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Stifle or Support: Academic Culture and Engineering Ethics Education [Full Research Paper]

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Abstract

This research paper explores the dynamic between academic culture and engineering ethics education. Culture provides a lens through which to view the values, decisions, and norms of organizations, including universities. Culture can influence internal responses to external forces, such as accrediting agencies, industry stakeholders, and government priorities, all of which have articulated the importance of ethics in engineering education. This study examines how engineering educators experience academic culture related to ethics and societal impacts education in engineering. This research paper is part of a larger study that includes semi-structured interviews with educators who teach ethics and/or societal impacts to engineering students across various disciplines and represent 26 institutions in the United States. The larger project explores faculty members' teaching practices and perspectives, including influences on their ethics-related instruction, and the influence of academic culture is the focus of this paper. The present analysis is underpinned by a framework of organizational culture in higher education, which proposes six dimensions: environment, mission, socialization, information, strategy, and leadership. The dimensions serve as guideposts in the deductive analysis of the interview transcripts to understand which aspects of academic culture are salient in engineering ethics education. The findings point to the tension between the espoused value of ethics and its limited visibility in the curriculum, the influence of the religious mission of a university, the way in which the importance of ethics is communicated to students via academic integrity, and the role of formal leaders in supporting ethics educators. This research illuminates the cultural undercurrent that affects ethics education with the aim of creating environments in which ethics education and ethics educators are supported.

Introduction and Background

Ethics is an integral part of engineering, a profession that serves public welfare and operates at the intersection between the natural and built environment. The university experience is critical in developing professional and societal responsibility as future engineers learn both content knowledge and professional socialization. Faculty members are crucial in these processes as they influence engineering education through their course instruction and informally through their role as socializing agents [1]. Faculty members and students both shape and are shaped by their environment. Within the academic environment, culture provides a way to view the values, decisions, and norms of a group [2]. Culture can influence internal responses to external forces, such as accrediting agencies, industry stakeholders, and government priorities, all of which have articulated the importance of ethics in engineering education [3][4]. This study examines the dynamic between organizational culture and ethics education. This research builds on previous work that examined the role of academic culture in faculty members' perceptions of engineering ethics education via a mixed-methods comparative case study of two engineering departments [5].

Engineering Ethics Education

Engineering ethics in the present study is inclusive of microethics, the obligations of individual engineers to their colleagues, employers, and clients and macroethics, the responsibilities of engineers to the public and environment [6]. Both domains are reflected in the accreditation criteria for engineering programs in the United States [3]. Accreditation can be a significant external influence in shaping engineering ethics instruction [7] [8]. However, there are multiple factors that can affect an educator's decision to teach ethics in the context of engineering. These factors can be personal, such as their intrinsic motivation and professional background [9]. Within the academic environment, factors such as course type and discipline can affect faculty members' views of engineering ethics education [10] [11].

Culture

The study of culture is rooted in anthropology, sociology, and social psychology [12]. Coming from different disciplinary perspectives, culture is variously conceptualized. A commonly employed definition of culture is a "pattern of shared basic assumptions invented, discovered, or developed by a given group as it learns to cope with its problems of external adaptation and internal integration that has worked well enough to be considered valid, and, therefore, is to be taught to new members of the group as the correct way to perceive, think, and feel in relation to those problems" [2, p. 313].

The examination of culture by conceptualizing a group as an organization has resulted in the proliferation of research on organizational culture over the past few decades. In their 2011 meta-analysis of organizational culture, [13] reported 4,600 articles have been published on the topic since 1980. Organizational culture describes internal dynamics that are shaped by structures, processes, and values, and the culture of the organization is "reflected in what is done, how it is done, and who is involved in doing it" [12, p. 3]. Although primarily situated in business, there is growing attention around organizational culture in higher education. Universities are complex organizations that are influenced by a multitude of internal and external factors. Organizational culture helps explain how universities respond differently to the same external forces, such as accreditation. The norms, values, and assumptions that define the culture of the university shape its symbolic and instrumental operation, with impacts on decision-making and priority-setting.

The study of ethics and culture are intertwined because values are core to both. Through socialization, individuals adopt the values and assumptions of the culture with implications for ethical judgement [15]. Culture can help predict ethical standards within a group [16]. Past research explored the interplay between culture and ethics, including perceptions of rules in science among United States born and non-United States born researchers [17] and differences in teaching practices and perceptions among engineering ethics educators from various cultures [18].

