



Ethics Education as Enculturation: Student Learning of Personal, Social, and Professional Responsibility

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Introduction

This paper explores how engineering students understand the meaning and role of ethics within their own life experiences, the context of their education, and their projections of professional practice. While the majority of work in engineering ethics educational research seeks to implement and assess new educational activities, approaches, or paradigms, this project seeks to better understand *students' understandings of ethics*, in their own words and on their own terms. The project takes a distinctly empirical approach, seeking to identify what is most salient about ethics and ethics education from the perspective of the students whom we interviewed, but we also draw some tentative lessons from the project that might guide future engineering ethics educational activities and, to a lesser extent, engineering education generally.

The paper draws on 18 semi-structured interviews with undergraduate engineering students, each lasting approximately 90 minutes, and additional direct observations of relevant activities, including an “ethics code” orientation, socialization, and signing event hosted by our institution, Rensselaer Polytechnic Institute, for incoming first-year engineering students. The paper is the result of early steps in the implementation of a longer-term, NSF-funded research project that extends the inquiry to the development of students’ understanding of ethics over the entire arc of their undergraduate educational experience [1].

Our argument unfolds in five steps. In the section that follows this introduction, we situate our inquiry within the broader field of engineering ethics research, connecting in particular to work on “macroethics” [2] as it intersects with scholarly work in our primary fields of science and technology studies (STS) and engineering studies. The next section reviews in greater detail this project’s research design and data set as well as the methods used to collect and analyze our data. The third section reviews our key findings for this stage of the research process, drawing extensively on students’ articulations of the role of ethics in their individual lives, their educational experiences, and the profession. In the fourth section, we identify implications of our findings and how they offer insight into both the teaching of ethics to engineering students and the broader challenges facing engineering educational environments having to do with educational and disciplinary cultures. Finally, we conclude the paper by reviewing our key findings and reflecting on what they portend for the project, and engineering ethics teaching and research, moving into the future.

Contextualizing the Project: Engineering Ethics Education Research and Practice

Over the past decade or so, engineering ethics education has witnessed tremendous innovation and, along with that innovation, has experienced much-needed diversification. This diversification is seen in both instructional approaches and research agenda. On the instructional front, educators are preparing students to attend to a wide range of modalities of ethics decision making. On the research front, scholars are tuned in to this instructional diversity and are investigating the effectiveness of ethics instruction across many dimensions, including

comparisons of instructional modalities and strategies for integration with technical content/practice [3], student competencies across instructional modalities and institutional contexts [4], student experiences with ethics instruction [5], and student understandings of the social and professional responsibilities of engineers [6].

In her 2008 book, *Engineering and Social Justice*, Donna Riley identified challenges surrounding the engineering “worldview,” in which engineers “see themselves and the profession as apolitical, objective, and value-neutral, allowing implicit assumptions about the world to govern our choices” [7]. Such worldviews could be somewhat eschewed by case-based approaches to engineering ethics, in which the cases themselves might call the reader’s attention to the political, subjective, and value-laden nature of engineering. Such approaches are common within mainstream engineering ethics textbooks [8, 9]. However, such ethics textbooks, and the educational contexts in which they are used, exist within a broader engineering social milieu that tends to occlude these particular insights; case-based approaches are susceptible to mechanistic views of ethical problem solving, allowing students a false sense of objectivity in responding to abstractions that do not challenge them as to *why* such cases are likely to occur in the first place [10, 11].

This reduction is perhaps the result of a tendency to focus on what engineering ethicist Joseph Herkert has characterized as “microethics,” a concern with ethical decision-making by individuals, instead of the contrasting “macroethics,” which turns attention to the engineering profession itself, the institutions in which it operates, and its collective responsibilities to society [12]. From our disciplinary home within science and technology studies (STS), we see a promising approach to emphasizing the political agency of engineering by attending not only to the combination of but also to the connections between the micro and macroethical levels. Far from casting aside the microethical concerns that clearly make up the bulk of an engineers’ direct experience with ethics, our project intends to demonstrate the ways that immediate, situational ethics connect to the structural dimensions of engineering and engineering ethics.

Given that individuals are typically quite sophisticated in their abilities to read subtle social cues regarding appropriate/desired/expected behaviors [13], it is not surprising that engineering students “learn” ethics by observing how behaviors and decisions are modeled across their educational experiences [7]. But we also know people frequently disregard understood norms for reasons that are more difficult to pin down, particularly when they assess a given social system to be biased against their interests [14]. In the case of student cheating, for example, it is untenable to argue that students simply do not understand that cheating is widely agreed to be wrong. While it is more tenable to suggest that students’ moral reasoning skills are impaired when they are under duress, that approach concentrates attention on the individual cheater—and micro-ethical reasoning—rather than the systemic problem of cheating as it exists across many engineering education institutional contexts. We assert that taking a systemic view of the educational context will provide novel insights into the structural precursors leading to the proximate “cause” of cheating among students: What, in students’ experiences, “causes” cheating (among other students or for themselves)? How is cheating justified by students who understand it to be “wrong”? What situational or organizational features do students think should be changed to prevent such actions?

