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Early-Career Engineers' Stories of Ethics and Equity in the Workplace: A Thematic Analysis

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Abstract

As new engineers transition from educational settings to professional careers, they face the imperative task of acquiring not only technical expertise but also hands-on experience and practical insights to be effective in their engineering work. This experiential learning encompasses problem-solving, critical thinking, project management, effective communication, collaboration with multidisciplinary teams, adaptability to industry trends, and a profound understanding of real-world constraints and challenges and therefore involves addressing various ethical dilemmas. In today's society, heightened awareness and expectations concerning ethical and equity issues underscore the need to assess the preparedness of early-career engineers to navigate this complex landscape in their professional journeys. To help transition engineers develop into ethical and equity-minded professionals while adapting successfully to their changing roles and responsibilities, we need to understand how early career engineers experience and perceive issues related to ethics and equity in their workplace. This understanding will allow for the development of a comprehensive educational curriculum, professional development initiatives, and leadership skills, for personal and professional growth.

This study presents the findings from research carried out by interviewing 13 early career engineers from diverse engineering disciplines across North America, delving into their educational backgrounds, current work projects, and challenges related to professional ethics, equity, and inclusion. After conducting semi-structured interviews, the data were analyzed using Thematic Analysis. The analysis presented in this paper focuses specifically on the stories the interviewees shared when asked about their experiences related to ethics and equity in the workplace. Participants shared examples of ethical dilemmas related to oversight of work and quality control, safety, doing work beyond one's expertise, equity in pay and promotion, the ethical environment of the organization, and conflicts of interest involving the desires of different stakeholders. Equity stories fell into two broad themes: (1) inequitable or discriminatory allocation of resources or opportunities, and (2) discriminatory comments, uncivil behavior, and uncomfortable situations. Recommendations for future research include qualitative and quantitative studies to capture the essence and types of dilemmas faced by new engineers around professional ethics and equity.

Introduction

Due to the impact of engineering designs and products in today's societies, the formation of ethical and inclusive engineers is imperative. Professional ethics have long been included as part of the required content for engineering students. Engineering academia has traditionally focused on the ethical obligations of engineers by developing standalone courses on the subject or by integrating ethics-related content in engineering technical courses [3 ,4]. In recent years, engineering educators and engineering education researchers have attended to subjects such as empathy, ethics of care, and the issues of diversity, equity, inclusion, and justice (DEIJ) in engineering curricula (e.g., [1, 2]). Therefore, the meaning of what constitutes professional engineering ethics and ethical behavior has begun to expand. However, research that discusses DEIJ issues in relation to engineering ethics is rare, with a few exceptions e.g., [5, 6].

On the relationship between justice and professional ethics in the broader literature of the workplace, Crawshaw and colleagues [7] stated: "'Justice' involves a type of moral appraisal. In particular, an action is said to be 'just' or 'fair' if it conforms to certain standards of ethical propriety" (p. 887). They argued that although both organizational justice and behavioral ethics research are concerned with questions of right and wrong, until recently, the study of ethical behavior at work has focused on them as two distinct scholarly traditions. Discussing the importance of linking the two, they stated [7]:

> The process theories of justice offer an important avenue for integrating behavioural ethics research. If fairness decisions are made through a series of cognitive steps, then there are a number of stages in which ethical considerations could intervene. (p. 891)

In the case of engineering education, Rottmann and Reeve [6] identified "a long-lasting division between ethics and equity in engineering education" (p. 146) and framed it as the micro/macro divide. While micro-ethics refers to individual professional responsibilities, macro-ethics has to do with the responsibilities of engineering as a profession. Macro-ethics topics may be harder to attribute to individual responsibilities, but they are essential for engineering to fulfill its appropriate role in society. Similar to Kakkad [8], who argued that becoming more active and vocal on issues of social justice is an ethical responsibility for psychologists, one can argue the ethical responsibility of engineers regarding issues of equity and justice. Such responsibility can be inferred from the attention of codes of ethics in different engineering disciplines to DEIJ issues, although these codes show different levels of attention to these issues [9]. While the ACM code of ethics explicitly focuses on fairness and inclusive practices and cautions against discrimination and causing new or enhancing inequities, others might focus on public welfare broadly linked to issues of equity in society. Nevertheless, these codes all envision a responsibility by engineers to care about the broader impacts of their work in society, including a commitment to benefiting humanity [9], suggesting an important link between engineering professional ethics and equity. Although the connection between ethics and equity in some capacity is being made in academic settings, whether such a connection is realized in the practice of industry is yet unknown.

