

Integrating Ethical Considerations In Design

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Integrating Ethical Considerations

In Design

There has been a significant effort to understand how ethics can be effectively taught and integrated into engineering education experiences. Much of the extant research and theory associated with ethics in engineering education relies on scenario-based and hypothetical assessments.^{1,2} Much scholarship and content of trade publications also relies on professional codes of ethics that provide broad considerations of behaviors that would be right or wrong and of appropriate uses of disciplinary expertise. Students often find these teaching and learning tools to be unrealistic and difficult to relate to their own circumstances.^{2,3} Over the course of everyday engineering design work, many students do not realize they are engaging in ethical processes at all,^{2,4} and have little to no recognition of how their considerations shape and are shaped by the organizational context of the program. Indeed, it is often only on looking back “after things turned out nasty” that reasoning seemingly unrelated to ethics may be identified as ethical.¹

Likewise, students may not recognize that engineering design is inherently tied to ethics. However, the products of an engineering design process, and especially the use of those products, undoubtedly are.¹ Scholars have argued that ethical issues arise on a day-to-day basis in the engineering design context,² meaning that ethics is implicit throughout design processes. While recognition of major issues is important in an engineering education context, this view of ethics does not allow for an integrated understanding of the way ethics is implicated in the micro-level everyday decisions and reasoning associated with design.¹ This more nuanced understanding would “provide a firmer basis for thinking about ethics in the engineering design process” (p. 514) and might encourage more incorporation of ethical thinking into the entire design process. Nuanced micropolitics are interwoven throughout the technical and other decisions that comprise the design process, and all decisions and agreements that emerge through this process could result in social and ethical impacts that must be considered at every stage.⁵ By providing a naturalistic look at how ethics is considered and handled in practice, this study furthers the “everyday ethics” approach² and furthers our understanding of ethics in engineering education.

Human-centered design

In the context of design, there are many different values, such as innovation or a primary concern for safety, that guide design decisions and processes, and can impact how designers think about the ethical issues related to their designs and the implications of their “everyday” ethical decisions. In the engineering education context, the design model offered to students can have a significant impact on how they make design decisions, how they prioritize the many and often competing elements of design work, and potentially how they engage in design work in the future as professional engineers. For instance, if the design focus and coursework is on technical design in a particular area of engineering, then it is likely that technical concerns and decisions would be prioritized over others.

We contend that nowhere is the everyday ethics approach more evident than in human-centered design. A human-centered model of design (HCD) centers on the social-technical solutions to problems and product or service opportunities, and centers on appreciation for the

users' knowledge, skills, and experiences; understanding the role of the user in design; and attention to all human stakeholders who may be affected beyond the targeted end user.^{6,7,8} When team members design for humans, they need to integrate the unique interests, knowledge, and cultural practices of potential users for the immediate situation and over the long run.⁹ Zoltowski et al. (2012) found that students perceive and experience HCD in different ways, and these perceptions affect their ability to integrate considerations of relevant stakeholders into their design. Zoltowski et al. found seven distinct ways that students experienced (and understood) human-centered design: technology-centered; service; user as information source input to linear process; keeping the users' needs in mind; understanding the design in context; commitment to involving stakeholders to understand perspectives; and empathic design. While some subjectivity impacts how HCD is understood and executed in practice, its overarching principles highlight the importance of consideration for stakeholders throughout design work. These different orientations toward design affect how students engage in the design process, whose needs are considered and to what degree, and even their understanding of the overall goal towards which they are working. Building on these findings, this study explores the relationship between an HCD design orientation and students' understanding of the role of ethics in their design projects.

Specifically, the program studied in this paper uses an HCD model for design, encouraging its students to approach design by keeping central the human users of such design.¹⁰ This approach is reflected in the design process model the program uses and teaches to its students, shown in Figure 1.