While cheating may be interpreted as a prototypical microethical challenge, a macroethical lens invites us to respond to it as a systemic outcome of engineering educational culture. This not necessarily to say cheating is a pervasive problem, or that the problem of cheating is homogenous across educational settings, but merely that the problem of cheating goes beyond “a few bad apples” and that there are contextual, structural dimensions of the problem that are missed when focusing on shoring up the ethical fortitude of individual students as isolated ethical agents acting in a disinterested social context. This approach does not preclude the ethical responsibility of any individual moral agent, or the opportunities for moral creativity by individuals in the face of structural incentives for unethical decision making, but rather focuses analytic attention on those structural forces to guide interventions at that level. Cheating thus far has been a stand-in for all sorts of ethics-adjacent problems engineering students face, from interpersonal conflicts to institutional relationships to interpretations of technical standards. This work is thus twice broad, by interpreting microethical problems as having macroethical components (and vice versa), and by examining ethics in personal, social, and professional domains.

As Godfrey has noted, diagnosing “the problems” in engineering education—and in our case, engineering ethics—often rests on “incontestable assumptions” [15], such as the assumption that engineers are individual, rational actors or the assumption that engineering culture endorses unethical behavior. Godfrey points out that change-oriented engineering education researchers must turn attention to the *specific cultural conditions* encountered within our educational institutions in order to identify spaces for cultural reform. Furthermore, the authors recognize that engaging students in conversations about changing their educational experiences could contribute to a culture of mutual respect and facilitate transformative change [16, 17]. In light of these methodological considerations, the present analysis uses a student-oriented approach to problem framing, data collection, and interpretation in order to attend to students’ own experiences and meaning-making processes surrounding ethics [18, 19].

Research Design and Methodology

The larger project within which this analysis is situated aims to trace the development of students’ understanding of ethics over the entire arc of their undergraduate educational experience. One of the major goals of that project is to track change over time within individual students and across a cohort of students. The present analysis, in contrast, seeks to provide a snapshot in time of a small set of students, many of whom are very early in their educational program. This analysis seeks to answer: *What commonalities do we see across students’ diverse understandings of and experiences with ethics, and how do these commonalities provide insight into the overarching educational culture and its most salient features in shaping students’ ethical imaginations, community norms, and individual practices?*

Eighteen undergraduate students at our institution were interviewed for this analysis, with each interview following a semi-structured interview script and lasting approximately 90 minutes. Students volunteered to be interviewed after a brief introduction to the project by the authors during the participants’ engineering courses; additional students were invited to participate via snowball sampling. The students in this analysis represent a diverse array of majors in engineering and lab-based sciences, at all levels of their respective undergraduate careers, a

variety of socioeconomic and regional backgrounds, multiple political perspectives, and a distribution of genders (including trans/gender non-conforming students).

The interview protocol moved from rapport-building questions, through open-ended questions regarding student thinking about and experience with ethics issues, and on to more focused questions about specific dimensions of ethics, including instances of both negative and positive ethical outcomes and where opportunities existed for better attending to ethics within engineering education.

Since many early-stage engineering students at our institution have had limited explicit exposure to ethics through their course content, our interview protocol used a progressive query technique to encourage students to elucidate tentative articulations. For example, all interviewees were first asked to describe ethics in their own words and to illustrate it with examples from their own experiences. Later, students were asked, respectively, about the personal, professional, and social responsibilities of engineers. At each stage, the interviewer asked student to elaborate relevant themes by drawing on the student's own terminology, sometimes asking for clarification, specific illustrations, or comparisons between the student's individual experiences and how the student understood the experiences of others. The logic of this protocol is to avoid preempting students' own understandings by providing our framework or our terminology before they have had multiple opportunities to provide their own articulations.

Interviews were transcribed in full or using thematic/summative overviews, and transcripts were closely read and annotated independently by the authors. Transcript annotations were compared within and across transcripts to identify broad themes, with attention to how the different interviews complemented, refuted, or added nuance to our understanding of the themes identified. In this way, our analysis worked progressively toward themes that performed both categorizing and connecting functions [20]. For this present analysis, we selected examples from the transcripts both for their representativeness and their ability to articulate especially useful insights surrounding prevalent themes.

Key Findings: How students experience and make meaning around ethics

Our analysis identified four key findings that respond to our research questions: 1) Students perceived deficiencies in their understanding of and/or attention to ethics; 2) Despite initial reticence, most students desired to discuss their ethics-related experiences, and identified a range of instances from their lives relevant to our queries; 3) Students framed ethics issues almost exclusively in the negative—avoiding harm or disaster—and struggled to describe positive instances of ethics; and 4) Students identified trust and safety/security within the educational context as prerequisites for improved ethical outcomes. Each of these findings will be illustrated by drawing on student experiences and empirical examples captured during interviews.