Research Question

This study addresses the question: how do educators experience academic culture related to the ethics and societal impacts education of engineering students?

Theoretical Framework

This study is situated in a framework of organizational culture in university education [14]. Tierney's framework includes six elements that are defined in Table 1.

Table 1: Framework of Organization Culture, Adopted from [14] and [19]

Environment	Definition of, and attitude toward, the environment
Mission	Definition and articulation of organization's overarching ideology, including its basis for decision-making and agreement among members
Socialization	Process for new members learning about the organization, including what they learn and by whom
Information	Access, dissemination, and definition of information
Strategy	Process and people involved in decision-making
Leadership	Formal and informal leaders, the organization's expectations of them

Although there are many definitions and frameworks related to organizational culture, [14] was selected since it is situated in the university setting.

Methods

Study Overview

The present study is part of a larger project that explored ethics and societal impacts education in engineering and computing. The aim of the mixed-methods project was to identify potential exemplars of ethics and societal impacts instruction, including their context and impact on undergraduate students and recent graduates. The first phase of the project was quantitative, and over 1400 educators responded to an online survey. More information on the survey development and results is published [20][21]. A sub-set of survey participants were invited to complete a follow-up interview; the selection criteria and process were previously reported [22]. The interview was designed to learn more about the participants' ethics and societal impacts teaching practices and perspectives, including internal and external influences. The interviews included questions related to institutional culture, which serves as the foundation for the present study. The study was approved by the Institutional Review Board for human subjects research.

Data Collection

The interviews were conducted between September 2016 and April 2017 via Skype. A total of 37 educators participated in an interview and represented a range of disciplinary, institutional, and geographic contexts. The interviews were semi-structured to have both consistency and flexibility across the data collection. Questions relevant to the present study include:
- How would you describe the culture at your institution in regards to the macroethics education of engineering and computing students?

- Do you feel supported by your department/school in your teaching of macroethics?
- Describe the extent to which you believe other engineering/computing faculty at your institution value macroethics instruction for engineering/computing students.
- How do you perceive that your discipline/department compares to others in terms of teaching macroethics?

The questions above were framed as "macroethics", but ethics and societal impacts were used interchangeably in the interviews given participants' limited familiarity with the term "macroethics." The interview questions were designed to broadly understand institutional culture as one potential external influence that could shape practices and perspectives related to ethics. Discussions related to institutional and departmental culture and environment also arose organically during some of the interviews. The theoretical framework was integrated *ex post facto* as a lens through which to view the data.

Data Analysis

The audio files were transcribed using Trint, an online transcription service. The transcripts were cleaned and verified for accuracy by the author. The first step in the analysis was identifying the interviews in which academic culture was discussed. Since the interviews were semi-structured, substantive discussions of academic culture did not arise in every interview. The comments could emerge in response to direct questions about culture or organically throughout the conversation. The 28 transcripts that included academic culture were reviewed again to understand the context in which the topic was discussed and to extract the relevant segments.

Given the theoretical framework was selected after data collection and therefore did not inform the interview protocol, this research examined the utility of using [14] *ex post facto* by applying it to a sub-set of the transcripts. Of the 28 interviews that included discussion of academic/institutional culture, six were included for the present analysis. The six interviewees were from five universities that were purposefully selected to represent variation in institution type: (1) private not-for-profit (religious) baccalaureate: arts & science focus, (2) private not-for-profit master's: larger programs, (3) private not-for-profit (religious) doctoral: high research activity, (4) public doctoral: high research activity, and (5) public doctoral: very high research activity.

The six elements from the framework [14] served as guideposts in the analysis to understand which aspects of academic culture were relevant in engineering ethics education. The segments from the sub-set of six transcripts were first coded deductively. The next step followed focused coding [23] to develop themes from the interview segments within each deductive code. The themes are detailed in the following section as the most salient findings for addressing the research question.

Limitations

One limitation is that the interview was not designed to focus on academic culture, and it was not oriented on the theoretical framework. Therefore, the data might not capture all elements of the framework that could be relevant if they were authentically elicited during the interviews. However, the data provide an opportunity to explore academic culture in the broader context of

how engineering faculty members develop and deliver ethics education within the ecosystem of higher education. Although the present study focused on academic culture, there are factors beyond it that influence engineering ethics education. The focus of the research is intentionally narrow to localize the role of culture, and future work could account for the broader array of external and environmental factors that might be relevant.

