

Disciplinary Leaders Perceptions of Ethics: An Interview-Based Study of Ethics Frameworks

Laurie A Pinkert

Jonathan Beever (Associate Professor)

Beever is Associate Professor of Ethics and Digital Culture at the University of Central Florida, and director of the UCF Center for Ethics. Learn more at jonathan.beever.org

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Abstract

Understanding institutional leaders' perspectives on ethics frameworks can help us better conceptualize where, how, and for whom ethics is made explicit across and within STEM related disciplines and, in turn, to better understand the ways developing professionals are enculturated toward responsibility within their disciplines. As part of an NSF-funded institutional transformation project, our research team conducted interviews with academic leaders about the frameworks of ethics in their home departments, programs, and fields. This paper reports on a series of eleven (11) interviews whose content describes the perspectives of disciplinary leaders from biology, chemistry, computer science, mathematics, mechanical and aerospace engineering, optics, philosophy, physics, psychology, STEM education, and writing and rhetoric. Contextualizing frameworks through the participants' identification of experience, content, and audience allows us to better understand the landscape of ethics practices and procedures that act as the explicit training and education STEM learners receive in their disciplines. If ethics is an important educational focus for engineering, and the work of engineering relies on interdisciplinary connections, then understanding how ethics is taken up both within and across those collaborating disciplines is an important means of supporting ethics in engineering.

Introduction

Perhaps one of the most common frameworks of ethics in STEM disciplinary contexts are standards on academic integrity found in course syllabi. These statements about plagiarism, cheating, and intellectual property have been standardized and are practically copied and pasted into each new syllabus. These principles are perceived as being so common sense that many instructors no longer attend to them when going over the syllabus with students. Such "common-sense" ethics are not unique to higher education contexts but can be found in almost any organization. Yet, just as students still get in trouble for plagiarism under the guise of ignorance, engineering professionals can participate in ethical missteps which might be labeled as implicit, understood, or common-sense. Therefore, it is important we do not work under the assumption that frameworks are commonly understood among everyone in our discipline. Rather, we must work to refine our *disciplinary frameworks* at the programmatic and institutional levels.

This project stipulates *disciplinary frameworks* to be those explicitly-designed and institutionalized practices and products related to ethics in the disciplinary context [12] [13]. These may vary in breadth, visibility, and depth but form the shape of ethics within each discipline. Our stipulated definition of frameworks responds to loosely defined usage in other ethics literature. Foote and Ruona's 2008 work synthesizes what they call "ethical frameworks"

which, while not explicitly defined, seem to consist of components of the institutionalization of ethics including “leadership, infrastructure, stakeholders, and organizational culture” [14]. In the context of public health ethics, Petrini argued for a distinction between normative foundations and practical frameworks of that field, but did not offer an explicit definition [15]. There, “practical frameworks” seemed to connote ethical decision-making strategies and procedures that utilized or applied normative tools toward practical ends. Yet others working in health and bioethics use “frameworks” in the opposite way, pointing directly at normative theories and tools, while still stopping short of explicitly defining the term [16]. Similarly, the term is widely used and under-defined in engineering ethics as well. Peters et al., thinking about AI ethics, mirror the approach of Petrini in bioethics in differentiating between normative tools and practical frameworks: they outline two frameworks intended to translate “ethical principles into actionable strategies” [17]. Walling’s approach to frameworks in engineering ethics takes the other tack, using the term to refer to traditional ethical theories [18]. By stipulating the boundaries of the term *disciplinary frameworks*, we align our thinking more closely with the components of the institutionalization view rather than either the ethical decision-making strategies or the normative theory views.

Disciplinary frameworks of ethics make visible strategies for the institutionalization of ethics taken up within and across those disciplines. If ethics is an important educational focus for engineering, and the work of engineering relies on interdisciplinary connections, then understanding how ethics is taken up across those collaborating disciplines is an important means of supporting ethics in engineering. Understanding institutional leaders’ perspectives on these ethics frameworks within those collaborating disciplines can help us to better conceptualize where, how, and for whom ethics is made explicit across and within disciplines and, in turn, to better understand the ways developing professionals are enculturated toward responsibility within their discipline.

As part of an NSF-funded institutional transformation project, our research team conducted interviews with academic leaders from disciplines in and around engineering about the frameworks of ethics in their home departments, programs, and fields. This paper reports on a series of eleven interviews, describing the perspectives of disciplinary leaders from biology, chemistry, computer science, mathematics, mechanical and aerospace engineering, optics, philosophy, physics, psychology, STEM education, and writing and rhetoric.