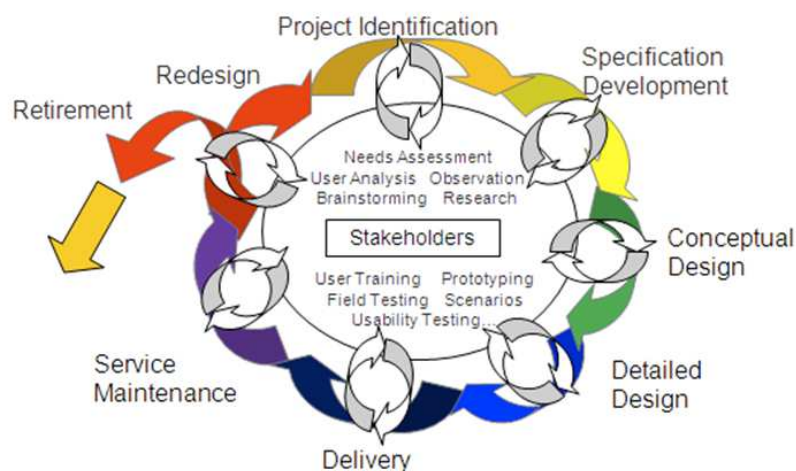


Figure 1: Program Design Process (EPICS, 2010)

We use a communication lens to explore the influence of this design approach on students' engagement in their design work. This project contends that a communication lens is not only appropriate, but is needed to provide insight into the study of ethics in the engineering education context. Ethics is a subjective and fluid concept, which we argue does not exist in isolation, but rather is communicatively constructed through language and discussion within project teams. Just as interdisciplinary identities are negotiated and managed in interdisciplinary team work,⁹ so are individual and collective perceptions about ethics and how it is incorporated

into design work. Its understanding and importance in an engineering education context is dependent on the interactions of team members, the institutional forces present such as organizational discourse and literature framing the projects, and the requirements and concerns of the project itself. Given the communicatively constructed nature of engineering ethics, questions arise about how ethics itself is conceptualized, manifest, and confronted by project teams. At present, the communicative constitution of ethics in engineering design teams has not been well researched. Such scholarly attention to ethical processes and outcomes contributes not only to how the discursive process emerges through language and talk in this particular context but also to how teamwork and ethical work in general can be enhanced through better understanding of its development.

While an emphasis on the human stakeholders who may be impacted by design seems to suggest an ethical orientation, it remains unclear whether an HCD model of design actually promotes or affects ethical considerations for designers. This study explores the complexities of students' perceptions about ethics in design by focusing on the communicative underpinnings of design and ethics. We examined the way students' language reflected and created team-level orientations toward appreciation and incorporation of users in design to answer the question: how is ethics communicatively constructed and handled in multidisciplinary design teams? Through a discursive analysis of interviews with team members of design projects, we examined how students communicatively create and position the user in their design work. We additionally identified the common lines of reasoning evident across all students' descriptions to suggest how an HCD-rooted service learning program reflexively influences students' ethical orientations toward design.

Methods

We used a discursive approach to examine the reflexive relationship between an engineering education program's orientation toward Human-Centered Design and students' understanding and engagement with ethics in their own design work.

Participants and Context

We present findings from EPICS, a project-based engineering design program at a Purdue University, in which students work in multidisciplinary project teams to deliver solutions to real-world problems. We discuss findings from twelve project teams distributed between four classes. Project teams were comprised of 3 to 9 students from varied engineering majors, years in school, and backgrounds. These project teams were housed within classes themed around similar topics or project partners and advised by professional engineers, engineering educators, and faculty in other disciplines with relevant experience. Projects often spanned a full year to several years, with membership changing somewhat between academic semesters as enrollment in classes shifted. Students participated as many semesters as they desired, and many remained with one project for a full year to several years.

Procedures

We conducted in-depth semi-structured interviews with 69 team members, comprising the majority of the 77 team members total. Interviews averaged about an hour (range: 28:04- to

1:11:49, mean=M = 52:47 minutes). The interview protocol contained questions about the team's project and goals, specific decisions and considerations that were made, and the role of ethics in general and specific to the project. Follow-up and probing questions were offered to expand on these descriptions or ask about specific instances observed during design team meetings. Interviews were transcribed, checked for accuracy against audio recordings of the interviews, and de-identified to protect the confidentiality of the participants.