Positionality

The positionality statement is written from the perspective of the author who conducted the data collection and analysis. I recognize that my identity impacts the research process from topic selection to method to communication [24]. As a PhD student at the time of the interviews, I had a different identity from the faculty members with whom I was speaking. Given the role of power dynamics in organizational culture, I likely had a different understanding and was privy to different information as a graduate student than I would be as a faculty member. I was also an outsider relative to the academic cultures being described because I was not a member of any of the universities included in the study. This position could provide the benefit of seeing the culture from the outside with greater objectivity, but also meant my interpretation was limited given the complexity of culture that is most fully understood from members of it.

Findings

Five themes were identified through the focused coding that illuminated engineering faculty members' perceptions of academic culture related to ethics education. These themes and representative quotes are discussed in the following sub-sections.

Ethics is an espoused value in the environment but only visible in select courses

One theme that emerged from the segments within the "environment" deductive code was the espoused value of ethics at an institutional level but its visibility being limited to select courses. When asked to describe the institutional culture, the faculty member at the private not-for-profit (religious) baccalaureate: arts & science focus institution responded,

> I don't know that I would. Yeah, I mean I think it's similar to what it is for a lot of us in terms the highly valued but not always understood exactly how we're doing that.

The general education requirement was pointed to as the main curricular opportunity in which students explicitly learned about ethics. Similarly, the participant at the private not-for-profit (religious) doctoral: high research activity cited the general education program at the university as formal inclusion of ethics. In both these cases, one institutional lever for ethics was the common curriculum for all students, not specific to engineering. At the public doctoral: high research activity where two of the participants taught, there was an ethics across the curriculum approach within their engineering program. One participant commented, "the whole campus knows about this. And of course some professors focus on it very intensely and some professors just not so much." The other participant noted,

I would say, for most faculty it [ethics] is completely invisible. They do not acknowledge the importance of ethics in their own classrooms. If you talk to them and say do you think ethics education is important for engineers, they'll say 'yeah, but just don't put it in my classroom.' I mean nobody disagrees with it as important, but at that same time they turn around and they don't touch it.

This theme indicated the tension between the value assigned to ethics education and its relatively limited role in the engineering curriculum.

The religious mission of a university can be influential for ethics courses

The role of the mission emerged in relation to the religious affiliation of the university in one interview. When asked about the institutional culture, the faculty member at the private not-for-profit (religious) doctoral: high research activity replied,

It's a part of who we are. We're a Catholic University… I think that religious foundation and the fact that it's part of our academic program. It's one of our learning outcomes. And I'd say it's very much part of our culture.

In this case, the religious mission of the university, its culture, and an emphasis on ethics were woven together. The faculty member at the other religiously affiliated institution in the sub-sample did not cite the mission or influence of religion. This raises a point for future enquiry to better understand the prevalence of religion in institutional identity and culture and its perceived effect on engineering ethics education.

The importance of ethics is communicated institutionally with a focus on student integrity

The theme that emerged from the "information" code was the way in which the importance of ethics was communicated to students. The faculty member at the private not-for-profit master's: larger programs institutional cited the honor code when asked about institutional culture. Similarly, the participant at the private not-for-profit (religious) baccalaureate: arts & science focus institution noted,

I go through the code of ethics and pledge of integrity. I've always on all my exams had students print their name and then sign a commitment to the pledge of integrity.

These comments allude to framing ethics in terms of academic integrity and having explicit mechanisms for emphasizing ethical behavior.

Shared decision-making and buy-in among faculty can facilitate the integration of ethics

This theme emerged in the one interview in which "strategy" was coded. In this context, strategy was operationalized through decision-making and consensus-building among the engineering faculty members. The participant at the private not-for-profit master's: larger programs noted:

> We have a relative few number of faculty; they're all strongly supporting it [ethics]... We have, between civil, mechanical, electrical, and construction management, about 20 faculty between the full time ones and the part time ones and I've seen it uniform across the board. When you have a smaller group, it's easier to get consensus and when you have a smaller group, we're not in a big city, [institution] is not a really large university, you have to pretty much make a decision to be here and so we get a lot of people that are, they're quite happy with the organization and the organization's beliefs.

This perspective speaks to various aspects of the institutional culture, including how people are drawn to it in the first place and then how they choose to engage once they are part of it. The example above indicates consensus building and value convergence that support what the participant described as an ethics across the curriculum approach within the engineering department.