Developing *external* frameworks of ethics (such as adaptable strategies for ethical decision-making, professional development activities, and responsible conduct of research programs) are certainly important [1], but building a culture of ethical STEM also must involve developing robust understanding of the ways in which these frameworks are introduced, refined, and engaged. Additionally, the development of new frameworks may be more effective if it takes into account those already familiar to its potential participants and those complementary to

existing infrastructure. If we aim to eventually understand the roles and impacts of the ethics frameworks within engineering and across the interdisciplinary teams in which engineers work, we must first know where, how, who, and what contextualize the introduction to and uptake of the frameworks themselves.

Literature Review: Where, How, and For Whom?

Existing literature has emphasized narrowly defined projects looking separately at *how*, *where*, and *for whom* ethics is made explicit. For example, several projects have examined the perspective of leaders on ethics in both industry and academic settings to examine *how* influential practitioners understand fundamental concepts like ethics and compliance [2][3][4][5]. While leaders' conceptual knowledge or understanding can certainly influence the culture of ethics within an organization or discipline, it cannot necessarily be taken as a proxy for the understanding of the larger group that leader represents. Leaders often maintain authority and/or responsibility for implementing and modeling the values of their group but they do not control all aspects of the infrastructure that supports ethics frameworks. Leaders can, however, not only offer an important perspective but also an important view of the group and its activities, including a view of the landscape in which ethics frameworks are engaged for members of their groups.

When the infrastructural landscape of ethics frameworks has been studied, it has often been examined from a disciplinary perspective. Broad meta-analyses, for example, have drawn attention to the diversity of ethical approaches in engineering [7] looking at *where* ethics is made explicit. Bielefeldt's 2016 work, for instance, took a national perspective, analyzing curricular mapping of ethics through surveys of administrators and faculty across the U.S. to understand how ethics is taught [6]. National trends on where ethics is made explicit can provide important benchmarks but can sometimes offer insufficient recognition of the roles that institutions play in affecting the implementation of larger disciplinary norms. Without sufficient institutional granularity, it can be difficult for individuals who are invested in developing a culture of ethics on their campus to understand the range of frameworks in place on their campus. Additionally, there has been little focus on micro-level disciplinary differences that may impact the implementation of frameworks.

Beever, Kuebler, and Collins' recent analysis of ethics courses and *where* they are taught provides some further institutional specificity [9]. Courses are only one framework—albeit an important one—that cannot fully describe the culture of ethics and the experience of disciplinary frameworks at large. Without understanding how and when individuals are introduced to frameworks, we lack important information about the disciplinary enculturation process as it relates to the ethical norms of specific disciplines and interdisciplinary work. This work is especially important in the context of engineering, which relies on interdisciplinary connections

in particular at the intersections of so-called “hard” and “soft” skills, like ethics and communication.

Research Questions

We are conducting a five year study to improve understanding of how institutional infrastructure communicates ethical frameworks and promotes enculturation to disciplinary norms. The study includes interviews of faculty and students across STEM fields, along with analysis of key frameworks identified within and across disciplines. This paper reports on an initial interview phase in this study, discussing the analysis of transcripts from interviews with eleven disciplinary leaders at our institution.

Our primary research question for this phase of the study is: What kinds of ethics **frameworks** do disciplinary experts identify as present within their department, institution, or discipline? As noted above frameworks are defined as “the explicit content and structured experiences that shape professional development and disciplinary enculturation.” This larger question is informed by three additional research questions that help to contextualize the frameworks that are identified as relevant to disciplinary enculturation:

- Where do individuals **experience** frameworks relevant to their discipline?
- How are different kinds of **content** used to engage the frameworks?
- Who is the primary **audience** for the frameworks identified?

Contextualizing frameworks through the identification of experience, content, and audience allows us to better understand the landscape of ethics practices and procedures that act as the explicit training and education individuals receive in a particular 00 . Our approach provides a view that holistically evidences the *where*, *how*, and *for whom* ethics is made explicit, through analysis of its disciplinary frameworks.

Methodology

Research Site: We conducted interviews with disciplinary leaders at the University of Central Florida (UCF). UCF is a public university in Orlando, Florida, with more than 70,000 students, the largest university in the state and one of the largest universities in the nation. The university confers over 18,000 degrees per year across 106 undergraduate programs, 95 masters programs, and 34 doctoral programs (31 research and 3 professional). The College of Engineering and Computer Science is the second largest college at UCF, with higher enrollments than any other area besides the College of Science [10].

