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Out-of-Classroom Experiences: Bridging the Disconnect between the Classroom, the Engineering Workforce, and Ethical Development*

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The extant research on engineering ethics instruction shows that students receive ethics instruction within the engineering curricula. Unfortunately, the methods used in engineering undergraduate classrooms are described as "abstract" and have mixed results related to impacting students' ethical development. Thus, exploring how out-of-classroom experiences—as a curricular alternative—influences students' ethical development is warranted. This is an exploratory investigation to determine how out-of-classroom experiences influence students' ethical development. The authors define ethical development using three constructs: knowledge of ethics, ethical reasoning, and ethical behavior. We draw upon a conceptual model that suggests students' ethical development is impacted by what takes place inside and outside of the classroom. As the first phase of a multi-year, national study to holistically assess the ethical development of engineering undergraduates in the United States, we conducted focus groups consisting of faculty members and students at 18 institutions. All focus group participants were asked questions related to campus climate, ethics, and involvement in out-of-classroom experiences. Our data suggest that participating in out-of-classroom experiences: served as a complement to the classroom instruction on ethics; helped students connect learning about ethics to the engineering workplace; and, influenced students' ethical development. Given what we learned about the engineering undergraduates' involvement in out-of-classroom experiences, we suggest that engineering faculty members use classroom instruction to connect out-of-classroom experiences to ethics and encourage reflective practice in ethics instruction.

Keywords: out-of-classroom; ethics; qualitative

1. Introduction

Employers expect engineering graduates to possess a host of professional skills, including the ability to recognize ethical dilemmas when they arise and make appropriate choices [1, 2]. Yet, within the classroom setting alone, students may not be explicitly learning these skills [1, 3]. As a result, there may be a disconnect in employer expectations and deliverable skills that institutions can guarantee upon the graduation of their engineers.

The extant research on engineering ethics instruction shows that students receive ethics instruction within the engineering curricula [1, 2, 4, 5] with case studies and lectures among the common methods used to teach ethics [4–6]. Unfortunately, these methods are described as "abstract" [7], and have mixed results in relation to impacting students' ethical development [6, 8, 9]. While improving our understanding of the types of methods used to teach ethics is important, other scholars have found that there is a disconnect between ethics instruction and

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ethical development related to the quantity and/or quality of exposure to ethics [6, 10, 11].

There remains an assumption in the engineering curricula that ethics instruction primarily takes place in the classroom [4, 5, 7]. There are, however, other alternatives that can complement the classroom instruction on ethics to better prepare engineering students for the workforce, namely, involvement in out-of-classroom experiences (e.g. internships, service learning, campus leadership opportunities) [5, 11]. In this paper, we explain how these experiences can contribute to a student's ethical development.

When students are connected to the fabric of the institution through involvement with peers and faculty, myriad effects occur: students are more likely to persist and be retained [12–21]; students' career choices are broadened [22]; and students have an improved holistic educational experience [12, 16, 17, 21, 22]. While existing research sheds light onto the effects of involvement, less is known about which types of involvement are most significant. In addition, there has been little research into how involvement in out-of-classroom experiences influence students differently by majors. Finally, our understanding about the connection between involvement and the classroom is limited, especially for engineering undergraduates.

There is a need for a more nuanced examination of the intersections between involvement in out-of-classroom experiences and ethics instruction. Such examinations can illuminate alternative strategies for curriculum reform that may improve the skills that future employers expect to see when hiring engineering graduates. To this end, we ask the following research question to gain a better understanding of the ethics-related outcomes:

What is the relationship between involvement in out-of-classroom experiences and engineering undergraduates' ethical development?

2. Conceptual framework

Our conceptual framework of a student's ethical development throughout college draws upon the work of Astin's [23, 24] Inputs Environments Outputs (I-E-O) model, and Terenzini and Reason's [25] expansion of that model. Our framework (Fig. 1) conceives of several distinct, yet interconnected, domains affecting a student's ethical development: student characteristics (e.g. race, gender, and pre-college experiences and behaviors); institutional culture (comprising both organizational context and peer environment); and individual student experiences (including formal curricular experiences and co-curricular experiences). Institutional culture refers to the culture of the engineering school or department within the context of the institution as a whole, both of which influence student outcomes. This culture influences the experiences a student has while attending college [14, 23, 24]. Institutional culture is parsed into two constructs: the organizational context and the peer environment. The organizational context comprises the formal structure of the organization, the informal structure of the organization (i.e. the balance in priority between teaching and research, and faculty composition), academic policies and priorities (i.e. the presence of an honor code, or lack thereof), and faculty culture. The peer environment represents the environment created by the student body at an institution and within the engineering school or department. This peer environment includes the socio-demographic composition and other charac-