Department, college, and university leaders can set the tone via support for educators who are teaching ethics

Focused coding of the segments within the "leadership" code demonstrates the role of formal leaders in setting the tone for ethics education by supporting the faculty member teaching it. As an example, this was cited by the participant at the public doctoral: very high research activity university in response to describing the institutional culture.

> I feel a large amount of encouragement from certainly the department head and dean in integrating ethics issues into engineering coursework. Based on getting feedback that I receive both formally and informally, they're very receptive of this, appreciative in fact.

This comment indicates the support at the department and college levels that the participant received in developing and teaching sustainability-focused elective courses in which engineering students learned about ethical and societal considerations related to energy.

This theme was also reflected in the interview one faculty member at the public doctoral: high research activity university.

> And we got a new provost a couple years ago who we thought was just going to kill it altogether because he thought it was a bunch of nonsense at first. But as we spoke with him and as one of the Dean's of our college spoke with him, he started to realize its value and started to see how students who were in the minor had a very - a much more complicated understanding of design processes and more confidence in tackling ill structured complex problems.

This comment speaks to how tension can be perceived within the leadership hierarchy in terms of the value of engineering ethics and societal impacts education. The initial perception of the provost that the minor was "a bunch of nonsense" and that the provost had the power to "kill" the new program reflects the vulnerability of such education within traditional engineering departments. In this case, the engineering dean was an ally in communicating the importance of the program in which ethics was embedded across the curriculum.

Discussion and Conclusion

The themes indicate the various ways in which culture is conceptualized and the mechanisms through which it affects engineering ethics education. The cultural elements could be explicit, such as curriculum requirements and honor codes, or embedded in the interpersonal dynamics, such as support from leaders or consensus among faculty members. These findings speak to the three levels of organizational culture proposed by Schein [25]: artifacts, values, and assumptions. Artifacts are visible such as curricula and honor code while values are the goals and principles that underpin them, such as faculty members believing ethics are important to the education of engineering students. Assumptions are the underlying ways of knowing that are taken for granted, such as faculty members can and should teach engineering ethics. Examining culture across these three levels within the six elements proposed by Tierney [14] indicates tensions related to engineering ethics education. As indicated by the first theme, ethics is an espoused value, but that value is not always reflected in the curriculum. With ethics only visible in select engineering courses, the importance of ethics to engineering education and practice might not be communicated to students. One implication of this finding is aligning purported values with curricular requirements. Given social-technical dualism within engineering culture and the priority of technical subjects [26], the limited visibility of ethics or its separation from technical courses can continue to reinforce this false dichotomy. Another tension arises when ethics is narrowly constrained to academic integrity. Although an important component of emphasizing ethical behavior, academic integrity focuses on microethics and should thus be complemented with macroethics to capture broader responsibilities of engineers to society and the environment [6].

Another implication of these findings is the importance of building a culture within the engineering faculty, from the top down and bottom up, that supports engineering ethics education. Leadership, an element recognized by Tierney within the culture of universities [14], can validate the curricular inclusion of ethics and galvanize the efforts of faculty members teaching it in their courses. Having a critical mass of faculty members not only claiming the importance of ethics but also integrating it in their courses can mitigate the challenges that ethics educators face in terms of resistance from their colleagues [22].

This present study provides a preliminary exploration of academic culture related to engineering ethics education. The findings point to the tension between the espoused value of ethics and its limited visibility in the curriculum, the influence of the religious mission of a university, the way in which the importance of ethics is communicated to students via academic integrity, and the role of formal leaders in supporting ethics educators. The next step in this project is expanding the analysis to the full set of interviews based on the demonstrated utility of using the academic culture framework. Each transcript in the sub-set indicates different facets of academic culture that were salient in their unique context; thus, saturation was not reached. Additional data are needed to more fully illuminate the interplay between academic culture and engineering ethics education.

Although academic culture exerts an influence, it is only one of many factors in shaping attitudes towards, and practices related to, ethics. The individuals within a culture can be conceptualized

as cultural mosaics themselves: people are defined by demographic (e.g., age, gender identity, ethnicity, race), geographic (e.g., country, climate), and associative (e.g., family, profession, religion) features, and this combination forms the colorful mosaic of each individual [27]. Future work can continue to untangle the cultures that affect ethics education to better understand and support the integration of ethical and societal considerations in engineering education.

Acknowledgements

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