: the importance of ethics education in engineering curricula and a disconnect between academic and professional ethics. **Firstly, it was clear from comments of students, faculty, and administrators that ethics instruction was viewed as an important and necessary part of an engineering education despite the many barriers to its integration.** Perhaps the most refreshing finding of this analysis is that faculty and administrators indicated that ethics instruction was as valuable as the analytical and scientific skills traditionally taught in engineering.

Despite this general agreement on the importance of engineering ethics, participants identified a number of barriers to effective ethics education. Faculty and administrators frequently lamented the lack of a coordinated strategic effort to integrate ethics education into their curricula. This observation appeared to hold true regardless of the institution's classification. For example, a faculty member at a RU-VH institution commented:

> "I think we do a reasonably good job of conveying ethics. I think we all have a lot of integrity in our work as faculty and we convey that. What I'd like to see probably is a more formalization of the topic of ethics in our curriculum. I think there ought to be, and I'm just

> speaking from our department's perspective, there ought to be a course in ethics, a three hour course in the first semester and it's not just um, a required course that everybody has to take, it's a course that has, you go through academic honesty, then you go through professional honesty and you go through things like certification and you talk about these things. And I'm not aware that we have that at the moment so I think we can do better."

Both faculty and administrators commented on the challenge of integrating ethics education into an already over-burdened curriculum. An administrator from an RU-H institution pointed out the resistance to adding more units to an already challenging curriculum:

> "If we're gonna be competitive to get students to come here, we're not gonna have a hundred and forty-seven hour program with a three hour ethics course. OK?"

Of course, an alternative approach to extending the curriculum would be to replace current courses with ethics instruction. Several administrators commented on clear resistance from faculty with regards to replacing content with ethics such as this comment from an administrator from an RU-H institution:

> "I think most engineering faculty are . . . while they are very engaged with students, as we talked earlier today, I'm not sure all of them are sold on, say, the importance of these other issues: communication skills, ethics, compared to discipline specific topics. So there's aversion to pulling other things out of the discipline or losing time to focus on discipline specific topics."

Finally, some administrators noted the uncertainty about what is to be taught in ethics education and how best to accomplish these learning goals as articulated by a RU-VH administrator:

> "And so, yeah, everybody thinks it's important but not everybody is convinced that we can teach it nor does everyone make a distinction between ethical reasoning and understanding, of what's right and wrong, I think there's two big barriers and that's one of them and sort of . . . I would, again, articulate that as everyone agrees it's important that people be ethical but we're not convinced that we can teach people to be ethical and by . . . and by improper extension of that logic, we're therefore not sure we can teach ethical reasoning, which is untrue . . .and that is the other issue that comes up is you'll meet a lot of faculty who simply . . . they . . . we don't have a clue how we would teach this, therefore we shouldn't."

Faculty and administrators also seemed to agree on the fact that engineering students do not seem to exhibit much expertise in the three domains identified within our construct of ethical development. In particular they commented on the students' lack of ethical reasoning ability. As one administrator at a BAS institution commented

> "Ethical reasoning, I don't think most of them could describe how [it] is they've reached the conclusion to behave in the way that they're behaving, I mean, it's almost instinctual."

On several occasions administrators noted that this deficiency seemed related to engineering students' general orientation toward task completion and problem solving rather than a more reflective approach to their education. This perception is captured in a comment from an RU-H administrator:

> "And I can tell the professional students by their behavioural, cultural needs . . . they're driven and they have a mission . . . It doesn't mean that the arts and sciences are not or the education are not, it's just that they're a little bit more holistic with their approach to their cultural development whereas I find that engineers are, in some ways, the . . . culturally, they're one-sided."

One administrator at a RU-VH institution even went so far as to suggest that engineering faculty demonstrate a similar approach to their own work:

> "I think a big piece of it is the kind of people who we select as faculty. They're selected for a certain set of capabilities and perhaps those capabilities lead to making quick decisions about these kinds of things. It's pretty hard to decide to dedicate your life to developing a technology without being pretty invested in the certainty that this is a great thing to do and so I

> think that's a part of it. But I think . . . [long pause] . . . that there's certainly a . . . faculty are selected for a certain set of attributes that makes them non . . . not reflective of even the engineering profession and so, yeah, I think it . . . you know, I think that's a big part of it."