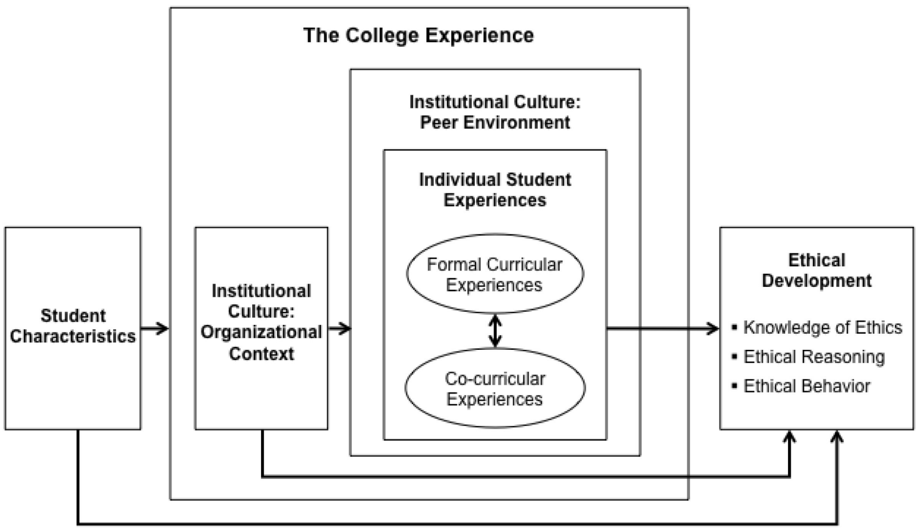

Fig. 1. Conceptual framework of a student's ethical development during college.

teristics of the student body, as well as understood norms, dominant values, and attitudes (e.g., the prevalence of cheating, students' opinions of cheating behavior). As a result of the student's college experiences, shaped by the institutional culture, ethical development is directly affected (see previous work for definitions of knowledge of ethics, ethical reasoning, and ethical behavior [8–11]).

This paper will specifically focus on the out-of-classroom experiences of students to better understand what outcomes result from being involved. We define "out-of-classroom experiences" as Greek life (i.e. fraternities and sororities), community service, design teams, co-ops, and internships; these are the experiences that our participants describe in our data. In our conceptual framework, out-of-classroom experiences are broadly represented inside the "Individual Student Experiences" box; as operationalized by Terenzini and Reason [25] and Reason [18], participation in internships are included in "Formal Curricular Experiences", whereas participation in student groups and organizations are included in "Co-Curricular Experiences."

3. Methods

3.1 Data collection

As part of a larger study to "address the lack of clarity about effective curricular and co-curricular approaches" [11, p. 471], we engaged in a multi-year, national study to holistically assess the ethical development of engineering undergraduates in the United States. Our methodology was informed by higher education and engineering education research that posits the transformative role that college has on students. Hence, our conceptual model (described above) suggests that what students experience in college influences their ethical development [11]. In order to recruit a diverse sample of undergraduate engineering students in the United States, we disaggregated institutions based upon their 2007 Carnegie Foundation basic classifications. Institutions in each category were sorted according to the combined number of students majoring in the traditional engineering disciplines of civil, electrical, and mechanical engineering. Finally, we chose institutions with the largest undergraduate engineering enrollment in each Carnegie classification group, with a few substitutions to allow for geographical and institutional diversity. The 18 institutions selected as participants had broad representation and awarded 14.3% of all engineering degrees awarded in 2010 [26].

We collected qualitative data from 18 institutions. During each campus visit, we conducted two 90-minute focus groups at each institution: one with engineering undergraduates and one with engineering faculty members. Students were randomly selected to participate in the focus group and recruited via e-mail; faculty were invited to participate based on their knowledge and/or involvement in the teaching of ethics in their programs. Each campus visit also included two 60-minute individual interviews: one with a senior academic administrator and one with a student affairs administrator.