Analysis

We examined the transcribed interviews to explore how the role and significance of ethics was discursively constructed in these project teams. Through a discursive analysis of participants' responses in the interviews, we explored how the students defined and understood ethics, the participants' experiences on their teams and in the design process that may or may not have ethical implications, and what discursive resources were being commonly utilized in the participants' talk that could indicate the ethical resources being offered by the program.

To accomplish this, we conducted a textual analysis guided by the principles of discursive psychology.¹¹ Discursive psychology scholars seek to analyze the ways psychological, material and social objects are invoked and attended in social interaction and other activities; this is the practical focus of discursive psychology.^{12,13,14} Instead of analyzing talk and interaction as something to "see past" in order to reveal an individual's "true" beliefs and attitudes, discursive psychology locates the creation of meaning and reality in social interaction; individuals as social actors actively create reality and shape identity through their talk.¹⁵

We approached analysis by considering discourse on two levels. First, we examined the "little d" discourse, or discursive practices used by individuals to see how they handled and managed certain concepts. We then looked for evidence of the "big D" Discourse, or interpretative repertoires that emerged as common lines of reasoning, metaphors, phrases, and other linguistic and conceptual markers. This "big D" Discourse suggested the discursive resources upon which all the students were drawing. We examined the interplay of these two levels of discourse to begin to describe how the discursive resources that were available and the discursive practices each student used to construct his or her notion of the role of ethics in their teams reflexively shaped one another. That is, we explored how students drew from the "big D" interpretative repertoires to shape their descriptions, appeals, and motives that characterized their specific discursive practices, as well as how those discursive practices when taken together constituted their group-level orientation toward ethics and design. In this way, we examined not only language use in the context of engineering design teams, but also how students embedded in this context discursively constructed the meaning and significance of ethics to their design work, and how they drew from and contributed to the development of various discursive resources in producing an understanding of design and their place in it.

Findings

Our analysis suggested that students had conflicted perceptions about the role of ethics in their design work. First, despite not being able to explicitly identify ethics and its role in their design work, upon analyzing students' descriptions of their project experiences more generally, a strong ethical orientation emerged. Students' talk positioned their users and stakeholders as

central to their motivations, intentions, and even design decisions. In analyzing their talk, we found that the design processes and centrality of stakeholders offered in HCD incorporated these considerations into their design work without them consciously choosing to incorporate it. Second, students' conceptualization of the role of ethics and its relation to the end user resulted in a limited positioning of ethical concerns in the design process. Participants overly connected ethical considerations to user experiences, resulting in a bounded notion of ethics that only fit into certain parts of design work.

Ethical Orientations through HCD

Participants struggled to explicitly identify ethics and its role in their design work. However, upon analyzing students' descriptions of their project more generally, a strong ethical orientation emerged. The human-centered orientation toward design that shaped the program's identity came out in participants' interviews as a Discourse of HCD, which acted as a common point from which students could draw in constructing and presenting their approaches to design in these projects. Using this discursive resource, students positioned ethics as a primary concern for themselves, their teams, and the program in general, throughout their descriptions of their design experiences. As such, ethical orientations toward design emerged in the motives and intentions constructed through their descriptions, even when it was not explicitly invoked.

Students struggled to identify or explicitly acknowledge ethics in their project teams. During the interview, one question explicitly asked about ethics by asking, "What does ethics mean to you? Try to define it." This was followed by probing questions pointing to personal versus engineering ethics, and asking about ethical issues encountered on the person's team. Many participants came to a halt with this question, using multiple vocal fillers and taking long pauses where they had not previously done so in the interview. Sebastian (Class B) articulated his struggle to conceptualize ethics: Something is ethical to me if... (exhale). Words like that, they're hard to just, um... I don't know. I think of something as ethical if it's doing the right thing, and that's just another word—the right thing—like, um—"