Building on Rottmann and Reeve's [6] arguments regarding the traditional division between ethics and equity in engineering, this paper describes findings from a set of interviews aimed at understanding the experiences of early-career engineers regarding both ethics and equity as they transition into professional practice. We argue that when we think about the formation of engineers, we must learn more about how engineers in practice view their responsibilities regarding issues of ethics and equity. In particular, we focus on what engineers consider as issues related to professional ethics and equity and how they engage with such topics in the work they do and in their workplaces. We focus on early-career engineers because this is a key stage in the formation of ethical and equity-minded engineers and because we want to use study findings to support changes in engineering education to better prepare engineering students for the types of ethical and equity-related challenges they will face early in their professional careers. As stated by Brunhaver and colleagues [13], a better understanding of the challenges of early career engineers and the issues they face in practice can inform engineering education in significant ways.

Literature Review

The early career phase in an engineering career is critical, marked by transitions from education to practice, organizational socialization, and identity development [10]. Navigating the early engineering career involves challenges that highlight the unpreparedness of engineering graduates for the workplace [11]. This section aims to synthesize key findings from recent studies on early career engineers, shedding light on the complexities they face, including challenges related to diversity, gender bias, and organizational culture [12, 13].

A recent investigation by Rottmann and colleagues [14] brought attention to the evolving dynamics of the engineering profession. The authors emphasized the challenges faced by early and mid-career engineers due to increased professional autonomy and a lack of formal guidance, hindering their support-seeking behaviors [14]. This insight aligns with the findings by Hess and colleagues [15], who argued for the recognition and integration of empathy and care within the engineering context. They advocated for addressing these phenomena, emphasizing their significance in fostering effective engineering practices and enriching educational approaches. The psychological impact of early commitment to engineering careers is further explored in a study by Huff and colleagues [16], wherein the authors identified three distinct patterns in engineering identity development during the transition from education to the workplace. These patterns encompassed the exploration of a strong commitment to career identities, a simultaneous exploration of non-career-related facets of identity, and, notably, the nuanced experience of gendered tension among women participants as they navigated the interplay between their engineering roles and family responsibilities [16]. Similarly, Klenk and colleagues [17] study delved into the experiences of early-career engineers, categorizing meaningful events. This research emphasized the importance of constructive feedback, trust, collaboration, and witnessing the impact of one's work. Using a transformative learning framework, the study provided a comprehensive understanding of the intricate nuances inherent in these professional experiences, distinguishing between actions, socially meaningful events, cognitively meaningful events, emotionally meaningful events, and contextually meaningful events [17].

Beddoes [12] focused on the experiences of women engineers in their early careers, revealing gender-based harassment, racial isolation, and negotiating intersectional dynamics related to race and nationality. Examining narratives of three women civil engineers, the study highlighted negative interpersonal interactions, emphasizing the impact of gender, race, religion, and nationality on newcomer experiences. The findings contribute insights into the challenges faced by women in engineering such as lack of diversity, gender bias, and reluctance to report harassment. The study expanded [18] the engineering socialization model, recognizing various forms of power-privilege dynamics influencing early-career outcomes [12]. The authors called for longitudinal and comparative studies, exploration of intersectionality, and evaluation of mentorship programs to develop targeted interventions that support the successful integration and career progression of international women engineers, addressing the identified challenges and leveraging the privileges they may encounter [12].

Expanding the understanding of the school-to-work transition, the study by Lutz and Paretti [10] on social and cultural dimensions of learning for recent engineering graduates delved into how new mechanical engineering graduates described significant learning related to the social and

cultural dimensions of their organizations. The findings highlighted the need for a broader spectrum of learning during the transition and advocated for making visible the social and cultural dimensions of engineering work [10].