At the beginning of each focus group, we defined ethical development for all participants; we read our definition aloud, then handed them a card with our definition on it so they could reference our definitions throughout the interview. See Table 1 to view our written definition of ethical development. Standardized open-ended interview protocols were used across the institutions in our study [27]; our interview protocols allowed us to have uniformity across institutions, while also allowing the flexibility of asking probing questions when necessary. According to Patton [27], standardized open-ended interview protocols are particularly effective, especially when there are multiple researchers interviewing at different sites (as was the case in our project). The researchers who moderated the focus groups prompted participants with broad questions related to our research question. All focus group participants were asked questions related to campus climate, ethics, and involvement in out-of-classroom experiences to understand the ethical development of undergraduate engineering students, and probing questions were used to follow-up when necessary. The questions comprising our interview protocols directly relate to college impact [14, 17, 23, 24] and student ethical development [8–11] research, as illustrated by our Conceptual Framework. See Table 2 to view sample interview protocol questions.

The information gained through the campus visits was used to develop the Student Engineering Ethical Development (SEED) survey administered to approximately 4,000 undergraduate engineering

Table 1. Definition of ethical development

We've defined ethical development for engineering undergraduates as:
1. Gaining an understanding of ethical and professional responsibilities for engineers (*knowledge of ethics*)
2. Refining the ability to recognize ethical problems and to generate ethical solutions in a professional context (*ethical reasoning*)
3. Learning to follow through on ethical intentions (*ethical behavior*)

Table 2. Sample interview protocols

Students

1. Can you tell me about a specific academic experience you've had here that affected or influenced your own personal ethical development?
2. Can you tell me about a specific non-academic experience you've had here that affected or influenced your own personal ethical development? Keep in mind that the content of these activities doesn't need to relate to engineering.
3. Please think about the culture of your college of engineering (or department, as appropriate). By culture, I mean a collection of knowledge, values, practices, symbols, traditions, social norms, and ideals you all share. Can you tell me about a specific aspect of your culture that affected or influenced your own personal ethical development?
4. What do you think is the one most important experience or aspect of your time here that affected or influenced your own personal ethical development?

Faculty

1. Can you tell me about a specific academic experience you believe affected or influenced your students' personal ethical development and why you think it affected them the way it did?
2. Please think about the culture of your college of engineering (or department, as appropriate). By culture, I mean a collection of knowledge, values, practices, symbols, traditions, social norms, and ideals you all share. Can you tell me about a specific aspect of your culture that you believe affected or influenced your students' personal ethical development and why you think it did?
3. What do you think is the one most important experience or aspect of your students' time here that you believe affected or influenced their personal ethical development?

students in Spring 2010 [11, 28, 29]. This paper draws upon the results from the qualitative data collected during focus groups.

3.2 Sample

We reviewed both student and faculty data, as we were interested in understanding the outcomes resulting in engineering students' participation in out-of-classroom experiences. Faculty members' comments provided context for students' comments about involvement, as well as offered background information on campus policies, institutional culture, and the student experience.

We analyzed data from 36 focus groups: 18 engineering undergraduate student focus groups (n = 123); and, 18 engineering faculty focus groups (n = 110). Males (84 students and 92 faculty) outnumbered females (39 students and 18 faculty) at both the student and faculty levels, mirroring the gender disparity in engineering programs. More seniors participated in our focus groups than students in other class levels (Freshmen = 26; Sophomore = 24; Junior = 25; and, Senior = 48). In addition, the majority of focus group participants were White, with a relatively small number of Asians and Hispanics comprising the faculty focus group participants (White faculty members = 100; Asian = 11; Hispanic = 5). Finally, a little more than half the faculty members were tenured (N = 62; 56.36% of the sample) and slightly less than half of the professors had more than 15 years of teaching experience (N = 48; 43.64% of the sample). See Table 3 for more detailed demographic information about focus group participants.

3.3 Data analysis procedures

Thematic analysis was the methodological approach used to analyze the data. The goal of a thematic analysis is to gain an understanding of the phenomenon and identify reoccurring patterns through the iterative process of reading the transcript data [30, 31]. This method is particularly helpful when making sense of large amounts of qualitative data; thematic analysis allows researchers to draw similarities and differences across the data set.