Finding 1: Students Perceived Deficiencies in Their Understanding of or Attention to Ethics

The students we interviewed consistently showed reticence in responding to queries about their understanding of ethics, especially upon its initial introduction during the interview. They expressed a range of causes for their reluctance or inability to provide a definition for ethics, “in

their own words,” from not knowing enough about ethics to not having though much about ethics to not having been taught about ethics. As one student put it,

[My friends and I] don't talk about ethics much. We talk about classes or church or videogames. (706, 15)

Those students who did attempt an answer tended to provide highly generalized but workable definitions, such as the following:

I would say ethics are tied to morality a little bit for me. Ethics are kind of how you treat others and treat other things. I'd say an ethical person is doing the right thing in the correct way. (702, 12)

After querying students about their definitions of ethics, we asked how or where ethics had been addressed in their education. Keeping in mind that our interviewee cohort included a fraction of first-term students, responses indicated very little attention to ethics across the board. Say third- and fourth-year students:

{How have ethics been covered in your courses at RPI?} I wouldn't say that they're even covered at all. I mean, just the brief mention that you should not do this because that would kill everyone. But other than that, it's not like a lesson that we have in class. (701, 22)

{How has ethics as a topic been encountered [in your education]?} I wouldn't say I've done much with ethics in my education. (706, 11)

The latter student went on to say that they¹ had not had any courses that covered ethics, but that they thought ethics might be covered in a science and technology studies (STS) course they hoped to take in the future. Other students pointed to other humanities and social sciences courses where ethics was addressed. One such student was pursuing a minor in philosophy, where “one or two units” were dedicated to ethics, but that that was the only place ethics was explicitly covered (707, 32).

Rensselaer's engineering students are required to take what is called the Professional Development course sequence, and those courses often include content related to professional ethics.

{In your courses, which dimensions of ethics [personal, professional, social] were addressed?} ... I'd say almost exclusively professional ethics. Especially in engineering I don't think any... Maybe one time, personal ethics [came up], about being nice to others otherwise nobody's going to want to hire you, but that's about it. (702, 42)

Note that even in this articulation, “personal ethics” relates to interpersonal relationships within a professional (i.e., workplace) setting—getting a job. Another student referenced “workplace ethics” specifically, but then suggested engineering courses do not entail much group work, and hence such ethics do not come up.

{How have you encountered these ethical dimensions in courses?} Most of our courses aren't very dangerous or environmentally impactful. There's not much workplace ethics because there's not

¹ Following recent usage trends, including among our interviewee population, we use the gender-non-specific, singular “they” throughout this paper.

many group projects. I've heard of a huge range of experiences, good to nightmarish, in [a design course that requires group projects]. (706, 39)

In addition to the required Professional Development courses, another cohort-wide ethics initiative at Rensselaer is an event called "Honor the Code": an engineering ethics and honor code orientation event that mixes student socializing with socialization into the engineering profession. This activity asks incoming engineering students to read fundamental canons of the National Society of Professional Engineers' "Code of Ethics for Engineers" [21] as well as Rensselaer's academic integrity statement and then to collectively sign a large-format poster to show individuals' commitment to supporting the principles of the NSPE Code and academic integrity. Groups of ~30–50 first-year students cycle through a short student-led presentation introducing Rensselaer's ethical expectations (focusing on academic integrity), meet the staff of the first-year advising office, and move to the signing area over the course of two hours. After signing the poster, students are served ice cream and have a few minutes to socialize before they have to leave to make space for the next group.

Students experienced the Honor the Code event differently as it related to their own identity and their subsequent educational experiences.

{Did you go to the ethics code signing event?} I did. They gave me ice cream! They gave me ice cream in case I had any ethical qualms, just 'Here you go. Shh.' *{What do you remember, other than the ice cream?}* I remember they sat us down and read parts of it [the code of ethics and academic integrity policy] to us. We didn't actually have to read the whole thing, which was a little questionable. But, you know, it's a room full of freshmen; what do you want? I have [the flyer with the NSPE Code and academic integrity statement] in my apartment somewhere, because I decided to keep it, because ethics *is* important to me. (704, 18)

{Do you remember the ethics code signing event or what you signed?} Nah, I don't remember too much, just like a basic, like, it's... I don't know. I understand it's like a code of ethics. Like: "Be good at, like... Don't cheat or steal other people's work," and blah, blah, blah. (708, 36)

Later in this same interview, this student refers back to the Honor the Code event.

I mean, the code of ethics thing that was during [orientation], was like... I feel like they kind of just put that there and then they don't really address it a lot anymore. (708, 47)

A few students referred specifically to their disciplinary majors and major-related coursework in discussing their understanding of or exposure to ethics.