Participants: Recognizing that program leaders often have the responsibility for implementing ethics frameworks that are mandated and the opportunity to support a culture of ethics beyond mandates, we sought to interview individuals with a leadership role within the departments in

our study. The interviewees described in this paper typically held a chair or director role within an academic department. In one instance the chair was unable to complete an interview and recommended a graduate coordinator to represent the leadership of the department. Department leaders were interviewed in biology, chemistry, computer science, mathematics, mechanical and aerospace engineering, optics, physics, psychology, philosophy, STEM education, and writing and rhetoric. This breadth of fields allows us to compare the ethics frameworks common to engineering with those of other fields with whom engineers might collaborate.¹

Data Collection: Disciplinary leaders were interviewed following a protocol approved by the UCF Institutional Review Board. All interviews were conducted remotely via Zoom, which enabled audio/video recording and automatic transcription. The semi-structured interview included the following questions such as: “Where do the students in your program or department encounter formal instruction in the ethics expectations of the discipline?” Follow-up questions were posed as needed to clarify answers or to enable the subject to elaborate. For example, when subjects were asked to describe vehicles for communicating ethics frameworks to students, they commonly listed classroom instruction. When encouraged to add additional examples, many would elaborate on other modes, such as guest speakers or professional-development workshops. Interviews typically lasted 20 minutes. Zoom-generated transcripts were reviewed and edited for accuracy before they were coded.

Data Analysis: We conducted qualitative thematic analysis of the transcribed interviews. Interviews were first coded for segments in which participants described a framework, defined as “the explicit content and structured experiences that shape professional development and disciplinary enculturation” [11]. Once a framework segment had been identified, the segment was then examined for three elements of the framework: experience, content, and audience (see Fig 1). These sub-categories of the frameworks were refined through a pilot study of four interviews [11] and include typical areas referenced in the literature with the addition of participant-generated codes. Experience codes describe the activity through which an individual would encounter the framework; Content codes describe the format through which the values or standards are communicated; Audience codes describe the intended audience for the framework.

Framework Elements	Experience	Conference
		Course
		Member Group
		Mentoring
		Practice
		Software
		Training
		Workshop
		Unspecified
	Content	Case Studies
		Codes of Ethics
		Conversations
		Experiential Learning
		Unspecified
	Audience	Post-Docs
		Professionals
		Students-Grad
		Students-Not Specified
		Students-Undergrad
		Unspecified

Fig 1: Coding Categories Associated with Experience, Audience, and Content

¹ We recognize that ethics frameworks are not solely the responsibility or purview of departmental leadership and we are interviewing faculty and students in another subsequent phase of this project. Therefore, these interviews are not included in the data reported here.

Results and Discussion

Our primary research question asked about the kinds of frameworks disciplinary experts identify within as relevant to their discipline. In the three subsections below, we offer results of the qualitative coding and discussion of those results for the three contexts in which we examined the frameworks segments: experience, content, and audience. In tables throughout this section the disciplines are abbreviated as follows: BIO = Biology, CHE = Chemistry, CS = Computer Science, MATH = Mathematics, MAE = Mechanical and Aerospace Engineering, OPT = Optics, PHI = Philosophy, PHY = Physics, PSY = Psychology, ED = STEM Education, and WR = Writing and Rhetoric.

The Experience of Frameworks: Understanding the Role of Institutional Scales

We coded for experience when the participants signified activities in which ethics frameworks may be communicated. We coded for the following experiences: conferences, courses, member groups, mentoring, practice, training, workshops, and software. Additionally, we maintained an unspecified experience category for any activity mentioned by participants, which did not fall into any of the categories above.

		DISCIPLINES										
		BIO	CHEM	CS	ED	MAE	MATH	OPT	PHI	PHY	PSY	WR
CODING ITEMS	Conference		X		X	X			X	X		X
	Course	X	X	X	X	X	X	X	X		X	X
	Member Group	X	X	X	X	X		X	X	X	X	
	Mentoring	X	X			X	X	X		X	X	X
	Practice										X	
	Software	X	X	X								
	Training	X	X	X	X	X		X	X	X	X	X
	Workshop	X	X	X	X	X	X		X			
	Unspecified	X	X				X	X			X	X

Table 1: Frameworks, Categories of experience. Types of content identified in a specific discipline are marked with an X. Grey cells denote that a type of content was not identified.

As evidenced in Table 1, the most common experiences were courses and training while the least common experiences were practice and software. The other codes were mentioned with relatively moderate frequency with mentoring and member groups/clubs being the second most common experiences mentioned across all interviewees.

Ten out of the eleven departmental leaders interviewed reported the presence of courses as relevant frameworks for their disciplines. When discussing courses, most of the participants identified one or two credit-bearing classes in their specific program, which provided examples of where or how ethics may be taught. In response to a question about where students might encounter the ethical standards for their field, one interviewee from psychology stated:

We have a number of courses. I think their first exposure to the ethical guidelines, if it's not as a part of general [discipline-specific core course] or another foundational class, is probably in the research methods course because they address the [expectations] that are most relevant to undergraduate students, namely ethical guidelines regarding publication and regarding research.

The identification of frameworks through courses within the core curriculum was common across fields. For example, one participant from mechanical and aerospace engineering noted the integration of ethics frameworks into introductory courses and capstone courses that bookend the students experiences within the curriculum:

So we have two courses. For freshman... This [course number] is Introduction to Engineering... where they touch on various engineering aspects, and part of it is a component for ethics. They also encounter ethical aspects of engineering in the senior design course.

