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# Elucidating Engineering Ethics Education During the COVID-19 Pandemic Era

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**ABSTRACT**

*Considering the significance and impact of COVID-19 global pandemic to the global economy and education, ethics should be highlighted as a fundamental facet of technology related disciplines, and professional responsibilities need to be taught in higher education. Introducing ethics to undergraduate engineering students is critical in order to develop professionals who will make important and consequential decisions and perform the best practices in the technology field. Therefore, undergraduate institutions should provide opportunities to students to acquire knowledge and skills about ethical principles that affect engineering practices. This essay addresses the history of engineering ethics education and some challenges in higher education institutions in the United States.*

**Keywords:** COVID-19, engineering education, engineering ethics, ethics education

**T**he COVID-19 global pandemic required unprecedented lockdowns and quarantines that changed the daily lives of individuals. Technology has contributed to sustaining everyday life during the pandemic through remote work/learning necessitated by an always-at-home culture (Taddeo, 2020). Moreover, technology has helped control COVID-19 disease by contributing to such practices as using digital technology for contact tracing and quarantine monitoring (Whitelaw et al., 2020).

Although the impact of technology to address COVID-19 is remarkable, concerns are rising about ethics of the creation and use of technology have been considered sufficiently. By "ethics" we mean the behavior of individuals to make decisions and take actions that are consistent with widely-shared communal or societal norms about right and wrong. The formation and deployment of technologies often provoke ethical dilemmas. For instance, several countries use government surveillance systems to detect and trace possible COVID-19 cases in ways that surprised citizens how easily they can be monitored by government or technology companies without knowing how gathered monitored information is used (Drew et al., 2020; Gasser, et al., 2020).

In another current example, the use of Zoom, a widely popular software tool for online teleconferencing, raised privacy concerns among users (Mohanty & Yaqub, 2020). Highly publicized incidents were reported about unauthorized, interloping individuals hacking into Zoom meetings and disrupting proceedings sometimes by playing inappropriate videos with sexual content. Of course, this action highly disturbed many users and meeting originators. These incidents, often described as "Zoom bombing" (Aiken, 2020), caused a panic about further Zoom meeting use and attendance. Also, Zoom hackers were reported to have recorded confidential meetings, hacked into cloud storage of recorded meetings , and sold in a black market sensitive information, further increasing worries about Zoom use (Parker et al., 2020). Moreover, such Zoom privacy breaches raised serious technical and ethical concerns about remote meetings in general (Gasser, et al., 2020).

In sum, because of COVID-19 pandemic has reinforced the notion that new technologies often are more complex than ever, and that the ethical, social, and cultural effects of technologies in increasingly more globally-connected and integrated economies require more attention and consideration than when economies were simpler. Considering the significance and impact of technology practices for this COVID-19 global pandemic, we believe that ethics is at the core of learning and practice in technology-related disciplines and should be emphasized more strongly in professional engineering education and practice, even though we acknowledge that the field of engineering certainly has identified and advanced ethical guidelines for various technology developments. Next, then, we consider ethical practices in engineering and engineering education that seem appropriate for the current- and post-COVID-19 pandemic era.

**Engineering ethics and engineering ethics education**

Learning from issues and mistakes can help secure the safety and welfare of the public. Drawing from various disasters that occurred by unethical decision-making in the past and potential threats related to rapid technological advancement, professional engineering associations and

societies have developed their own codes of ethics to provide a framework for engineering ethics education (Colby & Sullivan, 2008). Engineering ethics education is rooted strongly in reactions to willful ethical breaches that in a significant number of national and international disasters were caused apparently by individuals' a lack of morality, violation codes of ethics, and lack of professionalism. As a result, professional codes of engineering ethics were established in the 1900s, but statements of codes of ethics, themselves, were not infused into ethics education and do not necessarily promote problem-solving abilities necessary to resolve ethical dilemmas (Spier & Bird, 2007).