Conducting surveys among 625 engineers who graduated up to three years prior, Gilmartin [19] studied the outcomes of 'stretch assignments' among early-career engineers and found such assignments especially those involved in unfamiliar areas intensified gender and racial inequalities in the workforce [19].

van der Marel and colleagues [20] conducted interviews with 33 early career engineers to investigate their experiences and how they connected to the needs for autonomy, career intentions, competence, and relatedness. The authors found that "intersections of gender and race influenced the accessibility of opportunities supporting effectiveness and validation at the workplace" and emphasized "the role of effectiveness and the significance of social validation in shaping early-career experiences," explaining differences across the groups regarding leaving their positions, the organization, or the field [20].

Recognizing "tensions between calls for socially just engineering education and the corporate contexts constraining engineering work", Gewirtz and Paretti [21] studied the experiences of one early career engineer using the structure-agency approach (p. 111). The findings of their narrative analysis based on five interviews with the participants suggested the need for preparing engineers based on the complex identity negotiations experienced by early career engineers [21].

 Bielefeldt and Canney [22] explored the perspectives of engineers on ethical dilemmas. The findings of their study revealed that engineers working for NGOs or non-profit organizations reported the highest frequency of encountering ethical dilemmas. A small number of individuals reported changing jobs due to ethical concerns. The study also explored the relationships between perceptions of ethical dilemmas and attitudes toward professional social responsibility, finding higher social responsibility scores among those who perceive ethical dilemmas more frequently [22].

Hess and colleagues [23] conducted 43 semi-structured interviews to examine the ethical engineering practice of engineers from various engineering disciplines who worked in the health products industry. Using the critical incident technique, the authors identified influential workplace experiences that impacted the participants' ethical practice [23] and categorized the incident types into the following categories: cultural immersions, interpersonal encounters, ethical actions, ethical failures, and mentorship events. In another study on the practice of engineering ethics, using grounded theory, Chance and colleagues [24] explored experiences of global responsibility, sustainability, and ethics among early-career civil engineers. The findings stressed limited recognition of 'global responsibility' and a stronger concern for health and safety compared to broader public well-being. The authors called for greater integration of sustainability and ethical issues in engineering education and emphasized the importance of aligning civil engineering practice with global sustainability goals [24].

While there has been a body of research about the ethical formation of new engineers, prior work has considered equity issues in a limited way, and the connections these engineers draw between ethics and equity have not been studied.

Research Questions

1. What is the nature of experiences with professional ethics and equity as presented in the stories shared by early career engineers?
2. What connections, if any, can be made between ethics and equity in engineering based on the early-career engineers' experiences?

Methods

Participant recruitment

Thirteen early-career engineers, all within the specified experience range of 0-10 years, underwent interviews. The majority, comprising ten participants, possessed between 0-5 years of professional experience. These individuals represent diverse engineering disciplines and work in various employment sectors across North America. The initial stage of the study involved recruiting participants, with methods approved by the Institutional Review Boards (IRB) without any form of incentives. The methods used for participant recruitment comprised reaching out through social media direct messages, LinkedIn posts, professional networks of the researchers, and emails to local engineering societies and chapters. Participants were requested to complete a survey through the Qualtrics platform, providing their demographic information, followed by scheduling an appointment via the "You can book me" platform and submitting a signed consent document sent to them via email. The consent document explicitly outlined the principles of anonymity and confidentiality to the participants.