This participant notes the ways that courses might be used to both introduce and develop students' knowledge of or experience with the frameworks within their field, noting varying levels of development associated with varying levels of coursework. While most participants discussed courses as credit-bearing curricular-based activities housed within their departments, at least one participant referenced the idea that ethics might come up in the “humanities or social science courses” that an engineer might take during their university requirements such as general education. This was differentiated from the courses that an engineer would take within the discipline and those that the discipline would require, but highlights the possibility for connection throughout the broader courses a student might take outside the discipline.

Training, like courses, were mentioned by most participants as a framework that was common to the members of their disciplines. Training experiences were coded when the participant mentioned required preparation for a specified disciplinary or professional action. Those training referenced by our participants included CITI (Collaborative Institutional Training Initiative), FERPA (Federal Education Rights and Privacy Act) training, or lab (or lab-safety) training. CITI and FERPA training are both formal programs students must pass to conduct research at universities. Other training, such as lab training, can be more informal. For example:

We discussed Title IX things like no relationships please between, you know, graduate students and undergrads. That's a discussion that I learned to have to make, I guess.... Yeah, I guess, working within a lab and the lab culture and respect of others and respect of resources.

These frameworks of courses and training demonstrate the different scales at which frameworks operate, with courses typically affiliated with the specific department in which a program was housed and training being exclusively affiliated with a university-level (rather than departmental) requirement.

For instance, one participant from physics explained: “We have to do the CITI training... So, through the auspices of the University, which provides the CITI training modules online, [students] will encounter appropriate practices for ethics and research through that training.” Another participant echoed this institutional scale for training as relevant to faculty within their department, “Oh, in fact, our mandatory training for faculty are these modules that they need to take through [our content management system] about ethical contracts. I guess, these are the mandatory trainings.” None of the participants we interviewed mentioned department-specific training. Rather, training experiences were required at the institutional or broader national scales (such as those affiliated with federal research programs). Even in lab settings, in-house training consisted more of informal conversations rather than formal training programs. For instance, one participant from biology mentioned:

....I have to go to regular trainings on an annual basis for [animal-handling]. And how to handle [animal], which you know, I've been working with [animas] for [number] years. It's really the people that are in my lab that need to go to these meetings but I would say, aside from what's offered regularly with university and what's required of us on an annual basis.... I don't, I haven't seen much by way of Title IX or some of the “if you see something say something” with regards to domestic violence and reporting students at risk. Those have just been more periodic I think.

Despite the lack of program specific training, almost all of the participants made reference to these institutionally mandated training experiences as relevant for undergraduate students, graduate students, and faculty members.

Like training, software was another framework that was only described as operating at an institutional scale. We coded software experience as any application, script, or program that is run by a participant or by another individual on a participant's work in order to evaluate adherence to a specific set of values perceived as standard. Three of the eleven participants referenced software experiences, which primarily included programs like Turnitin.com or other plagiarism checkers. One participant from biology explained:

...for undergraduates and for graduate students—any honors in the major or graduate thesis or dissertation—has to go through [plagiarism checker software] before it's accepted by their committee. Also, I think a lot of classes may use that—not necessarily at the graduate

level but for undergraduates—to double check if they have an essay that, you know, hasn't been plagiarized.

While this framework was not identified by as many participants, it highlights the compliance aspects of frameworks within the institution that may be enculturating students. These may operate in complement to or in tension with other kinds of frameworks but are instituted at a higher scale (institution-wide).

Workshops provide an area in which participants noted both departmental scales and institutional scales in which students might experience disciplinary, interdisciplinary, or transdisciplinary frameworks for ethics discussions. One participant from chemistry explained:

I think that many grad students are going through an ethics program with the College of Graduate Studies—at least that was happening, a year or two ago, I'm assuming it's still going on—where they could get some kind of credit for taking a short course on [ethics].

The courses referenced here as offered by the College of Graduate Studies are not taken for academic credit toward a degree but rather part of a required professional development series that includes foci on individual and research ethics in which graduate students must participate during their time in their program. Although these institutional courses are not program specific and could range in topic, they were referenced by department leaders as a significant ethics framework for students in their department.

While it was beyond the scope of these interviews to capture all the ways that students might experience ethics frameworks in their courses, the participants' discussion of courses highlights their expectation that students encounter disciplinary frameworks here. This framing is important because it provides evidence of the diversity of scales, from program to discipline to institution, at which ethics frameworks work through this one lens.