Abbey (Class A) began her response to this question as a test of her knowledge: "Oh gosh, this is bringing me back to [my intro Engineering class] (laugh)... I'm trying to remember what we learned." Her response implied that there was a "right" answer, or that ethics in engineering was something strictly definable. Saul (Class B) similarly struggled to articulate his definition of ethics in engineering and phrased it as trying to get the "right" answer:

To me ethics is, um . . . especially in regards to engineering, is a, you know, a . . . moral guideline. I know it's not necessarily morals, but the ethics behind engineering and the design is, is it going to be beneficial, more beneficial than it is harmful?

Responses generally appealed to either managing the potential for harm, or adhering to established standards and codes. Sean (Class B) also deferred to established codes in his definition, while also acknowledging that ethics may not be *only* identifiable in the potential for harm: "Ethics would be...I guess the Hippocratic Oath, do no harm. Um...I think if there is technically no harm done, I suppose you could still do things that are unethical, like cheating, misleading." Similarly, Zander (Class A) offered his take: "Yeah, when you're a professional engineer, don't steal other people's designs or ideas. Don't take credit for that kinda stuff. What

else? You know, I've never given it much thought." Zander's reflection was representative of the overwhelming sentiment expressed by the participants, which was that they didn't often think about—or in some cases, they didn't really understand—ethics.

These articulations tended to view ethics primarily in grand, “disaster” scales but did not show evidence of the conceptualization of “everyday ethics”^{1,2} as implicit throughout the design process and present in all design decisions, both great and small.

While this explicit understanding of ethics in design was lacking, further analysis revealed that these descriptions offered an ethical orientation toward design characterized by HCD values. By drawing from HCD discursive resources to characterize their own and their team mates' motives and identities, students seemed to orient themselves toward ethical considerations, even if they were not overtly aware of it. For example, Steven (Class B) reflected on ethics in his specific project:

Because it's like, we're building [this device] for little kids. So I guess if little kids can hurt themselves with [it], but that's like . . . little kids can hurt themselves with anything, so is it any more dangerous than kids having compasses in class and drawing circles? Because I could murder somebody with a compass.

Steven's description suggested that ethics in engineering was linked to safety and limiting the potential for harm in his product. However, he went further than simply acknowledging this and compared the risk for harm associated with his device to the risks faced in everyday life by his users, putting some accountability for the potential for harm on the users themselves. While safety is of course a paramount concern and responsibility of engineers,¹⁶ this is an example of a consideration that goes beyond design, to incorporate the perspectives and needs of the stakeholders; to consider *their* experiences as situated and contextual.

Ethical orientations toward design were embedded within students' responses, even when they were not able to explicitly link their design considerations to ethical concerns. For example, when asked explicitly, students claimed to have faced few to no ethical considerations in their projects. However, ethical orientations were evident in more general descriptions of their project work, their roles, and retellings of design decisions. One interview question asked the participant to broadly explain their project: “Tell me about your project, and the purpose of your project.” Most students answered this question and included specific mentions of the end user's needs or desires, rather than narrowly describing the technical details or the overall project. For example, one project in Class A was focused on developing a braille e-reader for blind and visually impaired students. All five members of this team expressed the needs of this population and their personal surprise at the experiences of blind students, given how they themselves take for granted the use of this technology every day. Danielle mused:

I guess one thing, and looking back on it, it's common sense that you would think this, but they were telling us how they would [try to do these really common activities], these students that I think were in seventh or eighth grade, and it's something so second nature to us, we didn't even think of that application of our device. We were thinking more on school, on textbooks, and like reading full books, you know, that they can download from the Library of Congress.

While most participants were not able to link ethical considerations to these descriptions, a few were able to identify consideration for the user as the primary ethical concern for their project. Beth (Class C) reflected on some of the ethics resources offered in the program through lectures and surveys early in her interview:

The biggest ethical thing we had was how to refer to the students. And we talked about it and we decided, well we're not going to say "blind students." We're going to say "students who are blind." You know? Not using "blind" as an identifier, just saying, "Well, they're students who are blind."

