

Work in Progress: Conceptualizations of Ethics Among Doctoral Engineering Students

Simge Engelkiran, Thayer School of Engineering at Dartmouth

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Abstract

This study explores how doctoral students at the Thayer School of Engineering conceptualize ethics and examines how these conceptualizations influence their professional decision-making. Engineering practice frequently involves complex social, economic, and contextual factors, and the failure to adequately consider these dimensions can result in ethical lapses with far-reaching consequences (Hess et al., 2023). A stark example is the Flint water crisis, where cost-driven decisions led to contaminated drinking water and severe public health outcomes (Hess et al., 2023). This case highlights the urgent need to integrate ethics more comprehensively into engineering education.

Despite the importance of ethical responsibility, existing research suggests that many engineering programs do not sufficiently prepare students to navigate the ethical complexities inherent in their profession (Stephan, 2013; Hess et al., 2018). To address this gap, the present study employs a mixed-methods approach, combining qualitative interviews and quantitative surveys to investigate how doctoral students conceptualize ethics. The aim is to generate insights into how students define and apply ethical reasoning and to identify areas where ethics education may be lacking.

The anticipated findings will provide valuable perspectives on doctoral engineering students' ethical awareness and decision-making. Ultimately, this research seeks to support the development of more effective ethics education that fosters a culture of

social responsibility, equipping future engineers to make informed and conscientious decisions that positively impact society.

Introduction

Engineers routinely make decisions that affect public health, safety, and welfare. Accordingly, the profession maintains high ethical expectations. In the United States, undergraduate programs are guided by accreditation bodies such as ABET, which require students to demonstrate "an ability to recognize ethical and professional responsibilities in engineering situations and make informed judgments, which must consider the impact of engineering solutions in global, economic, environmental, and societal contexts" (ABET, n.d.). This mandate encompasses both micro-ethical (individual responsibility) and macro-ethical (systemic impact) aspects of engineering practice (Herkert, 2005).

While case studies and codes of ethics are common instructional tools, scholars have noted that these approaches can oversimplify the nuanced sociotechnical challenges engineers encounter (Bucciarelli, 2008). Many case studies focus on individual moral agents and often neglect how institutional and organizational contexts shape ethical behavior (Lynch & Kline, 2000). These limitations are especially pronounced at the doctoral level, where formal ethics training is minimal or absent. Doctoral students, who frequently engage in high-impact research and leadership roles, may face ethical dilemmas without adequate support or preparation. The Flint water crisis, for example, illustrates how engineering decisions rooted in narrow cost-benefit logic—rather than holistic ethical reasoning—can cause irreparable harm, especially to marginalized

communities (Hess et al., 2023). This underscores the need for ethics education that reflects the complexity of real-world practice.

Recent scholarship highlights the importance of grounding ethics instruction in the lived experiences of engineering professionals. Studies using Critical Incident Technique (CIT) have illuminated the role of organizational culture, stakeholder engagement, and moral conflict in shaping ethical perspectives (Hess, Strobel, & Brightman, 2017). These findings suggest that effective ethics education should go beyond theory to engage directly with the practical and relational dimensions of engineering work (Huff & Frey, 2005).

In response, this study investigates how doctoral students at the Thayer School of Engineering conceptualize ethics and apply ethical reasoning in both academic and professional contexts. Employing a mixed-methods approach—through surveys and interviews—this research aims to build a more comprehensive understanding of doctoral-level ethics education.

Research Aims and Questions

The primary goal of this study is to illuminate how doctoral students interpret and apply ethical principles in engineering and to identify critical gaps in ethics education. The investigation is guided by the following research questions:

1. How do doctoral engineering students at the Thayer School of Engineering conceptualize ethics within the context of their training and future careers?
2. In what ways do these conceptualizations shape their approach to professional decision-making?

3. What challenges and gaps in ethics education are perceived by doctoral students, and where might curricular or institutional improvements be made?

The answers to these questions will help inform the development of more relevant and impactful ethics education, aligned with the lived experiences and evolving responsibilities of doctoral students in engineering.

Methodology

Research Design

This study used a mixed-methods design to explore how doctoral engineering students understand ethics and how these understandings influence their professional choices. Combining surveys and interviews enabled both breadth and depth in data collection and allowed for triangulation of insights across methods.

Participants and Recruitment

The study was conducted in two phases. In the first phase, 173 doctoral students at the Thayer School of Engineering received an email invitation to complete an anonymous online survey, followed by two reminders. Forty-five students completed the survey. In the second phase, the same cohort was invited to participate in semi-structured interviews, with three reminder emails sent. Twelve students participated in one-hour Zoom interviews. Participation in the survey and interviews was voluntary, and informed consent was obtained in both cases.

Data Collection

The survey collected quantitative data on ethical perceptions and experiences, while the interviews provided qualitative insight into students' reflections on ethics in research and

practice. All interviews were conducted via Zoom, recorded with consent, and transcribed for analysis.

Data Analysis

Quantitative data were analyzed to detect trends in ethical awareness and decision-making. Qualitative data were analyzed using thematic coding to identify key patterns and insights regarding ethical reasoning and institutional influences.

Ethical Considerations

This study received IRB approval from the Dartmouth College. Participant confidentiality was strictly maintained. Survey responses were anonymous, and interview data were de-identified and stored securely. Participant compensation was provided through funding from the Ethics Institute Grant at Dartmouth College.

Preliminary Findings

1. Ethics as Minimizing Harm and Maximizing Benefit

Many students defined ethical engineering as the pursuit of minimizing harm and maximizing benefit, both in terms of technical work and broader social outcomes.

2. Influence of Lived Experience on Ethical Awareness

Students noted that their ethical awareness grew through experiences of marginalization, coursework, and professional exposure. These experiences fostered a deeper, more personal engagement with ethics.

3. Ethics and Diversity Are Deeply Interconnected

Participants consistently emphasized the intersection of ethics with diversity. Examples included the importance of inclusive design and the risks of algorithmic bias in technical systems.

4. Systems-Level and Policy Awareness

Students referenced examples like the water crisis to illustrate the importance of considering systemic and policy-level factors in ethical engineering decisions.

5. The Role of Conversation and Collaboration

Ethical reflection was often sparked through valuable discussions with peers or mentors. Students expressed interest in more frequent opportunities for these conversations.

6. Barriers and Recommendations

Students cited time constraints and a lack of field-specific ethics content as key barriers to participating in extracurricular ethics programs. They recommended programming that is more practical, flexible, and aligned with their research interests.

Summary

Doctoral engineering students view ethics as a multidimensional practice that encompasses technical, social, and responsibility considerations. They appreciate inclusive, systems-aware approaches to ethics and see opportunities to further strengthen institutional support and curricular integration.

Next Steps

This work remains in progress. Moving forward, I plan to deepen the analysis by exploring intersections between participants' disciplinary specializations and their ethical frameworks. Additionally, I will examine how institutional messaging, mentorship practices, and policy structures shape the development of ethical reasoning during doctoral education. The ultimate goal is to offer concrete recommendations for

embedding ethics more meaningfully into the fabric of engineering education at the doctoral level.

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