Board 246: Early-Career Engineers' Experiences with Equity and Ethics in the Workplace

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Abstract

Engineers are likely to face issues related to ethics, and the connections between ethics and diversity, equity, inclusion, and justice in their careers. Understanding the experiences of engineers can guide the development of education, training, and other interventions to promote ethical and equitable professional cultures. The experiences of early-career engineers as they transition into professional practice can shape their future attitudes and actions related to professional ethics, social equity in the work they do, and equity in the workplace. This NSF-funded project uses a sequential mixed-methods approach to study the experiences of early-career engineers with ethics and equity. Our poster will present findings from the first round of interviews with 13 early-career engineers from various engineering disciplines in the United States of America and Canada. Semi-structured interviews were conducted with volunteering participants allowing them to share their experiences, thoughts, and perceived challenges regarding equity and ethics. Transcribed interviews were analyzed using Reflexive Thematic Analysis (RTA). RTA is a flexible and inductive approach to qualitative analysis that develops themes and patterns in a systematic and reflexive manner. Initial findings indicate that some participants were exploited as they did not fully understand what their roles entailed as early career engineers. Others shared how school did not prepare them for non-technical skills that are critical in dealing with ethics and equity issues raised at the workplace including communication, teamwork, and conflict management. Both of these findings suggest a lack of preparedness for real-life situations in the workplace.

Keywords: equity, ethics, early career engineers, engineering education

Introduction

Every profession comes with its challenges and the engineering profession is no exception. Navigating the field of engineering, particularly in the early stages of one's career, can be daunting as uncertainties often arise regarding the expectations associated with the professional trajectory of early-career engineers. The difficulties encountered by engineers early in their careers, in different engineering domains depend on the specific characteristics of their employment contexts [1], meaning the nature of these challenges may vary across diverse fields and workplaces.

An undergraduate degree in engineering provides the foundation for an engineer to understand the technical aspects of engineering. However, undergraduate engineering studies alone provide insufficient preparation for the demands of the professional workplace, necessitating the acquisition of additional professional skills to ensure that engineers are fully equipped for proficient engagement in professional practices [2, 3]. Engineers in training must adapt to the requirements of modern times, moving beyond reliance on technical skills alone [4, 5]. Among the things new engineers must gain is an understanding of the ethics, equity, diversity, and inclusion-related challenges they may encounter post-graduation. This awareness is crucial for

equipping new engineers for a smoother transition into becoming ethical and professional practitioners. One way we can help better prepare engineering students for the workforce is to delve into the challenges early-career engineers commonly encounter and find ways for addressing these challenges.

The study is poised to offer valuable insights into the dynamic interaction among early career engineers, ethics, and equity. By doing so, it seeks to deepen our understanding of the challenges and opportunities that influence the ethical landscape of the engineering profession in the 21st century also contributing to a more just and responsible engineering practice that serves the broader needs of society.

Overall Project Plan

This National Science Foundation (NSF) funded project will make use of a sequential mixed-methods approach to study the experiences of early-career engineers with ethics and equity in the workplace. A sequential mixed-methods approach is a research methodology that combines both qualitative and quantitative research methods in a sequential order. The research approach involves conducting one type of research method first, followed by the other. For this research, qualitative research methods will be used in the early phase to explore and gain in-depth insights into the research problem. Subsequently, quantitative research methods will follow suit, allowing for the collection and analysis of numerical data to test hypotheses generated during the qualitative phase. The combination of both qualitative and quantitative methods will enhance the overall rigor and validity of the research by capitalizing on the strengths of each approach. This sequential mixed-methods approach will enable a more comprehensive understanding and enrich the research findings. The planned approach for this project is summarized in Figure 1. Presently, the first phase of this project has been completed, which is an exploratory qualitative study making use of interviews.