Transcripts were typed verbatim, maintaining the exact language that participants used to describe their experiences [30]. After interviews were transcribed, we generated codes (similar to the process of open-coding [32–34]). To generate codes, we read the transcripts to understand the undergraduate engineering experience. Codes were identified whenever participants described an important aspect of the engineering experience (i.e. initial codes were identified by isolating each transcript). Next, we compared the identified codes across each transcript. This process of comparing codes across institutions helped us to identify a pattern; students and faculty members were describing outcomes associated with out-of-classroom experiences. We grouped our codes into categories to make sense of patterns. It was at this point where we learned that participants were relating the role of involvement in out-of-classroom experiences to engineering student ethical development. Next, we re-read the transcripts to check the codes and categories against each other. In some cases, we had to compare what was said by students and faculty at the same institutions to understand how they made sense of involvement in out-of-classroom experiences. Finally, we constructed themes to help explain the patterns of data that would help elucidate a cohesive story.

During the data analysis process, we took several steps to ensure the credibility and dependability of our findings. First, whenever students and faculty members at the same institutions articulated disparate explanations, we made notes that there were multiple perspectives explaining the phenomenon.

Table 3. Demographic characteristics of participants in student and faculty focus groups

	Students (n = 123)	Students (percent)	Faculty (n = 110)	Faculty (percent)
Male	84	68.3	93	84.5
Female	39	31.7	18	16.4
American Indian or Alaskan Native*	1	0.80	2	1.8
Asian*	11	8.90	11	10.0
Black or African American*	17	13.8	2	1.8
Hispanic*	5	4.1	5	4.5
Native Hawaiian or Other Pacific Islander*	1	0.80	0	0.0
White*	93	75.6	100	90.9
Freshman	26	21.1	–	
Sophomore	24	19.5	–	
Junior	25	20.3	–	
Senior	48	39.0	–	
Tenured	–		62	56.4
Non–Tenured, but Tenure Track	–		22	20.0
Not on Tenure Track	–		26	23.6
Very high research institutions (n = 5)	30	0.244	32	29.1
High research institutions (n = 5)	28	0.228	30	27.3
Master's institutions (n = 4)	34	0.276	26	23.6
Baccalaureate and specialty institutions** (n = 4)	31	0.252	23	20.9

*Responses in the race categories may not match the total number of participants. Our demographic assessment instructs respondents to select all categories that apply, so respondents identifying as multiracial may select more than one category. In addition, some respondents did not respond to this item. **Because of the small numbers of institutions in each category nationally, baccalaureate institutions and specialty institutions have been combined to protect the anonymity of participating individuals and institutions.

Similarly, we identified discrepant evidence by noting when students and faculty perspectives varied across institutions. Next, members of the research team engaged in peer review, a process of ensuring that the interpretation of codes and themes are aligned [32, 33, 35, 36]. Four members of the research team reviewed quotes and placed quotes into thematic groups according to how they felt quotes should be categorized. Then, each member discussed their quote categories until there was consensus with the themes. Finally, we considered how our emic (insider) and etic (outsider) perspectives affected the analysis of data. Several members of the research team have engineering backgrounds (both as students and engineering faculty members) that help them better understand the experiences expressed by participants in this study (emic) [33, 37], whereas, other members of the research team have backgrounds in the social sciences (etic) [33, 37]. Our insider and outsider perspectives enhanced how we interrogated the data during the analysis process. Moreover, discussing the themes and findings—given our multiple perspectives—improved the reliability of the information presented in this paper [38].

4. Findings

During focus groups, students and faculty members described the undergraduate engineering experience in relation to ethical development. Overwhelmingly, discussions related to involvement in out-of-classroom experiences surfaced. Our analysis of the data revealed that involvement in out-of-classroom experiences was common amongst the students in our sample at all but one institution. At the remaining institution, involvement was rare and both faculty and students stated that the institutional culture encouraged students to focus on academics to ensure a timely graduation. Our findings focus on the other 17 institutions.