The Content of Frameworks: Considering the Variation from Codes to Conversations

Identified frameworks give us access to the nature of those experience but not necessarily their content. Identifying relevant discursive practices can help us better understand the content of each framework. Therefore, we also coded the interviews for content, which not only helps us to understand the formats in which the values of a discipline are communicated but can also provide important sites of content that can help members and non-members understand the standards and values of a discipline. We coded as content any documents, standards, pedagogical approaches, projects, or exchanges which were referenced in the frameworks. The content codes included codes of ethics, case studies, experiential learning, and conversations. Additionally, we included a category for any content related entity mentioned by participants that did not fall into any of the specific categories listed above. The content codes co-occur with experience codes, with content codes identifying explaining the specific formats in which the ethics expectations of the disciplines are communicated and experiences identifying the sites in which these communicative activities occur.

		DISCIPLINES										
		BIO	CHEM	CS	ED	MAE	MATH	OPT	PHI	PHY	PSY	WR
CODING ITEMS	Case Studies			X	X				X	X		
	Codes of Ethics	X	X	X	X	X	X	X	X	X	X	X
	Conversation	X	X	X	X	X	X	X	X	X	X	X
	Experiential Learning			X				X	X		X	
	Unspecified	X	X	X	X	X	X	X	X	X	X	X

Table 2: Content, Categories of content identified in a specific discipline are marked with an X. Grey cells denote that were type of content was not identified.

The two most prominent codes for content were codes of ethics and conversations. Our codes of ethics category includes any response referring to an established statement of expected behavior for individuals within a group associated with a profession or discipline. These standards of behavior could be explicit or implicit, formal or informal, written or verbally communicated. Many of the codes of ethics identified were situated at the disciplinary or professional level rather than at the programmatic institutional levels. For example, one participant from optics suggested:

Most professional societies, or many professional societies, have Code of Ethics that when we are members of those societies we agree to uphold those codes. But I'm sure people are aware that they exist, they probably don't spend a lot of time looking at them...

Even though this interviewee speculated these professional standards were perhaps not well known, the person still argued they existed and mentioned some professional organizations have training related to these codes. Participants from every discipline seemed eager to affirm that codes of ethics were a relevant framework, mentioning existing codes of ethics or less formal standards within professional organizations or conferences. A few, however, offered more implicit examples. One participant from mathematics reflected on their program, explaining:

Then you know I think for me it's more like you know, because you get PhDs or you follow your supervisors, you know, I mean your supervisor is a good model. So, you just follow the style in some way, so....you cannot cheat, that's basic, right. So, and I mean, you have to do the math. Not to do anything else right. So, I mean just that's something I think. What you're supposed to do, I think you know I just stay in sync....

Here, the participant offers a less formal way to know what ethical standards of behavior are acceptable or not. This assumption that ethical behavior is more common knowledge or easily

observable in other in the program is mirrored in another participant's response when they argued: "I think also that we have it, in some ways, we have it built in to the doctoral systemthat students understand that it's an expectation."

Outside of the formal and informal ways these codes of ethics are related to students, faculty, and professionals, the participants also reported having conversations among faculty and students about what is ethical in their discipline or department. One participant from psychology articulated:

There are many, I believe, who can competently talk about this, and who are providing lived experiences to their students about why it's important, what we're doing about it, and in what ways it is difficult. Because that's the part that I think is often overlooked. Ethics are often sort of described as well, you either have them or you don't and it's positive or negative, and of course you do with this, not that I mean who would? But, of course, the devil is in the details, and it is in those dilemmas where you have two bad choices and now, how do you decide between when you will inherently violate one or the other principle, what do you do?

This participant underscores the importance of having conversations about ethics and ethical dilemmas instead of leaving it up to chance that students will pick up on them simply by observation. Echoing this participant, another interviewee, from writing and rhetoric, asserted the importance of having conversations with students about ethics. They argued:

I mean we're talking to them about the foundational knowledge of critical thinking as the foundational knowledge of everything that we do in the world, well beyond higher education or their ability to write well. Or, to be able to communicate effectively. Let's move away from the idea of even writing well but to effectively communicate can be life and death for students right for us as citizens....

It is evident from just these two examples that these disciplinary experts value the implications of having conversations with students. Unfortunately, more often than not, these conversations are only being reported as taking place from faculty to students. When asked what types of conversations faculty members are provided, the data becomes more scarce and is primarily relegated to faculty meetings or guest speakers. For example, one participant reported "that's a good question. We had [faculty name] come into our faculty meeting, right, and talk about various, I think, on campus possibilities for faculty members."

Case studies and experiential learning were not commonly reported as framework content: these codes were only mentioned by four of the eleven participants. While this may suggest that these two categories are not as common across disciplines, it does not necessarily indicate that they are not present. Rather, it suggests that disciplinary leaders did not readily identify them. It is possible that these two categories may be associated with a level of experience and familiarity that may not be accessible to department leaders who may not, for example, be regularly teaching courses in which these activities often occur. Alternatively, the language of cases and

experiential learning may be too field-specific to be used by these leaders and to, therefore, show up in our coding. Further discussion with additional participants at varied scales is essential to understand the departmental frameworks in a representative way.