The interviewer probed this response, asking Beth why she felt that this had ethical implications. She responded: "Um . . . well obviously, we don't want to insult the students. You know, they're our project partners, we care about them, we're trying to help them, we don't want to belittle them, we don't want them to feel like them being blind is defining them as a person."

Beth's description of her orientation toward her team's project partner illuminates one of the central ways these students positioned themselves as designers in relation to their users. Her consideration went beyond design, to incorporate the perspectives and needs of the stakeholders and to make sure she was not imposing or marginalizing them, even by accident. She attributed motive to her team, saying they care about and were trying to help their project partners. This discursive move positioned the users as valued partners, and the designers as caring people seeking to help.

While ethical orientations emerged through general project descriptions, the link to ethics and orientation toward users was extremely prevalent in students' talk about the EPICS program itself and their membership in it. These projects were all conducted as a part of a course for credit toward a degree, yet the majority of students described their reasons for membership in terms of desires to help the world, give back to the community, or do something meaningful for those around them. Danny (Class A) expressed this sentiment in his frustration that his team members were not putting in as many hours on their project as he was: "I was just consumed by this passion to help these people, and I know they were, too, so it was just really confusing me why they weren't going above and beyond."

The human-centered orientation was recognized by the students as a unique take on design across their engineering education experiences, and they acknowledged that it affected their ultimate designs and products. Danielle (Class A) summed up the HCD orientation of the program that emerged throughout many of the students' descriptions of their everyday work on these teams:

That's the thing that I really enjoy about [this program], is the human-centered design aspect and always keeping the stakeholders in mind, kind of drilling that into our heads. Because I feel like outside of the program, if you're not fully exposed to it, it's not a priority on other engineering teams. I've seen that with the [project] itself, because we actually got the project the same time a Senior Design project in mechanical engineering got the project, and they came out with something that, you know, had all these gears and gizmos and all these fancy things, but it weighed 500 pounds and still didn't work. And then we had a team that was, you know, freshmen, sophomores, juniors of all different

disciplines, we come out with a design that was under 20 pounds and had a pretty legitimate mechanism inside it to make it work.

Danielle attributed her team's success to their focus on the users and consideration for their needs and experiences. Reid (Class B) reflected on his recognition about the link between HCD and ethics in design:

I think the biggest thing I realized during this was that the human-centered design... almost directly results in ethical decisions all the time. I never think about that. And I really see it that way. Because every single time—we take ethics surveys all the time for [this program]. And everyone that takes it—not just in [my project team], but everyone else on other teams—always says, “You know, I can't really think of a time that we've really had to make an ethical decision.” And I'm sure people do it subconsciously, but when you're designing for a person and you're accountable to that person—which you're not necessarily accountable to a person in business—it's easy to just say, “No, forget it, we're going to do this.” But you really can't.

Reid's comments explicitly linked ethical considerations with a human-centered approach to design. Indeed, this was a significant theme through the interviews, in which students connected user experiences with ethical considerations—sometimes, to exclusion, as the next section of this analysis discusses.

Discretely positioning ethics in the design process

The human-centered orientation was reflected in many of the participants' descriptions of their design work experiences and the EPICS program itself, and emerged as a central characteristic of the motives of many of the participants. However, participants overly connected ethical considerations to user experiences, resulting in a bounded notion of ethics that only “fit” into certain parts of design work. As the design process moved into more technical phases, team members articulated a more narrowed scope of the design process and design priorities but seemed not to recognize ethics as a part of that process. Ethics was often discussed as an external factor to be considered at an appropriate time, rather than recognizing that adhering to standards and doing good technical work are ethical considerations. Indeed, even when students described making technical decisions—such as choosing a material that would be more durable, safe, or comfortable, or ensuring designs adhered to relevant standards—they positioned these considerations as strictly technical or design-focused. They failed to consider such decisions as inherently ethical, or even as potentially having *some* relation to ethics. Recalling the program's design process discussed above, different goals and priorities are emphasized at different points throughout the life of the project. While student membership shifts every semester, the project itself lasts for a number of semesters, often giving students the chance to experience only a few of the steps in the process in a given semester. Descriptions of ethics were inextricably linked with interaction with the user, and the role of the user in design seemed to shift with the design phase in which students were currently engaged.