{Has there been any discussion of ethics in your engineering classes?} In nuclear [engineering], there is the impact on the environment, and that is a big part of nuclear just because if you aren't smart about every little thing that you do when working with nuclear waste, specifically when working with reactors, that's the big one... So then the biggest part of ethics for nuclear, I would say, is what you do with the waste so that you're impacting the least amount of living things, not just humans.

{How has ethics been addressed in your education, as a topic in general?} I can't really think of how it has. I mean, it's just the basic... like, in chemical engineering courses, you want to be able to design something that's not going to kill an entire city! ... I can't really think of any direct ethics lessons that I've had in my classes. (701, 4)

Later in the interview, this same student made a stronger point, indicating not only that ethics had not been addressed in prior coursework, but that they could not imagine a time where such a topic even could arise.

I can't think of any time that in a class they would just be like, 'Alright, let's talk now about the right thing to do!' (701, 18)

Finding 2: Despite Initial Reticence, Students Want to Discuss Their Ethics Experiences

Despite initial reticence, students opened up with further prompting and most ended up identifying instances of ethics-related experiences that they then elaborated on. The experiences they shared were diverse, both thematically and in terms of the seriousness of the perceived ethical infractions. Some students discussed ethics-related experiences within their coursework, some their residential experiences, and some extracurricular activities. Others relayed more generalized matters of appropriate student conduct and student-institution relations. Notable in these articulations is that students found relevant examples from their experiences across the range of personal, professional, and social dimensions, some prior to the interviewer's prompting in each area and others after such prompting.

In the context of ethics-related experiences in the classroom or regarding coursework generally, students overwhelmingly pointing to or, after prompting, elaborated on matters surrounding cheating. Perhaps not surprisingly, cheating was the most-discussed specific experience with ethics across the interviews.

RPI has the ethics policy in every single syllabus, like the whole, 'Hey, don't cheat. You'll get a letter to the dean, and you'll get suspended, and, like, fail the course.'² But like, they don't really talk about an ethics point as well, as far as, like, 'If you don't do this stuff, you're not going to be prepared for further, more-advanced classes, and you're not going to be ready for your job,' and things like that. So I feel like, if they highlighted that more, I would probably be more reluctant to cheat. (708, 72)

Students expressed a range of experiences with and attitudes toward cheating as an ethical infraction. As with the prior statement, another student focused on cheating as contradicting learning and, hence, eroding professional competence.

{[Following the theme of cheating introduced by the student] *Why shouldn't people cheat?*} I think, from a student's perspective, you get more practice and you learn the material better when you don't cheat. I like the idea of going to college, learning, being comfortable with the material, being in the loop, because especially for a nuclear [engineer], mechanical, aero, stuff like that, if you were to graduate without extensive knowledge about your field, I don't know how you'd grow accustomed to the work environment. (707, 76)

The student above who referred to academic integrity statements on syllabi also discussed the range of student attitudes toward "taking classes seriously."

{In what ways do you agree or disagree with other students' attitudes toward ethics?} I don't know. I obviously have friends on both sides of the spectrum, as far as taking their classes seriously. I have people who are very focused on getting the grade, and not really understanding

² The student is referring to the requirement that all course syllabi include a statement regarding Rensselaer's academic integrity policy as well as course-specific penalties for various violations of that policy.

the material well enough. And I also have people who study relentlessly in order to know what they're doing one hundred percent of the time. (708, 24)

Here, we presume those students “who are very focused on getting the grade, and not really understanding the material well enough” are, in some regard, understood to be transgressing ethical norms, even though those norms are not made explicit at this point. However, the above quotation from this same student, which comes much later in the interview, provides an answer: not understanding course material means not being adequately prepared for one's engineering career.

Another articulation described the pervasiveness of cheating and the student's experience of fear surrounding cheating and its consequences.

I've seen a lot of cheating. I mean, anyone would be lying if they said that they hadn't seen cheating in college. I'm very, like, fear-driven; I'm very paranoid with stuff like that. So whenever I'm in a situation that I feel like I could be a part of something that could get me in a lot of trouble with the teacher—because it's a no-tolerance policy in all of my classes, always... In high school, I'd cheat every once in a while, because it was, like, pathetically easy and everyone did it. But here it's very... I've seen it; I don't like to be a part of it at all, mostly for the fear of being caught, somehow. Because even though I know it's unlikely, it's just kind of a paranoia I have. (707, 70)

Concerns voicing fear, risks, and negative consequences of cheating provided contrast to those perspectives that highlighted cheating as an ethical transgression.

{[Following the theme of risk introduced by the student] *How do you or other engineering students view your ethical responsibilities towards the idea of risk?*} The only thing I can think of is someone cheating, and they're taking a risk if they get caught. But I haven't done that because that's not really worth the risk for me. *{Do other people do that though?}* Oh, I assume so. Highly, often. I mean it's RPI. I mean Chegg a little. Well, Chegg's not really cheating; Chegg's a guide.... I guess that's risking your own success, because you're not really learning, so there's something that's risky. (702, 31)

The interview protocol explicitly prompted students on ethical experiences related to extracurricular activities, and so several interviewees elaborated on those.