Table 1. Demographics of participants

Pseudonym	Gender	Race	Discipline trained in school	Current Field of Employment	Years of Experience	Current Place of Employment
Alex	F	White/European	Mining Engineering	Mining Engineering	5+	Mining
Amos	M	White/European	Mechanical Engineering & Materials Science Engineering	Mechanical Engineering	4-5	Academia
Bangalore	M	Indian/Southeast	Civil Engineering	Civil Engineering	5+	Private
Bob	M	White/European	Engineering Physics	Mechanical Engineering	4-5	State University (Academia)
Carl	M	White/European	Civil Engineering	Civil Engineering	5+	Private
Cesar	M	White/European	Civil Engineering & Industrial Engineering	Civil, Industrial, Mechanical & Geotechnical Engineering	2-3	Private
Fred	M	White/European	Civil Engineering	Civil Engineering	6 months -1 year	Academia
Jade	M	White/European	Chemical Engineering & Biological Engineering	Analytics Engineering	3-4	Private

Jessica	F	White/European	Computer Engineering	Computer Engineering	3-4	Private
Jordan	M	Black/African American	Computer Engineering	Computer Engineering & Electrical Engineering	4-5	Private
Kaylee Williams	F	Black/African American & White/European	Civil Engineering & Geotechnical Engineering	Civil Engineering & Geotechnical Engineering	4-5	Consultant
Sara	F	Middle Eastern/North African	Chemical Engineering &Mechanical Engineering	Mechanical Engineering	4-5	Private
Spencer	M	White/European	Civil Engineering& Environmental Engineering	Civil Engineering	4-5	Consultant

Interview

Utilizing the Internet for conducting interviews is a convenient way to obtain data for research purposes [25]. To achieve flexibility yet be consistent with the data collected across interviews, semi-structured interviews were conducted via the Zoom platform. The recorded time frame for the interviews ranged from one hour thirty-six seconds (1:00:36) as the longest and forty-three minutes fifty-eight seconds (43:58) as the shortest, enabling participants to express their experiences, thoughts, and feelings concerning the advancement of ethics, equity, and inclusion progressed in engineering.

The interview protocol included a variety of questions about early career-engineers education and training related to ethics and asked them to share their experiences around ethics and equity. This paper focuses on the experiences and examples early-career engineers shared in response to the two interview prompts listed below.

Ethics
For the purposes of this research project, we are defining professional ethics as "what professionals should or should not do to impact others, and society in general, in their professional practice"

Could you please share a dilemma you have had related to professional ethics in the time since you started working as an engineer?

Equity
*For the purposes of this research project, we define **equity** as "fairness that comes from explicitly considering individual backgrounds and access to resources or opportunities and developing designs that address the unique circumstances of individuals to achieve fair outcomes". This contrasts with the term **'equality'** which is defined as "treating all persons the same regardless of their individual circumstances".*

Could you please share an example of a situation where there was equity or inclusion challenges since you started working as an engineer?

Data Analysis

Thematic analysis
Thematic analysis, a widely used approach in qualitative research, was used in this study to identify, analyze, and report patterns within data [26]. As described by Braun and Clarke [26], "[a] theme captures something important about the data in relation to the research question and represents some level of patterned response or meaning within the data set" (p. 82).

Data coding: ATLAS.ti was the platform used for this study to generate, and organize the codes. After verbatim transcription, the data was systematically coded. In particular, we identified parts of the texts where participants referred to particular events and stories related to ethics and equity. Then, we developed codes for each identified story to capture the main issue(s) that were raised. This was done by breaking down the data into smaller segments and assigning descriptive labels or codes to capture key concepts, themes, or patterns within the data.

Identification of Patterns: At this stage, the research team looked within the coded data for patterns and categorized the developed codes into themes. The purpose of this phase was to review and refine the identified patterns to capture the essence of the data.

Findings
The following section presents the main themes developed to describe the types of ethical and equity-related experiences interview participants described when we asked them to share stories about dilemmas or situations they encountered in the workplace. The ethics-related experiences spanned a wide range of topics, including quality control and oversight, safety, doing engineering work beyond one's expertise, equity in pay and promotion, the ethical environment of the organization, and dealing with conflicts of interest. While some examples describe specific events, other stories were told in a way that implies the events were routine or encountered many times.

Professional Ethics Stories
Quality control and oversight
Many of the ethics stories the early career engineers shared were related to issues of quality control and oversight of work. Carl is an early career engineer who did a design without another engineer doing an independent design check, as he explained:

> [For] structures engineering or bridge engineering, it's generally common practice to have two engineers design something. So, one engineer to do the design, and then another engineer to do what's called an independent design check. And so, I think my first cross with ethics or something that could be construed as questionable ethics is there's certain clients that don't know the standard practice per se. So, I think sometimes companies try to save time and money and forego things like independent design checks, which is unfortunate.

