

## Ethics in Engineering Education during COVID-19 pandemic

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The COVID-19 pandemic has disrupted our daily lives, directly impacting the way various systems operate around us. It has led to a human, economic, and social crisis (United Nations, 2020<sup>i</sup>), which will require a combined effort from multiple disciplines to solve the emerging problems. Engineers are at the forefront of this problem-solving effort tackling a myriad of problems, including challenges in supply chain, infrastructure design, healthcare systems and delivery, and others. With the increased engagement from engineering in tackling this pandemic comes an increase in public attention towards the ethical duties of an engineer. In the past, various catastrophic events such as Chernobyl nuclear accident or the Challenger space shuttle complications have led to revisions of professional codes of ethics. Such disasters have shown that there is often a lack of concern for public health and welfare due to various external pressures on engineers (e.g. professional, organizational, financial, and political) (Lambrinidou and Edwards, 2013<sup>ii</sup>). Such ethical concerns have been attributed (among other reasons) to engineers not considering socioeconomic inequalities, history and geopolitics, which is lacking in the US engineering education system (Cech 2014<sup>iii</sup>). In fact, engineering education in the US has always valued technical over social or ethical competency (Nguyen et al., 2020<sup>iv</sup>). Thus, unsurprisingly we expected a similar lack of ethical considerations when engineering students are presented problems arising from the COVID-19 pandemic.

A survey was deployed to 165 graduating engineering students at a public US university to evaluate the ethical concerns not addressed in US engineering education. The two open-ended questions related to this topic were, 1) *“What are some ways that engineers could address the COVID-19 pandemic? Please explain.”*, and 2) *“How important is it that engineering classes focus on challenges in today society, such as the COVID-19 pandemic? Please explain.”*. The first question attempts to capture students’ concerns on social problems, such as socioeconomic and racial inequalities, when thinking about the pandemic. The second question attempts to capture students’ interest in ethics and societal challenges. A lack of emphasis on social aspects in the open-ended student responses would show a lack of macroethical concerns. Student responses to the first question were qualitatively coded into groups, such as designing more efficient systems, complying with public guidelines, supporting healthcare and essential workers, finding a cure, providing facts, models, or policy recommendations, and others. With regards to the second question, responses were first coded into an ordered scale: very important, fairly important, little important, not important, and unsure. Then, the responses were coded qualitatively into groups of reasons, such as engineers must be resourceful and adaptable, engineering concepts are more important, engineering provides real world experience, engineering should help the society/communities, and many others.

Most (51%) student responses to the first question aligned with designing more efficient systems using engineering concepts and techniques, followed by complying with public guidelines (15%). Responses addressing ethical challenges were less frequent, with encouraging discussion on safety measures (4%), being an advocate for change (1%), and continuing to address global issues (1%). Overall, students were more motivated in applying their technical skills to address problems arising from the pandemic, while adhering to already established public guidelines, rather than considering social aspects of the pandemic and establishing new guidelines that address ethical concerns. For the second question, most (76%) students responded very important followed by fairly important (14%). Within the category of very important, student responses focused on engineers being resourceful and adapting (53%) and providing real-world experience (24%) as skills engineering education can cover in order to tackle the pandemic. With much lesser frequency, students responded with topics of ethics, such as students should help the society/communities (5%), students should be required to learn ethics (1%), and the pandemic challenges can cause permanent changes to society (0.5%).

The survey results revealed that engineering students are in fact interested in improving society and addressing problems related to the pandemic. Engineering education, however, often focuses on technical knowledge rather than ethical development which is apparent in the themes that emerged in the responses. The role of ethics within the engineering profession, whether broadly or as it applies to specific circumstances, is often given a cursory lesson rather than being woven throughout the curriculum. When ethics are incorporated into curriculum, programs tend to focus on microethics concerning issues that arise in particular contexts and interactions between individuals, rather than macroethics that address societal concerns more broadly. This could possibly be addressed through changes in curriculum content, such as integrating different ethical scenarios into the problems we have our students solve, such as a COVID-19 pandemic ethical scenario to highlight how the professions engage with technical solutions under differing circumstances.

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<sup>i</sup> United Nations, (2020) “Everyone Included: Social Impact of COVID-19,” <https://www.un.org/development/desa/dspd/everyone-included-covid-19.html>

<sup>ii</sup> Lambrinidou, Y., and Edwards, M., (2013) “Learning to Listen: An Ethnographic Approach to Engineering Ethics Education,” *ASEE*, Paper ID# 8224.

<sup>iii</sup> Cech, E. A., (2014) “Culture of Disengagement in Engineering Education?” *Science, Technology, & Human Values*, 39:1, 42–72.

<sup>iv</sup> Nguyen, L. M., Poleacovschi, C., Faust, K. M., Padgett-Walsh, K., Feinstein, S. G., and Rutherford, C., (2020) “Conceptualizing a theory of ethical behavior in engineering” *American Society for Engineering Education*, #30127.