{How have these ethical dimensions been addressed in your extracurricular activities?} I know just on the [athletic] team, there's a lot of things you have to uphold as a student athlete. There's a lot of things you're expected to do. You're supposed to take care of yourself and look out for your teammates and be supportive of everyone and not do dumb things like just go out and make a bad example of yourself through grades or social life. (701, 23)

{[Following up on the student's discussion of participation in a student club] *What are the professional dimensions of ethics in [your club]?*} All of the programs our student group plans... I guess, the ethical part beforehand would be, ‘Is it ethical to, like, hold a scavenger hunt for the students of RPI during GM [spirit] week that has, like, these certain questions? Are all these questions OK to ask? Are they offending anyone?’ Or would it be depleting this entire organization's resources and money to hold this scavenger hunt and give away all these big monetary prizes?’ (701, 48)

Ethics experiences beyond coursework and extracurricular activities included a range of infrequently identified, but substantially elaborated issues—often sensitive ones. Two students spoke passionately about residential life issues related to living in a fraternity, including

challenges around illicit alcohol or drug use. In particular, they had each experienced acute tension between the ethical imperative of protecting the health and safety of their peers while also negotiating what was perceived as Rensselaer's "no tolerance" policy regarding alcohol and drug infractions. Another student spoke about war, working with the military, and weapons policy in the US. Another spoke of an experience where a peer consistently mocked another student with a disability, and framed the whole experience of harassment as "what's wrong with engineering." A separate interviewee described an experience with sexual harassment in a research lab.³

Finding 3: Students Almost Exclusively Frame Ethics-Relevant Issues in the Negative

A third finding of this research is that interviewed students almost exclusively framed "ethics" issues in the negative, meaning that, without prompting, they understood ethics-related issues to occur predominantly or exclusively *when things go wrong*. Most of the quotations above bear this out. Similarly, many students described ethics-related instances in explicit terms of "avoiding harm" to consumers, the public, or the environment.

{How would you define ethics?} It goes with a sort of moral code, but, like, a societal moral code, so looking out for a greater community of people and making sure you're doing the most you can not to hurt anyone in the work, or just in your daily life, that you're doing. (701, 5)

{How would you define ethics?} For me personally, it's the ability to discern doing the... I don't like to put morals into it because that's so arbitrary based on culture, but doing the thing that does the least harm to as many people as possible. (704, 20)

{How has ethics been addressed in your courses?} Ethics, I can't directly recall it ever really coming up. I mean, it's pretty cut and dry. I know if you're creating a structure or just any product, you do have to look at ethics when building pretty much anything. Just as a little side note, be like, 'Oh, will this thing that I'm creating somehow be bad for people? Will this hurt people? Who or what will it hurt? What could go wrong?' (707, 37)

In terms of the prevalence of the negative framing of ethics, one student noted, without prompting, the tendency to focus on disasters instead of things going right.

{What are the responsibilities of engineers more generally?} Making things that function, and that function well. ... I don't feel like they do have a lot of responsibilities otherwise. Because I do feel like the only thing that engineers are really, really culpable for tend to be, like, disasters. Like, when things don't work. There's not a lot of people who say, 'Ah, this works, and that's great! Let's praise the engineer that did that.' It's usually only in the science videos that people show in classes that are, like, 'Here's the guy who engineered this thing, and it still works today!' It's like [performatively unenthusiastic] 'Cool, OK.' (705)

Since this finding was anticipated, our interview protocol made it a point to ask explicitly about "positive ethical experiences." Multiple students struggled to answer this question, with some failing to identify any examples and others succeeding.

³ These examples are included because of their importance and relevance to understanding the breadth of "ethical experiences" students shared with us. Despite the importance of these particular experiences, however, the authors do not elaborate on these data points due to the limited scope of the present argument and the nuance required to treat these issues appropriately.

{[Can you share] a positive ethical experience?} Um. Alright, let me try to think in terms of something that may have happened. Because, like, I don't really do anything in my classes that would require a lot of ethical decisions, I guess. So I'm trying to think of... Maybe in [my club], and something that we had to do... Uh, I can't think of, like, anything really. (701, 28)

{Can you tell me about a time that you experienced a positive ethical interaction?} Hmm. [[Pause]] That's a good question. Um. [[Pause]]. Ah, well an easy one that I can think of is... So at work, we're in charge of our own time cards. we don't actually swipe in and swipe out like everyone else does at work. We report our own thing, so ... we could lie and say we worked extra hours when we didn't. But at least I don't think any of us have so far, that I know of at least. (702, 49)

At one point, a student who was asked about positive ethical experiences immediately reframed the question to discuss questions of fault in a disaster.