Although ethics education was much needed in engineering higher education, nearly 80% of engineering programs did not include ethics-related courses in their curriculum before new accreditation was introduced (Herkert, 2000). In accordance with the establishment of engineering professional organizations' codes of ethics, the Accreditation Board for Engineering and Technology (ABET) Engineering Criteria 2000 (EC 2000) emphasized professional and ethical responsibility in engineering disciplines. Training students in accredited engineering programs and ethics education has become a core requirement in engineering education programs across the United States (Hess & Fore, 2018).

Ever since, engineering educators strove to design effective ethics education into engineering education curriculum by defining core elements of engineering ethics which resulted in engineering programs embodying engineering ethics education within core courses or some established stand-alone ethics courses. As an example, Li and Fu (2012) asserted as a result of a Delphi study that an expert panel, including engineering ethics experts, faculty, current engineers, and students, is suitable to develop engineering ethics education curriculum. However, recently, there have been other compelling suggestions for ethics education contents.

Harris (2008) provided a view of the humanistic ethical view while asserting that engineering students should be socialized to think of their discipline as legitimately having both technical and humanistic ethical elements. Bairaktarova and Woodcock (2017) warned that merely teaching ethical awareness was insufficient, that ethical behavior does not necessarily flow from ethical awareness, and that ethical behavior itself should also be taught in conjunction with ethical awareness.

In addition to diversity of what to teach, disparate approaches have been suggested for effective teaching of engineering ethics. Haws (2001) suggested several pillars for engineering ethics education based on the review of previously published papers: professional engineering codes of ethics, conceptual development of ethical reasoning and theories, ethical intelligence through humanist book readings, ethical heuristics for ethical inclusion, case studies practice, and field-based learning. He asserted that integration of theoretical foundation, field-based learning, and case studies

can generate the most effective outcomes in engineering ethics education through the complementary effects of the three. Harris et al. (1996) emphasized past ethical violation cases to engineering students, which can happen to any engineer, instead of the more obvious catastrophic examples. It is important for students to recognize the difference between high-profile cases and a case that one is more likely to experience in the profession, because such catastrophes are infrequent in engineering (Bairaktarova & Evangelou, 2011).

For effective ethics education, some researchers stressed the role of faculty who teach engineering ethics. Lynch and Kline (2000) argued that it is essential for engineering educators to have students consider the socio-ethical aspects of engineering practice that demonstrate pairing practical education with ethics education. Dyrud (2005) claimed that engineering faculty should have some level of expertise in the area of ethics in order to effectively teach this subject to students. This involves the engineering educator adequately preparing themselves to be an authority for students in this domain. Because the concept of ethics is socio-culturally-bound, it is important to introduce non-technical aspects as well as technical professionalism in engineering ethics education in higher education.

How to effectively and efficiently deliver ethics education and training in higher education should be assessed. Engineering educators reported challenges in adding extra credits to the degree requirements and supplying additional teaching resources (Cummings & Lo, 2004). Further, due to the ambiguous nature of ethical training, it has been challenging to decide how much to cover each ethical feature due to the absence of explicit ethical standards in engineering ethics education. Further, due to the interdisciplinary aspects and cultural differences in engineering education, development of a generalized ethics education has been challenging (Davis, 2006).

**Conclusions/ implications**

In order to mitigate ethical concerns about technology during and even after the global pandemic, investigation is critical to determine the nature of engineering ethics education and to ensure a sound ethical foundation before joining the field. However, due to the diversity in teaching engineering ethics and the constraints on how much curriculum content can be devoted to ethics training, embedding ethics into the engineering curriculum to address rapid industry changes posed by the COVID-19 pandemic. Moreover, because the concept of ethics is highly socio-culturally bound, professional engineers and engineering educators need to accept and embrace the non-technical aspects of engineering curricula, which naturally includes the topic of professional ethics. Although pedagogical techniques for teaching ethics to students vary widely, the well-worn technique of utilizing ethics case studies remains popular within limits.

Nevertheless, higher education administrators and professors, industry leaders, and policy makers should discuss and develop the diverse ethics content and guidelines internationally.

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