Almost every interviewee mentioned some form of content *not* specified by the categories we identified. Sometimes these references were vague as was the case with one participant from mechanical and aerospace engineering who said, “Faculty pursue their own professional development by going to conferences. So, it's not so much directed from the department other than you know faculty meetings, but the professional development of faculty members are [sic] typically self-driven.” Others were more specific and discussed general experiences offered to various audiences without going into the specifics of what content was covered. Another participant from writing and rhetoric highlighted this relationship:

Absolutely, so we teach students about disinformation and misinformation and our role and responsibility to respond to misinformation is just it, you know as we both know, like somebody thought it wrong but disinformation is an intentional manipulation and so where is our responsibility to respond to that and to verify?

Even though this participant mentions teaching, we cannot assume a conversation or any other specific content category is encompassed in it. Every person we interviewed made at least one comment about content which could not be coded more specifically.

Our participants exposed the importance of ethical standards and the necessity of having conversations about them with students. Interestingly, the people who are in charge of those conversations—faculty—are the ones who receive the least amount of attention when it comes to this same content category. Participants may also need to clarify certain content approaches which are less clearly defined in their initial comments.

The Audiences for Frameworks: Increased Expertise Decreases Direct Engagement

In this study, “audience” signifies those intended to receive the framework experience.

Participants who referenced a training, for example, may have attributed that experience to a specific population such as students, faculty, or professionals. Thus, we narrowed this code into the sub-categories of professionals, faculty, post-docs, and students (not specified, undergraduate, and graduate). As with the other codes, we also had an unspecified category for any audience which may have been identified but did not fall into one of the categories above.

		DISCIPLINES										
		BIO	CHEM	CS	ED	MAE	MATH	OPT	PHI	PHY	PSY	WR
CODING ITEMS	Faculty	X	X	X	X	X	X	X	X	X	X	X
	Post-Doc											
	Professionals			X	X	X	X	X			X	
	Students-Grad	X	X	X	X		X	X		X	X	X
	Students-(Not Specified)	X	X	X	X	X	X	X	X	X	X	X
	Students-Undergrad	X				X		X	X	X	X	
	Unspecified	X			X		X	X	X	X	X	

Table 3: Audiences, Categories of audience identified in a specific discipline are marked with an X. Greyed cells denote that a type of participant was not identified.

The two most common audiences referenced by participants were faculty members and general, unspecified student populations. All eleven participants identified these audiences during their interview. However, the audience categories of professionals, faculty, and more specific student audiences were mentioned with relative frequency among all of the interviewees as well. The category of professionals came up regularly across participants but also exclusively in the context of codes of ethics – where professionals are identified as members of professional organizations shaped out of specific disciplines. One participant noted:

...[M]any professional societies have Code of Ethics that when we are members of those societies we agree to uphold those codes. But I am sure people are aware that they exist, they probably don't spend a lot of time looking at them, and I mean some professional societies may offer some ethical training...”.

Comments like these suggest a gap between disciplinary ethics enculturation and training and what happens at the professional level, which is less direct, less explicit, and even more backgrounded. Further, codes of ethics are limited in their applicability. Codes of Ethics are usually adopted at the level of the professional society, and only in some cases have “bite.” As another participant observed:

I hope I made clear that, while the APA guidelines are: everybody should be aware of them and so well them, but they technically don't guide everyone. Now, meaning, the only people over which APA has any authority are its members. If you're not a member of APA -- for example, I am not a member of APA -- conceivably APA would say that's

not our problem. You know and likewise could say, even if we censure this person that has no impact we can tell them not to ever be a member of our organization and I could say, well, I don't care. So that's just something... It is not at the legal status at the self-enforced, self-policed professional organization level, and so, unlike.. For example, professional engineers.

In terms of faculty, participants often discussed external methods through which a faculty member may be exposed to ethical frameworks. These exposures were described more at the disciplinary level in outside organizations than at the programmatic or institutional levels. One participant from physics explained:

So, this is a sort of a conference for faculty and graduate students from diverse backgrounds. And I definitely learned a lot about mentoring at that conference, so I attended some sessions. And it talked about effective practices and mentoring and how to mentor your students, not just in their technical subject area but also thinking about their lives as a whole.

Yet, some participants did mention faculty meetings as a primary context in which faculty would experience frameworks at the programmatic level. An interviewee from physics brought up such a point, saying:

...that's a good question. We had [faculty name] come into our faculty meeting and talk about various on campus possibilities for faculty members. I know him a little bit because he sponsored the senior design project with me, so I was happy to have him come in.