Students described the more technically focused phases less in terms of concerns about the user. In fact, many participants justified their assertion that their projects had incorporated no

ethical considerations by adding that they did not have involvement with a project partner or specific user at a given point in time. In their descriptions, the students' articulations of the role and identification of ethics suggested that they primarily considered ethics in the realm of interactions with a project partner or user. For example, Harrison was unable to think of any ethical issues the team has faced thus far, saying: "I don't think we've done much involving—because of the phase of where the product is at, they haven't done much involving the users." This response explicitly linked ethics to users, and situated ethical and human-centered concerns as part of a *different* phase of the design process. In this way, students positioned ethics as a primary consideration, but only during appropriate times within design work. In many cases, participants were only able to come up with an example of an ethical concern their team faced that was not a "disaster scenario" if it explicitly involved the user.

Abbey (Class A) responded to the question about what ethical considerations her team had faced by saying: "Not quite yet. I feel like that'll come into play more once we have our project partner." Zander (Class B) responded: "I could just be blind, but I don't know. Yeah, especially in my project team, because we don't have a user." In the absence of a specific person serving as the end user, students struggled and often failed to identify other ways ethical considerations could be relevant to their work.

Daren, an interaction design graduate student who joined the project team developing the braille e-reader, caused frustration among his team members with his specific focus on the user experience. Danny expressed his take on this tension, saying that Daren's focus was not appropriate and maybe even distracting for the team: "It was really confusing because he came in and everything he wants to do, it's *so far out*." His frustration implied that such a specific focus on the user's experience with the product didn't make sense during the conceptual phase, in which technical functionality was the primary focus. Danny continued this thought and described his team's assessment that user needs didn't fit into the current phase of their process, instead opting to delay that consideration until the functionality had been established:

But we didn't go into *really* specifics about the user interface (UI) and how is this going to be meet the user [needs], because we knew that we had a really, really long time developing technology before any of that was relevant, and we didn't want to waste time. We got caught up in it for a little bit—how is this exactly going to work? What's the UI going to look like? And then we realized that we didn't need to do any of that; we essentially needed dimensions, we needed power consumption, and that was it. Because if the mechanism failed and it didn't end up working—and that's really the biggest part of the project, or the biggest hurdle we have to face—that there was no point in doing everything else.

This example is stark, especially given how clearly and passionately Danny and other members of his team had previously positioned themselves as concerned about and focused on the blind students for whom they were designing. Here, Danny not only positions consideration of user needs as outside the current scope of the team's focus, but even suggests those considerations were not yet "relevant" and would in fact be a "waste" of time.

In these examples, students seemed to discursively position ethics as an appropriate consideration for a certain part of the design process, but not as a permeating issue that must or

even can be considered throughout. This technical focus makes sense and is an essential part of engineering and design work. Indeed, the intention behind a minimal viable product is to rapidly develop the concept in its most basic form before iterating and refining it. However, Danny's description illustrates how even in a person with a clearly human-centered approach to his project, this non-user framing of his work excludes and leaves no room for the day-to-day considerations that have ethical implications. Indeed, in their talk the students seemed to privilege *either* consideration to the exclusion of the other.

Additionally, the nature of the interactions with the project affected students' orientation toward their design work, Sebastian (Class B) excluded his project from ethical consideration because in his words, this phase was just an initial test to see if the product worked. He described his take on his team's product:

This is basically just going to one teacher, and I don't see much of a[n ethical concern] with it because we're sending it to him and it's going to be just a lesson plan for a few weeks, and if it's effective, then great, and if not, it's just an experiment then and we can just narrow it down.