Bob shared how his former company practiced engineering in a questionable manner by violating the code of ethics and installing equipment that may not serve the right purpose due to a lack or no quality control officer:

> We would be given monumental projects and expected to turn them around in a matter of weeks, which these projects required years of development for them to function safely. In that way, we were encouraged to flesh out systems in a way that wasn't realistic and supply that to customers, and in my opinion, that is a direct violation of ethics, especially [in cases of] water management ... the way that we went about our engineering ethics was questionable at best.

Bob also recalled a situation of products that were unsuitable:

> They would be installed in the field, and we would determine that it wasn't going to serve the needs of our purpose. Rather than having a change order with a customer and saying, hey, we're not going to meet our deadline. We need to change some parts and send you another one that'll be suitable. We would send them the same broken part twice to give ourselves a little bit more rope so that we could work on the parts.

As another example, Cesar shared his experiences on how a company cut corners and used sub-standard material to deliver projects:

> And it was difficult at the time to get material… on time, but then also employees. So there was, a lot of unethical stuff in my opinion, where they may not have used the proper rebar to build this pipe that was required to, and they still shipped it out. Or sometimes we may not even have enough fly ash. He would work around it just so his report could say that his mix design passed the concrete break test, even though he didn't use what was specified in the contract and that mix design. So those short pins were taken. Or when it came to testing material, when you crush up a concrete pipe, basically it is a simple machine, but the machine that he was using, he calibrated it to a point where anything would pass. Which is wrong, because he told me towards the end when I quit, he's like, Yeah, this machine, I calibrate it because I know my material wouldn't pass in another plant, but I calibrated it here so material can pass here, and I can just make money.

At another company, Cesar shared how he got fired barely one week into the job for speaking the truth about field testing of materials and being unwilling to compromise safety.

Safety

Several participants shared stories about safety as the core issue. Participants' stories under this category were either related to the safety of employees or concerned about the safety of customers and the public. For example, Bob shared the following incident that happened to a coworker:

> …an individual walked into a piece of machinery that is designed to go up upwards of 800 degrees Celsius, and it started to turn on with this individual inside of it. The only

reason why that individual survived is because she started to destroy the product, which set off alarms in our system, and that was how the individual was saved.

Regarding the safety of the public, Spencer shared his experience with a client who thought the safety measures concerning a potential flood project were unrealistic:

I just had to really just convey there were only so many options that we had in order to convey these floodwaters in a safe manner that wouldn't put people at risk, and the client kept getting stuck on how, quote, unquote, "Unrealistic" the flood was. So, I just kind of had to defer to ethics as unrealistic as somebody might think that is, the responsible and ethical thing to do is to plan for the worst-case scenario.

Cesar shared a safety situation at the site:

Safety is huge when it comes to ethics, right? Especially in a concrete manufacturing plant, you have dust all over the place, it's super dirty. There was a lot of moving pieces within the warehouse. There was no safety incorporated in here. Guys weren't even wearing their hard hats when they were picking up a concrete pipe like 15 feet into the air. The crane even, it couldn't hold. The crane that they installed there couldn't hold that certain concrete pipes due to their weight. But he still picked it up and just moved pipes all over the place. Or even chains, for example, some of those chains. And you can tell when a chain is not in use while he still used it. So, he was running the risk of his employees of a catastrophe happening, essentially. Having a 30-foot, no, like an 18-inch pipe just falling on someone.

Bob shared an unethical work practice that happened in the company where he was working during the Covid- 19 pandemic where his employer was not thinking about workers' health and safety:

I saw a lot of very interesting practices being employed. During the period of time when we were forced to work remotely, they used classifications to pull us back into the office. So, over the entire pandemic, doing engineering work, which is entirely on computers, which I had available at home, I was forced to be in the office the entire time, given shoddy excuses for why it was acceptable. Gosh, I remember at one point they installed a UV light pointing at their air conditioning unit, and they said that this makes it COVID-proof, which as you know is scientifically unfounded in every way.