Existing engineering education research—and our conceptual model—informs us that what takes place during college influences students' ethical development [8–11]. Despite the research, participants within our study offered varying opinions whether or not out-of-classroom experiences play a role in improving students' ethical development. What resulted from the disagreements between faculty (and some students) were rich discussions about students' ethical development and the perceived role that participation in out-of-classroom experiences played in their ethical development. Upon analyzing the data, the benefits of involvement in out-of-classroom experiences continued to surface. For the purposes of this study, we operationalize "out-of-classroom experiences"—as described by our participants—as involvement in Greek life, community service, design teams, co-ops, and internships. This is important to note because there might be other kinds of out-of-classroom experiences that were not discussed, or could surface if we talked to different students. We present our findings in three themes to draw connections between students' involvement in out-of-classroom experiences and how they made sense of ethical development. Participation in out-of-classroom experiences:

1. served as a complement to the classroom instruction on ethics;
2. helped students connect learning about ethics to the engineering workplace; and,
3. influenced students' ethical development.

4.1 Participation in out-of-classroom experiences served as a complement to the classroom instruction on ethics

Several faculty members—across institutions—described how students were more engaged in ethics-related discussions in the classroom when they were involved in out-of-classroom experiences. These faculty members agreed that out-of-classroom experiences helped teach ethics and helped enrich the classroom experience. In fact, one professor, at a very high research institution, stated how participation in engineering-related internships influences students, "I'm always astounded how many of them work and they often bring their work-related problems . . . you know, what they worked on, into the class . . ." When students brought what they were learning (or witnessing) from their out-of-classroom experiences into the classroom, the classroom transformed into a real-time case study for students to share how they would handle the dilemma if they were faced with a similar issue. According to the participants in our study, classroom conversations were richer when students shared incidents of witnessing unethical practices taking place at their out-of-classroom experience. In addition, when faculty members engaged the classroom with discussions on students' out-of-classroom experiences, they were able to leverage the momentum of the discussion and relate the conversation to their intended ethics instruction.

According to faculty members, when students participated in out-of-classroom experiences, they were exposed to ethical situations in ways that could not be simulated in the classroom. One faculty member who teaches at a master's institution expressed how students describe encountering ethics in their out-of-classroom experiences, "I know I've heard from co-op students that have had that experience, where, because they've been on a job somewhere, they've maybe seen professional ethics and ethical situations occur and so there's been some experience factor there that they've seen." Similarly, several of our student participants indicated learning more about ethics, and developing their own ethical identities—determining their own sense of right versus wrong—as a result of seeing unethical behavior at their out-of-classroom experiences. One such example comes from a student attending a baccalaureate/specialty institution:

> I would say that looking at them [the internship company] and having that experience, whether or not it was that they practice good engineering ethics or bad engineering ethics, I think reflecting on that helped me decide for myself what is good or bad engineering ethics and what's important. . . I need to make a point of avoiding that in the future focusing on that sort of stuff, too.

In this example, representative of many of the students involved in this study, the student discussed identifying unethical behavior within their out-of-classroom experience. Other students agreed that participating in out-of-classroom experiences extended their understanding of ethics beyond what is learned in the classroom; involvement provided students with the opportunity to see the complexities of ethics, that there is more to ethics than cheating behavior within the classroom setting. Moreover, processing what they witnessed in their out-of-classroom experiences allowed them to make sense of the ethical dilemmas that they encountered.

Participants in our study expressed that involvement in out-of-classroom experiences served as a laboratory to engage with engineering-related ethical dilemmas and prepared students for the workforce. One faculty member at a high research institution discussed out-of-classroom experiences connecting the classroom instruction on ethics to the workforce (or "real world" as this faculty member describes):

> I've found that internships are probably the most helpful in teaching ethics because you . . . well, once again, they come out with the idea that they're going to be the most ethical person in the world but they get to see real world ethics as it's being done by the professionals.

Another faculty member at a high research institution described, "I think they're [out-of-classroom experiences] a primary way that students learn . . . you can *tell* them in class, you can't *show* them in class very easily . . . (emphasis added by authors)."

Consequently, involvement in out-of-classroom experiences became the mechanism that provided students with concrete examples of what they learned in the classroom about ethics. If it were not for involvement in out-of-classroom experiences, the explicit connections between classroom instruction and ethics might not have been made for students until they entered the workforce.

4.2 Participation in out-of-classroom experiences helped students connect learning about ethics to the engineering workplace

Faculty members offered several explanations of reasons why teaching ethics was challenging. For example, students with limited work experience might not connect learning about ethics to its application in professional engineering contexts (i.e., the workforce), and students have limited understandings of the complexities of ethics when they lack experience interacting with diverse people. According to these faculty members, students who had these limited experiences also had a challenging time understanding the severity of unethical behavior and the complexities of ethical dilemmas. One faculty member at a high research institution articulated this challenge, " [Faculty members] are kind of in a bind, we can't really . . . what we teach them doesn't really make sense until they've actually experienced it, and they won't experience it until after they graduate."