When asked if ethics would be more of a concern for him if the product was going to be distributed widely, he responded: "Um, it's different because there's a lot more people involved, it's more of a permanent thing, and it's going to affect a larger population as compared to just, you know, a few short weeks in one school in [another state]." This sentiment was echoed by Raquel (Class B), who described ethics as being less present in a smaller, more localized environment:

I think it affects more teams than others, I think just because all of the teams that I've been on have been like local teams, so like the issues, ethical issues, aren't like a huge deal. But I feel like the teams that deal with like, um...maybe like the international teams, you know, like the ones that work with like, they work with like [third world countries]...there are probably a lot more ethical issues to look at than the ones I've been on.

In sum, students' abilities to incorporate ethical considerations into their day-to-day design work was affected by their conceptualization of ethics as inherently linked with stakeholder interactions. Still, despite their inability to explicitly identify it in their interviews, students' talk about their design experiences showed a significant ethical orientation toward their projects that was created through an HCD discursive framework. Yet this same framework that encouraged ethical considerations was also bounded by its link to users, which resulted in a limited recognition of the role of ethics throughout the design process.

Discussion

Ethical training of engineers is a central concern to engineering educators, future employers, and the governing bodies of the field.¹⁷ While there is still much more to learn about this, our study provides some insights. This study offers both successes and challenges with the development of ethical engineers, as well as practical implications for engineering educators trying to develop curriculum that encourages students' ethical development. Our findings suggest

that while students still struggled to explicitly identify ethics and articulate its role in their day-to-day design work, an HCD approach to design oriented them toward ethical considerations, motives, and decisions. However, students linked ethical concerns to specific interaction with users in ways that constrained identification and intentional integration of ethical considerations in day-to-day or more technical aspects of their design work.

We found evidence of the human-centered design orientation in students' talk about their design experiences, suggesting importance of an engineering program's overall orientation toward design. This suggests that a human-centered approach communicated at the programmatic level through program texts, lectures, and discourse from instructors and by the program as a whole may encourage students to develop and internalize ethical considerations.

Our findings align with extant literature on moral intensity and its effect on ethical reasoning.^{18,19,20} The fact that many of these teams had real human users depending on their projects, and many were focused on assistive technology and learning outcomes, came out as a strong motivator for many of the students and as a primary way the program itself was characterized. For example, Sara explained her team's serious approach to their project: "And it's real-life stuff, too; it's not something small that we're doing. You know, [teams] see the reward in getting their design prototypes back from the project partners and seeing how it's impacted their lives and improved them." Similarly, teams without a specific project partner or in which students perceived less potential impact on their users framed their work differently. Recall Sebastian, who noted that his project was "just going to one teacher" and thus required less ethical consideration. He explicitly articulated a notion that a product going to more people would be more ethically concerning, and thus he was not as motivated to worry about all the little ethical details given the small scope of his team's current objectives. This response exemplifies the "magnitude of effects" component of moral intensity, which suggests that the magnitude of the perceived consequences will impact their assessment of a given situation, and may even affect moral action.²¹ Sebastian described himself as less concerned about the ethical considerations of his project because it was on what he described as a small scale, affecting the magnitude of the potential risk.

An additional component of moral intensity is moral proximity, which suggests that the feeling of social nearness to the potential victims of an action will impact an individual's assessment. Students' descriptions of ethics as tied primarily to specific human users or project partners suggests that their ideas about ethics, its role in these design projects and processes, and their responsibilities as student designers, were bounded and inherently linked to explicit interactions or implications to a specific user or project partner. In terms of moral proximity, this finding demonstrates a greater sensitivity to defined stakeholders, and a concurrent lack of influence offered by more abstracted stakeholders.

Another interpretation of this finding suggests that ethics in these teams was directed by and linked to a human-centered orientation. Many students were not able to expand this orientation beyond overt or clear links between their everyday work and the specific human stakeholders involved. This finding supports Zoltowski et al.'s (2012) discussion of the importance of critical experiences in aiding students' experiences of HCD. Critical experiences may include meetings with users or other events that students found transformative to their thinking about the stakeholders and their user's experiences. It is difficult to distinguish the

origin of the human-centered orientation that emerged in these findings, but its emergence as a central shared discursive resource across the participants in this study suggests that something about the service-learning and HCD-oriented identity of this program affected students' engagement with and understanding of ethics in design.