Bob also shared how those who really need and will benefit from safety practices are the same people who would fight safety regulations: "And one of the strangest lessons that I learned from this is oftentimes when you are advocating for safety regulations, the ones who are going to push back most vehemently against them, are the people in the most danger".

Doing engineering beyond one's area of expertise
Some participants discussed taking on tasks that might go beyond their expertise as an ethical issue. For example, Fred stated:

Just being able to turn down work by saying, I'm not qualified to be doing this. I don't have experience doing this before. I either need somebody to walk me through this or have somebody else do this work for me because I don't have experience with this. Recognizing those limits, I think, was the most ethical dilemma that I ran into.

As another example, Carl shared:

I have a house project where I want to put a patio roof on the back of my house, and my wheelhouse is bridges and retaining walls, but it seems like I need to pull a permit through the county and then have an engineer stamp these drawings for a patio roof. And so, I'm going through the ethical dilemma of I feel that I am qualified and competent to stamp drawings for a roof, but I've never done it before.

Equity in pay and promotion
Many participants raised issues of pay and promotion when talking about ethical dilemmas. Alex clearly states that at her company there is no holistic standard for promoting workers: "but there is no standard for promotion." Amos shared how the company uses different standards regarding employee promotion, also the company has not been transparent and ethical in treating workers:

So, I started pushing for it. Then I got pushed back from my supervisor saying, oh, no, you're not allowed to apply to anything period for a full year after employment. That's company policy, which I was not told about during my interview or when I started working. I was pissed.

This was one area where interviewees were drawing connections between ethics and equity. However, the equity implications were for the interviewees, not for the public impacted by the engineering work.

Ethical and inclusive environment
Ethical and equity issues also overlapped for participants when they described how they had been impacted by work environments. Kaylee shared how a male colleague tried to throw something at her. She also shared how another colleague talked disrespectfully toward her: "Someone said they literally didn't want to listen to me because I was a woman".
Sara shared how a male colleague made an advance towards her:

So even when I was there, there were a few little things that someone tried to make a move, did things. But at the point that I got mad. It's so hard to figure out what is the right thing to do. But I knew that if I didn't say anything, probably it meant to them that it was okay, to make your second move. But at the same time, I didn't want to make a big deal out of it because it was so small, a stupid thing a little boy does.

Amos's trust in his boss was betrayed after he found out his boss wrote on his file all private discussions they had:

Even the times when I raised concerns with my boss and had conversations and I was told that it was just between us, I actually found out when I left the position that my personal file at the company had had notes on all the meetings, I had had with him, which was very disconcerting, very uncomfortable finding that document.

Another example of the impact of the work environment was cases where participants felt forced to make unethical decisions by signing off on work.

Yeah, well, one time I remember like I was doing a design, like a specific design where someone had to cross. Anyways add to be like in close proximity. To my design. And I was a new engineer. And. Anyways, it was like a group project and one of the engineers, a senior engineer that was working with me, told me to sign. On a specific project that like it's like and like I wasn't a because I was new, I wasn't able to ensure that the project was West safe for the person using it. Just using the, using the design. So, anyways, just before it got issued, they've no, someone noticed that there was a mistake in the design and someone could have like would have like could have been injured. But because I signed on to that thing just because I trusted my senior, I trusted my supervisor. I could, I, like I could have been liable for it. I could have lost my license.

Dealing with conflicting interests
The stories in this category are about the conflicting responsibilities of engineers to different stakeholders. As one of the respondents, Bangalore stated: "I'm trying to serve my client, but [at the same time] there are obligations to my coworkers or obligations to, I don't know, the public…" he also shared his experience with Non-Disclosure Agreements (NDAs). According to him:

… you'll have to sign an NDA, and even though it's important, you really can't share that information with some of the people. So, having straight-up conversations telling them, "I'm not in a position to share that with you at the moment, but we can get back to this at a later time.