{Can you tell me about a time that you experienced a positive ethical interaction?} I don't really know, the classes are so technical-based, and not really, like, they don't really talk about ethics problems at all. One, I guess in [a Professional Development course], we did talk about ethics and who's at fault for a bunch of stuff. That's the whole point of the class, kind of. It's, like, we're supposed to debate who's at fault, why did it go wrong, things like that, from a design standpoint as well as from a legal standpoint. (708, 64)

Other students responded to the question about positive ethics by simply inverting the negative and focusing on the importance of avoiding harm.

{What is an example of the ethical problems you were thinking of?} OK, so you're a chemical engineer, and you have a reactor plant where you're synthesizing some material, right? Making some drug or something, I guess. And there's a lot of toxic byproducts that come out of it.... I guess, restrict-regulations are pretty loose, a lot of times. So let's say you can just, like, dump it into the water supply for this nearby town, and just pollute the water supply, endanger a lot of people. Or you could responsibly, like, take the waste and dispose of it somewhere else, which would cost you a lot of money and time and effort, rather than just dump it out of the backside of the building. The ethical decision would be to responsibly manage this waste, as opposed to just like, destroying a bunch of people's lives, I guess. So that's the scale I'm thinking on. (701, 15)

Further in the same interview, this student equates the "right thing to do" with teaching that it is bad to "hurt all these people."

I don't think you can teach someone to have ethics. Just, hmm... Well, I guess you can teach people like the right thing to do: you can teach people, like, 'Hey, this would be pretty bad if you, like, hurt all these people.' (701, 19)

Another articulation connected the theme of "avoiding harm" with the positive framing of "competence" of the engineer.

{Why do you view it as your responsibility to remember certain knowledge?} There's a lot of things that, if I forget them, that's how shit goes wrong. And if I'm making things, and I'm not making buildings, but like, I want to make small-scale, everyday usage stuff. And even if I'm going to make things like that, if I don't remember the things that I learn here, that's how things will fail and break and people won't want to use it, at best. At worst, it's like 'Recalled! Because babies died.' You know, things like that. And then there's blood indirectly on my hands. If there's going to be blood on my hands, I might as well go all in and make weapons and stuff. (705, 54)

A very specific thread of this framing—that ethics are relevant primarily when things go wrong and the imperative of avoiding harm—involved avoiding harm specifically to the environment. Many students referenced the ethical responsibility of engineers to the environment, some more critically and some less so. The student quoted above felt that more attention was needed to environmental responsibilities within the engineering profession.

{What are the ethical components of an engineers' relationship to the environment?} What's a nice way of saying, "None?" I feel like there should be, though. At this point in time, they should be working to do the least amount of harm to the environment, [working] to no or negative harm. But that's not always the least expensive way to do things, and it's not always what your employer wants. (705, 60).

One student, when prompted on environmental responsibilities specifically, articulated connections across diverse areas of responsibility.

{Why should engineers care about the environment?} I think everything pretty much you see is designed by an engineer.... And I think that with that amount of influence on a country, on a society, on people, that you also have to consider what the impacts are, from every aspect of what you're doing, on people and on the environment. I think that's a responsibility, a direct responsibility. If you want to create things, you have to take into consideration most every aspect you can of how it could negatively affect people, the environment, you know, anything. For future generations and in the present. And you have to, kind of, get to know the problems and solve them as best you can. (707, 93)

Another student responded to the question about environmental responsibilities by focusing simply on impact, without framing it as a matter of avoiding harm per se.

We have to take care of the environment because we live in it. We effect it; the environment affects us. Engineers might have more impact on the environment, but we have the same responsibilities to it as everyone else. (706, 33)

Finding 4: The Importance of Trust and Safety

A final finding of the project for this analysis involves students' assessment that trust is a prerequisite for ethical outcomes and that settings that breed insecurity risk producing unethical outcomes. One student, for example, defined an ethical workplace precisely according to such trust.

{What are the responsibilities of engineers in their workplace?} I guess it's all about just acting professionally, not lying to the people you're working with, and just making sure that it's a professional environment.... Because we're working in a team, we all have to be able to communicate effectively and be able to trust the people we're working with. Things like that. So I guess it's an ethics-based, an ethics code based on *trust* between each other. (708, 37, emphasis by student)

Not surprisingly, mutual trust among students was identified by several students as an important component of productive learning environments.

{Why shouldn't students cheat?} There are instances where you're taking what somebody has worked on and taken the time to learn, and has put forth their own thought and spin on something, and you're just taking it. That's not only a disservice to yourself; that's just stealing from somebody who has actually been willing to put the time in. And when you do that, especially for

an incentive like a grade, that, that's rude not only to the person that you stole from but to everyone else who didn't do as well either, because they didn't understand the topic or they tried their best and didn't quite make the grade or whatever, and especially if that person that you stole from is like, top in the class, that is not what you, that's not showing what you can do, and that's ruining it for everyone else. You've messed up the curve at that point and are screwing over an entire class worth of people, depending on obviously what the grade is. (704, 56)

Several students shared their expectation that the learning environment be built on mutual trust between students and university representatives (i.e., faculty, administrators, staff) as well. Perhaps not surprising from an organizational sociology perspective [e.g., 22], some students noted that violations of this trust led to, or was the result of, ethical compromises.