Another participant mentioned a similar situation where their program had invited a guest speaker or organization to present at their faculty meeting. As these participants reveal, even framework exposures conducted at the programmatic level can be outsourced to others outside of the department and can be more general discussions about ethics and ethical frameworks rather than discipline specific frameworks.

Almost all of the participants mentioned the existence of programs or training for faculty members in various contexts such as conferences or through journal publication standards, but hardly any of them gave specific details. For instance, one participant said, "...there's training for faculty, I mean, it's not a large resource, I don't think, I mean the training for faculty." This pattern supports the trends we found in the other two coding schemes – faculty are supposed to be the ones who mentor students in ethical frameworks for their discipline but the degree to which they receive exposure themselves is vague.

The other most commonly referred to audience population were students. All eleven interviewees discussed students as an intended audience for ethical framework exposure, but these references were broad and did not address whether the experience was for undergraduate students, graduate students, or both. When discussing student organizations, a participant from philosophy reflected that:

Those kinds of extra-curricular activities where there are opportunities for a broad scope of different types of issues and ethics would be one, for example, we have several student

organizations. I mentioned earlier, the National Education Association, we have a student chapter of the National Education Association....

Although this participant mentioned the presence of student organizations and opportunities to encounter ethical frameworks, they do not specify the type of student to whom those organizations and opportunities apply. This same vague reference to the general student population is underscored in other participant responses such as the following from a participant in computer science:

We try to, I try to at least, imbue that sense to all the students when we do this. It's like, it's time to sort of take your position in life seriously. You're going to go get paid a lot of money and be sort of kings and queens of the world, but with great power comes great responsibility, right? So, that's kind of where I see it. It's a little different than the other engineering disciplines, I think, for that reason.

It is not clear which type of student is benefiting the most from these exposures to ethical frameworks at the programmatic, institutional, or disciplinary level. That being said, six out of the eleven participants did specifically reference undergraduate students while nine out of the eleven mentioned graduate students. It is possible, therefore, graduate students receive more experiences with their disciplinary frameworks than do undergraduate students.

The trend which is the most apparent across all the participant interviews is how little postdocs are mentioned. None of the eleven interviewees said anything specific about the types of experiences and opportunities available for postdocs. It is possible all or many of our participants thought of postdocs when discussing faculty members which would explain why they are never explicitly mentioned. Alternatively, it is likely the case that few of our participants regularly work with postdocs and so the category may not be ready-to-hand. However, because postdocs typically are given different privileges, statuses, and opportunities than their faculty counterparts including both together may not elucidate the nuances of who is being exposed to these frameworks.

Finally, we sought to explore how often the different experiences and content codes emerged when referencing the various audience groups. The only audience group not applicable to this analysis were postdocs because, as previously mentioned, none of the participants mentioned that audience group in their interviews. The participants seemed to report membership groups such as organizations or conferences as the primary experiences for professionals while codes of ethics were their primary form of content. However, both these categories were more commonly applied to other audience groups such as students. For faculty, their primary experience, as mentioned by our interviewees, was training and they gained exposure to frameworks mostly through ways which were outside our coding scheme.

Students received different treatment depending on their status. Undergraduate students were exposed to frameworks primarily through their courses. This pattern was not the same for

graduate students who were exposed to frameworks through mentoring and training. The content the undergraduate students obtained was unspecified by our coding scheme but the content for graduate students came through conversations followed by codes of ethics. Students, in general, were thought to obtain frameworks in their courses through codes of ethics and conversations. However, both of these content areas were outweighed by the fact our participants explained new, vague, or unspecified content which was actually the most common for this audience type. Finally, interviewees sometimes referenced experiences and content without a specific audience in mind for them. This unspecified group's primary experience was membership organizations whereas their primary content area was codes of ethics.

These trends demonstrate how experiences and content are perceived to be related to our different groups of audience members. Based on our coding, it appears that as rising professionals advance in their education, their exposure to ethical frameworks is less direct. Undergraduate students should experience these frameworks in their classes by engaging with codes of ethics through conversations. Graduate students should also interact with codes of ethics through conversations but these take place more so in mentoring and training opportunities. Faculty members have training programs and professionals have membership groups neither of which prioritizes direct learning through conversations. Professionals seem to engage more with codes of ethics while our data also shows a decent amount of uncertainty or vague affirmation about the frameworks content faculty receive. Thus, disciplines are concerned with the exposure students are getting to ethical frameworks more so than they are their faculty and professional colleagues.

Implications and Limitations

Our study focused on how ethical frameworks are perceived to be incorporated into disciplinary programs at one large institution in the United States. Our data reveals experience- and content-based frameworks are typically targeted at one or two specific audience groups rather than equitably distributed among them. That is, rather than expecting members of a field at all levels to be familiar with the same frameworks, we isolate certain frameworks to students, to faculty, to professional, et cetera. Such siloed frameworks interactions may lead to two potential outcomes:

1. Individuals may have a distorted understanding of a discipline's frameworks and, thus, its ethics.
2. Individuals may be less likely to feel enculturated into the discipline.