First Phase: Qualitative (qual)	Second Phase: Quantitative (QUAN)	Third Phase: Mixed Method (QUAL)
• In this phase of the qualitative (qual) study, we carried out preliminary interviews with a total of 13 participants. • Purposive sampling was employed, specifically targeting early career engineers with 0-10 years of professional experience. • The participants were selected from diverse engineering disciplines and various employment sectors across North America.	• The second phase of the study introduces the quantitative phase (QUAN), which centers around the execution of a national survey with the goal of gathering approximately 1,000 completed surveys. • The advisory board members will provide guidance in reaching as many survey participants as possible. • Participants in this phase will be asked about their willingness to partake in a follow-up interview in preparation for the third phase.	• At this phase, a second round of interviews will be conducted. • To ensure a diverse and representative sample within the field of engineering, the study will utilize Purposive Sampling. This method involves selecting participants based on specific criteria, thereby facilitating a broader and more inclusive perspective. • The selection criteria will focus on various aspects, including workplace sector and size. This encompasses government organizations, small to medium-sized firms, and large private companies.

Figure 1. Overview of the full research study plan

Phase 1 Methods

Research Participants

Volunteer participants meeting the study criteria were identified. These criteria included being early-career engineers with 0-10 years of professional experience and representing diverse engineering disciplines, ages, genders, sexes, ethnicities, races, cultural backgrounds, and employment sectors within North America. This deliberate selection aimed to ensure a diverse participant pool, capturing a comprehensive array of experiences and perspectives within the engineering profession. Participant demographics are summarized in Table 1. Thirteen (13) early-career engineers, comprising 9 males and 4 females, volunteered to participate in this study. The participants were within the specified experience range of 0-10 years, with a predominant majority having between 0-5 years of professional experience. The interviews conducted delved into their experiences, reflections, thoughts, and perceptions concerning ethics, equity, and inclusion in their professional practices as early-career engineers, providing valuable insights into the challenges and opportunities in the engineering field. The data sources included online pre-interview surveys and interviews. These interviews were conducted in an open-ended, semi-structured format via the Zoom platform. The utilization of Zoom provided participants with a comfortable and easily accessible environment to freely share their experiences. The interviews were meticulously organized and transcribed prior to analysis.

Data Analysis

In this study, reflexive thematic analysis (RTA), as outlined by Braun and Clarke [6] was used to analyze the data. Recognized as a flexible and essential method for analyzing qualitative data [7, 8], RTA was implemented to explore prevalent patterns and themes within the dataset, with the primary aim of addressing the research questions. The overarching objective of employing a qualitative research approach is to create understanding of the contextualized and real-life experiences of participants.

For this study, reflexive thematic analysis was a good fit as it is a flexible way of analyzing qualitative data [7, 8, 9, 11]. The use of reflexive thematic analysis facilitated the development of themes and patterns within participants' narratives. RTA comprises six phases: (1) familiarization, (2) coding, (3) generating themes, (4) developing, and reviewing themes, (5) refining, defining, and naming themes, (6) and report writing [6]. These phases serve as a systematic guide for researchers, facilitating the exploration, interpretation, and presentation of qualitative data while ensuring rigor and reliability in the analysis [6, 8, 12].

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
Caser	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

Preliminary findings

This research is ongoing, and more work will be done before the poster is presented. A key initial finding is that engineers at the early stage of their career require proper mentorship as the trends from the semi-structured interviews show that:

- The ethical environment affects the productivity of early career engineers, as some companies lack standard operating procedures, therefore asking young engineers to take up duties that are uncomfortable and unethical.
- Some engineers pointed out that critical tasks were delegated to them without proper mentorship, supervision, or guidance.
- There are companies upholding good ethical practices, while some companies are less concerned about employee's safety and mental health.
- What is ethical for an early career engineer may differ from the client's expectation.

Conclusions and Next Step

Initial findings indicate that mentorship plays an important role in shaping the ethical development of young professionals within the profession. The ethical, equitable, and inclusive work environment significantly influences their engagement with the project, colleagues, and clients, improves their productivity, and supports their personal and professional development, underlining the importance of a supportive and principled workplace culture.

The research is a work in progress, and the next step will involve sending out national surveys. The survey will be informed by the interviews conducted in the first phase. This survey will be administered online to a diverse large sample size of early-career engineers, contributing valuable insights to the ongoing research.

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