Students and faculty members alike suggested that when ethics was taught in the classroom it was often discussed with abstract and outdated examples (e.g. bridges collapsing, buildings constructed incorrectly, etc.). This led some students to believe that ethical dilemmas—taught within the classroom—were merely hypothetical. However, when students were involved in out-of-classroom experiences, they were able to connect what they learned about ethics in the classroom to what they were experiencing outside of the classroom. One student attending a master's institution summarized the importance of participating in out-of-classroom experiences as follows:

> I think while you're in school, one of the best places to learn how to behave ethically is by getting involved in professional organizations and societies, because ethics is essentially like a social thing—you can't be ethical by yourself . . . so if you get involved, you're exposed to situations where you have to deal with other people, that helps with socialization and you get into situations where you have to make ethical decisions. If you're just in class, it's not going to happen.

The quotation above relates the abstract classroom conversations on ethics to the practical experiences students had when they were faced with ethical dilemmas. The student described how participation in out-of-classroom experiences provided exposure to ethics in ways that the classroom experience did not. This student also suggested that involvement provided the opportunity to test one's knowledge of ethics with peers.

Not only did involvement influence their understanding of how ethics worked within the university setting, students articulated how they were learning transferable skills that they would use in their careers. One student at a very high research institution described how case studies were routinely used at his engineering co-op. According to this student, ethics seminars at this company were a standard practice. Colleagues would discuss ethical issues within the workplace and then engage in dialogue aimed at finding solutions to the ethical dilemmas presented:

> We had a lot of like ethics training and stuff we had to do. While I was there, we had to do like a whole group ethics training and they'd give you a situation and you'd basically break down in groups, discuss the situation, discuss like the best thing to do . . . everything from like labor charging to like harassment. Pretty much anything that you could do that would be honest or show integrity, they talked about . . . So, I mean, it was definitely an intense . . . what they put you through about ethics.
>
> . . . I think it was good 'cause it . . . even if you didn't like learn something completely new, like situations that you hadn't thought of in a long time . . . maybe about money laundering or something and that wasn't something I had personally ever been really exposed to before, so that was kind of an eye-opener for me, going through that situation . . . Something you really wouldn't realize is terribly unethical, they'd bring it, you know, into a new light and say, 'Well, you know . . .' actually show you like why that behavior would be bad.

This student, and others who participated in similar internship and co-op experiences, described gaining better understandings of ethics as a result of their involvement. Thus, when students participated in these experiences, they realized that conversations on ethics did, in fact, take place outside of the classroom. In the case of students like the one mentioned above, they recognized that ethical training in engineering is ongoing.

4.3 Participation in out-of-classroom experiences influenced students' ethical development

The students participating in our sample described how their involvement in out-of-classroom experiences shaped their thoughts about ethics and ethical behavior. In conversations related to ethical development, some students articulated how their ethical development was influenced by participation in out-of-classroom experiences. For instance, one self-described student leader, who was involved in multiple out-of-classroom experiences at a baccalaureate/specialty institution, stated:

> I think a lot of it is just personal growth . . . Every single time that I take a test and I could look at someone's paper and I don't, like, yay, me. And so like that, to me, is like me doing ethical behavior . . . I think part of it is just me getting older and having more opportunities to do something unethical and not taking them. It's a lot . . . probably something that all college students are going through; it's a very like pivotal age for us.

Similar to the quote above, our participants acknowledged that they were routinely faced with ethical dilemmas. This is consistent with existing research on ethics that asserts that students are overwhelmed with opportunities to behave unethically [39, 40]; the students in our sample are no exception. What was illuminating, however, was our participants' abilities to recognize unethical incidents and process through various choices. The decision-making processes, revolved around being ethical and making ethical choices, were sometimes discussed in their classrooms—according to students—but were more likely to take place, be practiced, and refined in their out-of-classroom experiences.