I think if [university representatives] behaved in a more ethical way, I think people would be more inclined at the school to behave in a more ethical way. (708, 77)

{*Think about an ethical challenge you faced in your first year.*} My first year on the [athletic] team, everyone sort of figured out a couple months in or weeks in that everyone doesn't like one of the coaches very much. I wanted to have an open mind. And back then they were [directly coaching me], so I wanted to be able to trust their decision-making. And then there's all these people saying they [the coach in question] are awful at doing these things, and as the season went on, I started to realize that maybe their training plan for me wasn't the best thing for me to improve. So it's figuring out how I'm going to address this to them while being respectful. Because I've learned you don't just, like, question someone who's in charge, their authority to do the job they were given to do, I guess. (701, 37)

Concerns over trust and security extended in particular to the relationship students had with their instructors, and the derivative concern over the relevance and appropriateness of course material, with several students noting negative relationships leading to negative ethical outcomes.

Some of the homework is *very trivial and very unnecessarily complicated*, but there are solutions out there for these problems. I hated [a physics course]. I didn't like it at all. I wasn't really interested in learning it or didn't think was relevant. I had a friend, though, who really understood this stuff, and so he would help me. I don't know if you would define that as cheating because we were lab partners, but yeah. (708, 26, emphasis added)

{*What should engineering students view as the ethical components of cheating?*} That's a lot. Part of me is like, "Do what you do," I guess, "because engineering school is expensive!" Like if you're reading and you just don't get it, and *the TA is no help, and the professor is condescending*, and, like, I failed that class and it fucked a lot of things up for me. And in that situation, I would have cheated my way through anything. And if I had somebody to help, I probably would have understood, but I didn't, so it's like a last resort. (705, 65, emphasis added)

Supporting this line of reasoning, but from the opposite perspective, one student noted the positive influence of instructors who students assess to be committed to student learning.

I really like the professors who are really committed to students. Not all of them are obviously, because it's also a research institute, so some of them are just here for that sweet research money. But the ones who are truly committed to teaching and getting the students to achieve at a higher level is really what RPI is all about. And I really like those. (704,7)

Implications: The need to change the frame within which ethics is interpreted

In this section, we identify some of the implications that may be drawn from our findings described above. At this stage of the project, we see three sets of implications: 1) For ethics to be central to students' experiences, it should be treated explicitly and repeatedly throughout their education; 2) Ethics discourses should be disentangled from perceptions of moralizing, especially on the part of instructors and administrators; 3) Engineering education reformers committed to centering ethics discourse should attend to the diverse components making up students' educational cultures and not just individualized student knowledge about ethics or capacities for moral reasoning. Each of these implications will be briefly discussed.

Explicit and Recurring Reference to Ethics

We believe student reticence to discuss ethics evidenced in our findings is a direct result of their lack of exposure to discussions explicitly about ethics, and we see this as a generic challenge facing engineering education. We do not assume or imply that "explicit treatment of ethics" need follow any particular ethics or educational framework. To the contrary, we suspect that even informal, non-scholarly attention to ethics would be beneficial compared to the current situation, at least at Rensselaer. As with the students we interviewed, we suspect many engineering instructors also experience reticence to discuss ethics due at least in part to fear their knowledge of ethics is inadequate to "teach" it in the classroom, and, hence, ethics-oriented discussion is avoided. This applies not only to specialized ethics topics, such as moral reasoning, but even in the most general terms, such as, for example, the issue raised by one of our interviewees: the "ethical imperative" that engineering students learn their course material if they intend to work as an engineer. Students can practice ethics discourse, even if ill-structured and without the support of formal ethical framework, by being exposed to such discourse throughout their courses, in discussions with their instructors and advisors, and in many other ways.

Despite initial reticence, it is also clear from our interviews that students are willing and capable of discussing ethics, with nuance, across personal, professional, and social dimensions. The private setting of the interviews may have encouraged a candor less likely to occur in a classroom setting; nevertheless, educators hoping to increase the frequency of ethics-oriented discussion can tend to the *quality* of those discussions by fostering an open and supportive environment and consider ways to facilitate discussions of ethics that are not guided exclusively according to the instructor's expertise. Instructors and other educational staff can also consider ways of "teaching" the importance of ethics within any given organizational context by creating opportunities for ethics discussions outside of formal classroom settings. The Honor the Code event at Rensselaer is one example of such an opportunity, even if the desired quality of discussion about ethics was missed due to its necessarily fast pace. Though diagnosis of the specific ways such events could achieve high-quality discussion and student engagement is outside the scope of this paper, ethics-committed educators could take the opportunity to learn from similar "ethics broadcasting" events in their own institutions.