While it is clear that a HCD model does encourage more ethical engagement with design work and processes, it also seems that the service-learning program context itself had a significant impact on the students' perceptions about and engagement with their design work.^{8,22} Past literature suggests that organizational Discourses and strong organizational identities can have major impacts on their members' decision-making, prioritization of different types of considerations, and privileging or marginalization of different interests in approaching problems and making decisions.^{23,24} In some cases, strong organizational identities can sway members to privilege the interests of the organization above even their own personal interests.^{23,25} In the context of this study, the organizational context and influence of these identity processes may be utilized as ways to understand some of our findings. For example, the preferencing of organizational values could reflect in some students' articulations that their motives would push them to engage in this design work for the benefit of their various users, even at the expense of, or as a greater motivator than, their personal grade in the class.

The team-based context of design work was also a significant consideration in this study. Group communication theory may provide some insights into the team handling of ethics. Members of teams often discuss information to which every team member has access.²⁶ Group discussions favor shared information, rather than members bringing in their own individual knowledge that may assist with the team task. While they work separately on distinct and sometimes unrelated projects, teams in this program all adhere to the human-centered model of design, with posters hung in every lab room and numerous course requirements incorporating HCD thinking and processes in the students' work. This human-centered orientation came out strongly in the students' descriptions of their work on their teams suggests that the prevalence of this approach, and its associated values, may have acted as discursive resources for team members to consider and discuss the role of ethics in their teams. In fact, many students reflected during their interviews on the uniqueness of this program's HCD-rooted design model in comparison to other design and engineering classes in the university. Thus, while HCD is a central component of this program's projects, these findings suggest that students do not perceive it to be supported by the broader environment of engineering education in which they are situated. This analysis suggests that the internalization of the HCD model in this program encourages more ethical thinking and engagement with design, despite students' struggles to specifically articulate the role of ethics in their work. While this conclusion requires further investigation, the clear emergence of an HCD orientation and the indirect references to ethical considerations and motives suggests that HCD is playing a role in the ethical development of these students.

The findings of this study may be useful for improving approaches to teaching and assessing ethics in engineering education. Scholars have devoted significant attention to unraveling teaching and assessment of ethics⁴ and social justice^{27,28} in consideration of a variety of pedagogical approaches. Many efforts focus on an intervention or different approaches taken by a specific instructor, or in a specific class.⁴ While many scholars critique and make suggestions for improvement and reform of the social systems that shape and impact these

ethical and social justice orientations, the communication approach described in this study focuses on the communicative environment in which students who are developing their own identities and practices learn about and experience engineering. In utilizing a discursive approach, this study elucidates some of the elements of an engineering education program that impact the development of these orientations.

Conclusion

A clear human-centered orientation emerged in the students' talk about their design experiences. This orientation was utilized as a discursive resource for the students in constructing their motives, priorities, and engagement with their design projects in ethical terms. These findings suggest that this orientation directed students toward more ethical consideration of the role of their stakeholders, and impacted their understanding and engaging with their design projects. However, over-reliance on interaction with specific users may limit students' utilization of ethical considerations. Given these considerations, it may be beneficial for engineering educators to increase the frequency of ethical discussions relevant to specific similar project contexts, even to a daily or weekly level, similar to the way classes discuss technical concerns and homework problem solutions in most class meetings. Our findings suggest that this approach may be useful for increasing ethics-related discussions and considerations at the everyday level, which in turn could encourage more integration of micro-ethical considerations into the design process as a whole. Ongoing reflection about educators and students' own practices and verbalized thought processes could do much to enable students to be mindful about the assumptions with which they work in design contexts and how their decisions—however mundane they might seem—can have profound ethical consequences.

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