The second dominant theme heard from participants was focused on **the apparent disconnect between academic ethics (e.g. decision-making related to cheating, plagiarism, etc.) and professional ethics.** Regardless of institution type, students repeatedly commented that the connection between academic and professional ethics was rarely made explicit within their courses, with emphasis most often placed on academic, rather than professional, ethics. For example, one student from a BAS institution shared:

> "It does seem to an extent that they want us to take what we know about academic ethics and then try to apply it to engineering in the future. Besides that there's not so much real engineering ethics being taught."

Faculty also recognized this disconnect, but see it from a different vantage point. From their perspective, students fail to see the inconsistency in making expedient choices in academic settings and being an ethical professional in the future.

> "There's a big divide between these two halves of the discussion that we're having, between professional ethics and the academic ethics. There's no question of academic ethics to them. It's what has to be done today to get today's assignments done and to write something tonight to turn into Humanities tomorrow. That's not about ethics, that's about what we need to do. And then down the road maybe someday they'll be professionals and they'll have to worry about ethical dilemmas. That's something else. So there's a complete disconnect between the two. I mean, they might be heading for a great ethical professional conduct career, but right now it's not inconsistent for them to cheat like mad."

By and large, both faculty and students attribute students' attitudes toward academic ethics to the pressures placed on them by the current engineering culture of survival and competition. As one student from an RU-VH institution comments:

> "I think that once you get passed the weed-out courses, once you realize that no matter, as long as you do the work and you're trying and you understand the material, you're going to get a C or better, I think that ethics really improves, whereas when you're in the lower classes and everyone feels like they're going to be slaughtered just on purpose, people tend to have more of tendency of, well, this class is horrible, the professor really stinks so when you you're purposefully given the horrible professors that aren't going to teach you as much and you get desperate, that's when the ethics start to fall."

A faculty member from a BAS institution shares this same perspective:

> "It's always been about beating the system and getting through. We often turn the lives of the students into nothing but a gauntlet that they run through."

Interestingly, faculty encounter similar pressures but do not seem to make the connection between their own circumstances and those of their students. Consider the following comment from a faculty member at a RU-VH institution:

> "Deans are under the same pressure the faculty are, I mean, we . . . we're supposed to be producing research, graduate students and so on, they're supposed to be getting the departments up into the top ten in every field and so they look at what they're going to be rewarded for and the time that it would take to do something like this ethical unit, it's clear what the choice is going to be. Use the success metrics."

Recommendations

To better promote the integration of ethics within the engineering curriculum we might make several suggestions. To begin with, we would encourage engineering education leaders to continue, and even intensify, the message that ethics and professionalism are critically important and essential parts of

undergraduate engineering education. Furthermore, administrators should seek ways to creatively promote ethics education and a developmental view of ethics among faculty and students within their institutions. Finally, given the challenges of adding to or altering engineering curricula, we recommend the adoption of alternative pedagogies that offer an opportunity to integrate ethics directly into the engineering content. Service learning represents one such opportunity, and we recommend that institutions seek ways to encourage and reward faculty interested in implementing service learning into their own courses.

The second prominent theme identified during the site visits reported on here was the apparent disconnect between academic ethics and professional ethics in engineering classrooms. We certainly acknowledge the intellectual and practical distinctions between these two forms of ethics. However, we would also suggest that helping students learn ethical decision-making skills and principles that apply to both contexts should be a vital part of any ethics education program. Perhaps the simplest change to be made would be to implement alternative assessment strategies that emphasize professional skills and approaches to engineering work, sending the message to students that the work they are asked to complete in college is directly applicable to their professional goals.

At a broader level we would also recommend that institutions take a more developmental view in dealing with academic honesty rather than a punitive approach. A developmental approach would suggest the kinds of ethical standards that students should be moving toward, and provide opportunities for reflection and discussion when appropriate to help students recognize where they stand relative to that standard. Finally, we would also encourage our faculty colleagues to openly discuss with their students the kinds of ethical challenges they face in their daily work, as compared to the more abstract 'engineering disaster case studies' that are so common in ethics education courses. This may require deep critical reflection and discussion among faculty, but we believe that open, honest discourse is far more likely to support students' ethical development than almost any other action educators can take.

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