Involvement in out-of-classroom experiences provided engineering undergraduate students with opportunities to understand different perspectives and grapple with challenging dilemmas, thereby helping students "see" themselves as future engineers. As one professor from a high research institution described, service-learning experiences challenged students' viewpoints on ethical decision-making and they returned to the classroom with broadened perspectives, ". . . that kind of service-learning [showed] that they've gone through the process and they've confronted some real kinds of challenges and that affects the way they see the world after that one time through." A student attending a high research institution provided another perspective of professional growth, resulting from participation in a service-learning experience:

> Engineering doesn't have a purpose if you don't know what people want or what people need. . .So I guess because of that, going out, seeing those different angles of the community, seeing what is needed, kind of gives you inspiration to create things.

In this example and several others, students shared how their involvement outside of the classroom increased their knowledge of the roles and responsibilities required of engineers. In fact, involved students believed that their participation in out-of-classroom experiences influenced their dedication to the field of engineering. When students were involved in out-of-classroom experiences, they gained better understandings of the engineering field as a result of their participation. Learning about the responsibilities of engineers enhanced their knowledge of the engineering field.

One student attending a master's institution explained that involvement in an out-of-classroom experience influenced professional growth, knowledge of engineering, and ethical behavior, "The experience itself of going [on an international trip with Engineers Without Borders] was moving. Nobody returns the same person they were when they left." This student, who attended an engineering-focused study abroad trip, further described the outcomes that resulted from participation in this experience such as being more equipped to participate in teams, managing conflicts during collaborative experiences, delegating tasks, and setting collective group goals. All of these skills are valuable and transferrable skills within the engineering workforce. Additionally, they are some of the skills for which employers are looking when hiring engineering graduates. These professional and behavioral skills, according to this student, and many others from our sample, were developed as a result of their participation in out-of-classroom experiences.

5. Implications for practice

Our findings speak to existing research calling for new pedagogical strategies, which extend beyond traditional strategies (e.g. case studies) [4–6], of teaching ethics to engineering undergraduates. We illuminate how out-of-classroom experiences can influence students' ethical development and can complement what is learned about ethics in the classroom. Students who were involved in out-of-classroom experiences were exposed to ethical dilemmas in which they had to make decisions. Because of their involvement in these experiences, students increased their opportunities to make learning about ethics a more real experience than a hypothetical conversation taking place in the classroom. Given what we have learned about the engineering undergraduates' involvement in out-of-classroom experiences, we offer strategies to influence students' ethical development and simultaneously improve the classroom experience.

5.1 Encourage reflective practice in ethics instruction

Although involved students were able to articulate elements of their ethical development, many students were reflecting upon their out-of-classroom experiences for the first time. In fact, some students shared that they never thought about how their involvement in out-of-classroom experiences related to ethical development. Undergraduate engineering classes and programs that intentionally require students to reflect on their out-of-classroom experiences may better connect students' learning of ethics. In the classroom, professors could have students think about how case studies (e.g. collapsing bridges, mismanagement of company funds, falsifying reports, plagiarism) relate to the ethical dilemmas faced in their out-of-classroom experiences. If there is a coordinated internship or co-op program, require students to provide a self-assessment of their experience. Next, encourage employers to assess students. Finally, discuss with students their internship or co-op experience, as well as their self-assessment and evaluation from the employer. This feedback loop can aid in students' professional development as well as intentionally engage students about their ethical development.

Building these processes into the curriculum could help bridge students' disconnect of ethics being hypothetical to the real-world implications of making ethical choices.

5.2 *Use classroom instruction to connect out-of-classroom experiences to ethics*

Several faculty members in our study acknowledged that when students were involved in out-of-classroom experiences, they returned to the classroom "different." Faculty members described students behaving more ethically, being more engaged in the classroom conversations on ethics, and being more critical of practices within the engineering field. When students described witnessing what they considered to be unethical decision-making at their out-of-classroom experiences, some faculty members capitalized on those teachable moments by using students' experiences as real-time case studies to get the class engaged talking about ethics. By using real examples offered by students, faculty members are able to draw relationships between the ethical theories and case studies that are routinely used to describe ethics to practical experiences that students are likely to face upon entering full-time engineering jobs. Additionally, taking class time to talk about students' out-of-classroom experiences, and relating those experiences to classroom discussions, may help validate students' experiences, reinforce the significance of their involvement, and encourage uninvolved students to become involved.