Countering Perceptions of Ethics Discourse as Moralizing

While we are not at all surprised by the finding that students overwhelmingly frame ethics in the negative, we see opportunity here to create ethics learning opportunities that are not associated with ethical failures and individuals' deficiencies as moral agents. Especially at Rensselaer, we see significant potential in reframing the discussion away from "ethics" as about inadequacies and ignorance. Instead, we could shift the way we talk about ethics to highlight students' already-present capacity for ethical reasoning, to celebrate the nuances with which they assess real-world ethical dilemmas, and to identify the innumerable positive instances of ethical behavior always already surrounding us. This shift could encourage students to leverage their strengths and elaborate on what they already assess to be ethically robust behavior, especially in the face of abundant opportunities for compromising ethics. The shift could also change the way engineering course instructors think about "ethics" in their classrooms, providing openings for integrating ethics discourse across their lesson plans.

Our proposal here mirrors P. Aarne Vesilind's shift of attention away from "negative peace" and toward "positive peace" in his treatment of "peace engineering," creating a proactive effort to establish engineering ethics as a site of potential good [23]. One articulation of such a positive ethics from the literature is George Catalano's proposed fundamental ethics canon: "Engineers, in the fulfillment of their professional duties, shall hold paramount the safety, *health*, and *welfare* of the identified integral community" (emphasis ours) [24]. Though this canon only addresses the professional dimensions of engineering ethics, attention to ethics that emphasize the health and welfare of others—and *the social good* more generally—in the personal and social spheres promises to be a fruitful approach to integrating the microethics of the day-to-day with the macroethics associated with institutions and broad social systems [25].

Attending to Educational Culture and Not Just Student Knowledge

Finally, we find that if engineering educators desire to change how students develop and practice ethics, attention must be given not only to students' demonstrated ethical knowledge, but also to the educational cultures in which that knowledge is expressed. In the case of Rensselaer, students would certainly have benefited from having scholarly ethics vocabulary available to them, but the experiences that they identified as relevant to ethics, and their individual responses to those experiences, were shaped far more by institutional culture than by the degree to which they had command of ethics theoretical frameworks. To some extent, this implication was prefigured by our interest in macro-ethics, the systemic barriers to ethical outcomes, as well as the empirical focus of the study. Even so, cultural change seems to be a ripe area for intervention in ethics education for engineers.

As we saw in our interviews, students' value of trust is directly relevant both to how students imagine professional engineering experience and to student affect toward other students, instructors, and university administrators and staff. Valuing trust could be considered an articulation of a positive ethics, just as a violation of that trust is related to things going awry ethically. Certainly, our data showed a direct correspondence between perceptions of distrust and instances of unethical outcomes. Cultivating institutional cultures of trust are one tangible way that educational climates might be changed to facilitate ethics discourse and ethical behaviors.

Another potential site of reform at Rensselaer in regards to ethics outcomes is increased attention to “real-world” applications of engineering knowledge as way of building competence in both engineering technical skills and engineering ethics. This shift to ethics knowledge as “skills that must be practiced in order to be learned” could fit nicely with the contemporary emphasis on active and project-based learning approaches in engineering education.

Conclusions: Ethics research moving forward

Extending from research advocating attention to the intersection of micro and macroethical approaches, this paper has explored how engineering students understand the meaning and role of ethics in a variety of contexts surrounding their educational experiences. Building upon students’ own articulations, we found that students perceive deficiencies in their understanding of ethics; that despite initial reticence, most desire to discuss their ethics-related experiences; that they frame ethics issues almost exclusively in the negative; and that they interpret trust and security within the educational context are prerequisites for improved ethical outcomes, particularly around cheating. While many implications could be drawn from these findings, we attended to the importance of treating ethics more consistently (and more flexibly) across students’ educational experience; the importance of taking students’ existing knowledge about ethics seriously; and the opportunities for addressing perceived deficiencies in students’ ethics discourse at the level of educational culture and not merely (decontextualized) student knowledge acquisition about ethics.

As part of our larger, multiyear research project, we plan to use the findings described in this paper to inform our investigation of how students’ understandings *change over time*, for our particular cohort, during the course of their undergraduate education. We expect this work to contribute to the empirical record students’ understandings of ethics in their own terms. More fundamentally, however, we hope these findings will contribute to the trend in engineering studies research over the past several years that looks at the intersection of student learning and critical analysis of engineering institutions, both formal (e.g., educational institutions, professional societies, accreditation standards) and informal (e.g., engineering worldviews, educational cultures, dominant didactical/pedagogical frameworks). We hope to provide support for other ethics and education researchers who seek to better comprehend the broad structuring forces within engineering—including the underlying assumptions that engineering is apolitical, objective, and value-neutral—and how those forces manifest across a wide range of empirical settings. We hope other researchers can build on our findings by providing a wider range of student articulations of their understanding of ethics and ethics-related experiences and how those experiences are conditioned by the larger institutional contexts within which they are situated.

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