Carl also shared a potential conflict of interest situation at his firm but due to proper communication the issue was resolved:

I did the design of the walls, and then the project went out to bid, and then [name of agency] actually hired [name of company] again to do the construction management and construction inspection. And that could be viewed as a conflict of interest since we did the design and then we're out in the field inspecting the project. And generally, it's a good idea to have a separate entity do that design and the inspection is I guess the easier way to say it.

Bob as a young engineer was confronted with a choice to report unethical practice to higher authority or play along:

I was in a situation where it was either I could blow up my career by elevating this to the appropriate people, or I could go along with what I was being asked to do and bellyache about it when there was an appropriate opportunity. And it's not even as if this was

something where I had nobody else to speak to, my manager at that business, was in the process of a lawsuit because the employer was in violation of his contract. So, it wasn't as if these things were being pushed onto the lower rungs, there were issues across the board.

Spencer shared his struggle of practicing engineering in a safe and ethical manner despite the opinions of the client and standing up to a client who wanted a shortcut:

The client just wants to try to cut costs and not necessarily retain the current flow. They wanted to try to send it through a more complicated path or a path that was less likely to succeed. Really, they kept pushing for us to try to find a way to get out of providing that overflow path at all. So I guess the ethical concern that I had to solve was really conveying to the client like, "No, we have to do this. It doesn't matter that it's expensive".

Equity Stories

During the interviews, we asked participants about dilemmas they had encountered related to equity or inclusion in their workplace. The equity and inclusion stories shared by participants can be categorized into two broad types of stories: stories about inequitable or discriminatory allocation of resources or opportunities and stories about discriminatory comments, uncivil behavior, and uncomfortable situations. We note that most of the equity stories shared by participants highlight inequitable circumstances within the engineering workplace. When asked about equity, our participants generally did not provide examples of equitable or inequitable practices affecting the public, clients, or other stakeholders of engineering work. The types of stories we heard may have been because we asked participants about equity and inclusion, so they were thinking about times they felt included or excluded.

Inequitable Allocation of Resources or opportunities

Several participants shared examples of situations where they felt they were denied opportunities because of their personal characteristics. For example, Jessica working in the Information Technology (IT) field described:

Well, a lot of it was I felt like he was giving more responsibility to the guys. I wasn't trusted to do things and I wasn't sure if it was because I was the... Not only others count on one hand how many women were in it, but I was also the only one on the team and I can only name three female developers. So, he would never trust me with a project, never let me try to take on something to prove that yes, I can do it, I promise I can. So that was very difficult and I felt multiple times I dreaded meetings with him. I thought that he was going to find some BS reason to fire me and I would be terrified every meeting that I had with him.

Another participant described limited accessibility to restrooms in field environments which can limit career opportunities for some:

On site like in the field. So, a lot of people, are not comfortable. To do their thing if there's no bathroom So, there are people that have told me that they prefer to take a job. That Pay less? Just because if they would take, I'm trying to be not really specific here,

but I think you will get my point. They would take certain jobs that would, let's say, allow them to be on surface close to a bathroom. Instead of taking a job that would pay more, but like with require you to spend more time on the field with no bathroom. People if they would have to choose, they would take a job that pays less because it affects their dignity.

An engineer who had worked in practice for several years and then returned to graduate school noted inequitable access to physical resources to do work:

And I think equity challenges definitely come up when it comes to different students having different funding from different sources and professors having different funding sources as well. And then making sure that each student is getting the resources they need to complete their certain projects is definitely sometimes a challenge. I can't think of a specific instance, but it's kind of more of a daily thing where we're all part of this same kind of research consortium. So, you're grouped together in a lot of senses, but everybody has a different PI (principal investigator) and everybody has a different funding source. And so, it's inevitable that everybody, to some extent, has different experiences and different access to certain resources, which is just a challenging thing to navigate in the academic world.

Although this situation was specifically in an academic setting, resource issues could easily be imagined in a professional setting.

Discriminatory work environments
In addition to the stories that described specific opportunities or resources that were denied, other stories shared by participants demonstrated discriminatory comments, uncivil behavior, and uncomfortable work environments. For example, in one case an interviewee shared a situation where they advocated for a colleague who was experiencing discriminatory communication:

… the engineering intern in question, the one to whom all the derogatory comments were directed, is a woman and she's also gay. And I don't know if either of those was the catalyst for the derogatory comments, but again, as soon as we were both offended by what he said, we brought forth the issue to the higher-ups.