These outcomes are especially likely if internal tension exists between an individuals' internal ethics and those they perceive exist within the discipline. One potential solution, all else being equal, to these negative potential outcomes would be to map ethics-specific learning outcomes across curricula, scaffolding its complexity and depth from beginning to end of student pathways. This solution seems unlikely given curricular constraints at the disciplinary level.

Furthermore, based on the experiences detailed by our participants, faculty members bear the onus for mentoring and educating students regarding the ethical frameworks salient to their discipline but may not be receiving the necessary knowledge themselves. This overlap can cause faculty to avoid discussing ethics altogether because they may feel ill-equipped for the task. Students, therefore, may not get the specific training they would need to be properly enculturated into the discipline. The over-reliance on codes of ethics and on conversations to occur during training, mentoring, or classes can be limiting in scope but also may lead to ineffective communication if the conversation leader does not fully understand the ethics themselves. This cycle could erroneously perpetuate an idea of “common sense” or understood ethics – standards which are, ultimately, neither. This problem of faculty expertise demands increased attention on ethics engagement as opposed to ethics training, which in turn requires a reprioritization of faculty time and attention. This solution seems unlikely given professional constraints at the disciplinary level.

Identification of only unlikely possible solutions is a limitation of this study, which is meant to identify problems within and differences among disciplinary understandings of ethics. Future work will focus on developing possible solutions as a next phase. This study is additionally limited by its participant demographics. As outlined previously, disciplinary leaders, although experts in their fields and leaders in their disciplinary domains, may still not fully be aware of all the ways ethical frameworks manifest themselves within their own department, the institution, or the discipline at large. It is possible that as we continue to interview additional members of these fields including faculty and students of various ranks from the department, further patterns will emerge. In future work, we plan to interview students to determine where they witness and interact with frameworks in their discipline thus enabling us to compare the two perspectives – what the experts perceive the discipline is promoting versus what the students perceive they are acquiring.

Given this limitation in demographics, we did not code the number of times an experience, content, or audience was mentioned because the number of times an individual refers to a specific experience or content may not represent the number of times a corresponding audience within the field encounters that experience or content. In other words, a graduate student who is exposed to the codes of ethics for a member group may not be as enculturated into the ethical culture of the discipline in the same way as an undergraduate student who interacts with the code twice a week in class. Understanding the degree of enculturation may be limited in this study, but it does begin to give us a sense of their perceptions concerning the role of ethics frameworks, a sense of who is responsible for them, and an understanding of who is impacted by them. Future research can explore the relationship between framework frequency and perceived impacts from disciplinary leaders, faculty, and students.

Finally, this study evidences differences among diverse disciplines in and around engineering. This approach, while descriptive of the range of interdisciplinary connections made in and through engineering, does not offer as fine-grained results as would a study of sub-disciplines within engineering specifically. Looking at, for example, how aerospace engineering and electrical and computer engineering differ or align in their understanding of ethics frameworks would offer that level of detail. That fine-grained approach is space for future work.

Conclusion

The idea that ethics is common-sense and easily understood need not take precedence in our multi-disciplinary outlook on engineering ethics. Indeed, what we do in engineering ethics research is only as good as its actual implementation in institutional contexts and what we do in engineering ethics works in concert with the institutional and collaborative activities that engineers will encounter. Integrating the range of possible experience- and content-based frameworks can strengthen an individual's knowledge of disciplinary ethics and potentially increase how strongly they then enculturate to the field. Enculturation, in turn, will strengthen the inter- and multi-disciplinary collaborations driving the work of engineering, through recognition of the values and value differences that guide work across and within disciplines.

Mapping existing frameworks across engineering and STEM disciplines and larger university-wide landscapes is not only important for understanding the influences on individual's notions of professional responsibility but also for building stronger foundations for collaborative interdisciplinary work [8]. By understanding more about the contexts for frameworks, we can then study the variance in how ethics frameworks are identified and implemented in disciplinary contexts. Some disciplines in our study, again as perceived by their leaders, articulate a rich normative landscape that includes not only professional codes of ethics and professional cultural norms but also curricular and paracurricular ethics interventions. Other disciplines maintained a narrower implementation of ethics frameworks. These inter-disciplinary differences in perspective on ethics play a formative role in shaping disciplinary cultures, including individual senses of responsibility and collective engagement in ethical awareness and decision-making.

Acknowledgments

This material is based on work supported by the National Science Foundation under Grant #2024296. Any opinions, findings, and conclusions or recommendations expressed in this material are those of the authors and do not necessarily reflect the views of the National Science Foundation.

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