6. Implications for research

This study adds to existing research on the ethical development of engineering undergraduate students [8–11, 28, 29]. Notwithstanding, several limitations constrain our ability to generalize the findings more widely; these limitations provide opportunities for future research.

6.1 *Investigate outcomes by types of out-of-classroom experience*

Although the students in our sample offered examples of out-of-classroom experiences, it is unclear how different out-of-classroom experiences influence students' ethical development. For example, does participation in internships or Greek life influence different outcomes of ethical development? Future research, both qualitative and quantitative, should investigate the types of out-of-classroom experiences in which engineering students are involved. The results from such research could allow faculty, staff, and administrators to recommend specific activities for students to participate. Moreover, such examinations may offer better explanations of the skills students are receiving and provide strategies for how to recreate those skills within the classroom.

6.2 *Explore differences of out-of-classroom involvement by gender and race*

Some faculty members suggested that their female students were more likely to be involved in out-of-classroom experiences. We did not account for gender in this qualitative analysis, and cannot assess these differences. Additionally, our strategy of random sampling during the data collection process did not produce a significant number of participants to help us make comparisons by gender or race. Future research might consider employing a purposeful sampling strategy, to achieve equitable numbers of women and underrepresented students of color. Results from such a study might provide a more nuanced understanding of the ways that out-of-classroom experiences influence the ethical development of the engineering undergraduate population. Future research might also employ quantitative techniques to understand how levels of participation (e.g., not involved, moderately involved, over-involved) and types of out-of-classroom experiences influence ethical development for engineers, differences by race and gender.

6.3 *Examine out-of-classroom experiences of engineering or pre-engineering students at other types of institutions*

The 18 institutions sampled in this study were selected based on their Carnegie classifications and provided diversity along a number of spectrums (i.e. geographical, public versus private, broad degree programs versus specialty, number of students enrolled, gender, and race and ethnicity). However, there are other types of institutions that educate engineering or pre-engineering students that were not included in our sample (e.g., military academies, faith-based institutions, and community colleges) or were included in small numbers (e.g., liberal arts-focused colleges, historically black colleges and universities, Hispanic-serving institutions). Future research could examine the out-of-classroom experiences of students at other types of institutions, because it is possible that involvement in out-of-classroom experiences at other institutional types may or may not elicit the same results as identified in this paper.

7. Conclusion

The role of out-of-classroom experiences on ethical development is rarely presented within engineering education research. Notwithstanding, the engineering education community can learn from the institutions in our study. The purpose of this study was not to compare in-class experiences with out-of-classroom experiences. Rather, our data suggests that students' understanding of ethics extends beyond what the classroom curriculum provides when faculty members draw upon students' out-of-classroom experiences. In other words, the students involved in out-of-classroom experiences were able to relate their understanding of ethics to what they were experiencing outside of the classroom. Second, students' knowledge of the engineering workforce is increased as a result of their involvement; when students are involved, they actively connect their understanding of ethics to the engineering profession. Finally, the students involved in this study illustrated that ethical development does take place during their undergraduate career; participation in out-of-classroom experiences helps facilitate the process of ethical development as we defined it. Thus, our findings add to the engineering education discourse by suggesting "how" involvement is important and benefits both faculty and undergraduate students.

Faculty members can encourage student involvement in out-of-classroom experiences. Creating the space in the classroom to discuss everyday ethical scenarios will benefit students who are involved in out-of-classroom experiences as well as students who are not involved. When faculty, staff, and administrators create opportunities for reflection, opportunities that link the out-of-classroom experience to the ethical lessons taught in the curriculum, we begin to engage engineers and create more robust learning experiences. Finally, engaging students on the practical decisions they face in their out-of-classroom experiences could positively influence how students view ethics in all situations they encounter.

The findings of this study have implications for redesigning engineering curricula; by extrapolating what students and faculty members perceive to be the benefits of participation in out-of-classroom experiences, we can improve how ethics and professional responsibility is taught in the classroom. Furthermore, administrators can use what we have learned about students' out-of-classroom experiences when developing programming (i.e. structured internship experiences, engineering-focused student organizations, design teams) that will enhance students' professional understanding of engineering. As a result of these findings, we improve our knowledge of outcomes that result from involvement in out-of-classroom experiences. These findings can be applied to degree programs that service a similar professionally oriented student population, and set the stage for analysis of other majors.

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