This was a situation where the interviewee and the person receiving the communication had recourse to go to the Human Resources (HR) department of the organization. However, other stories described situations that made the interviewee feel excluded, but it would be hard to talk to HR.

Some participants shared the feeling of exclusion as minorities in the field. For example, a black engineer described the setting at a company-wide training:
I think the most uncomfortable thing…I hadn't seen another engineer at my job that was Black, and I saw one in a training I was in and I wanted to talk to her, but she actually came up to me on my way back to my room and was like, "Hi, I wanted to talk to you," and I was like, "Oh, that's great.' And we ended up having lunch together, but when we went, if you've been to a conference, they'll have a big hall that has all the tables, so we

sat at a table together and no one was sitting at our table. And the only other people who decided to sit at our table were also people of color from other offices, also Black people from other offices. We were the only Black people there, I think it was four of us at the time.

Discussion
In this study, we investigated the ethics and equity-related issues that early career engineers encountered, exemplified in their shared stories. When asked to share examples of ethical dilemmas, some participants shared stories that might be more in line with equity issues. This suggests that participants see ethics and equity as related to each other. These empirical findings are in line with previous research suggesting the connection between ethics and justice [7, 8]. In terms of ethical and equity-related issues, similar to some of the previous research, e.g., [12], our participants shared examples of being excluded from projects or harassed because of their gender. In addition, similar to [12, 14], some participants shared stories that raised their positive and negative experiences of supervisor support. Moreover, our findings regarding issues such as safety and adequate testing were identified in previous research on practicing engineers' experiences with ethical issues [23].

Many of the stories shared by the participants have been addressed in different codes of ethics from engineering professional societies. For example, the National Society of Professional Engineers (NSPE) Code of Ethics' [27] first fundamental cannon is to "hold paramount the safety, health, and welfare of the public." The safety stories participants shared often described the workplace, but the safety of workers and employees should also be considered by this cannon. The NSPE also requires that engineers "[a]ct for each employer or client as faithful agents or trustees" and provides details on how engineers should work to avoid conflicts of interest, a frequent concern for our interviewees. The concerns participants raised about pay and promotion equity and the equity stories about access to opportunities would fall under the American Society of Civil Engineering's [28] obligation to "supervise equitably and respectfully" and "encourage and enable the education and development of other engineers and prospective members of the profession". The equity stories describing discriminatory and unwelcoming workplaces run counter to the ASCE standard to "promote and exhibit inclusive, equitable, and ethical behavior in all engagements with colleagues." The stories shared by our participants provide real-world examples of how the cannons and principles in a code of ethics are actually encountered in professional practice. This can help instructors and employers to develop training that meets the needs of new engineers.

Limitations
The current study is limited in various ways. First, the subject of the interview was known to the potential participants, which might have impacted their willingness to participate and shaped their expectations of the questions they would be asked and, therefore, the topics they had in mind before participating in the interview. Second, many of the respondents had a background in civil engineering and related disciplines which might have influenced the kind of ethical and equity-related dilemmas they encountered.

Implications

The findings of this study can inform engineering educators regarding the kinds of issues early-career engineers encounter when it comes to ethics and equity. Based on the findings from this study, case studies can be developed for use in engineering courses. Moreover, the findings of this study can help organizations understand how they can improve their climate for engineers, especially those in their early careers.

Future research
Future studies can ask the questions raised in this study from a wider range of engineering disciplines and engineers in different places in their careers. In particular, they can look into the perceived relationship between ethics and equity among practicing engineers by using quantitative approaches. Moreover, using quantitative approaches, the prevalence of different issues raised by participants of this study can be investigated among engineers from different disciplines to provide a better picture of the kinds of issues that graduates from different engineering disciplines might come across. Moreover, future studies can examine whether and how the industry, the type of company, and other participants' demographics might affect the frequency and types of ethics and equity issues the engineers face in their practice.

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