Horizons of Engineering Ethics Education (HEEE): Survey Results and Meeting Highlights

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Abstract

This research paper reports on Horizons of Engineering Ethics Education (HEEE), a one-day event held in Indianapolis, IN on May 3, 2024 by the National Institute for Engineering Ethics (NIEE). HEEE involved 38 participants, some attending in person and others online. Most attendees were affiliated with higher education institutions or private firms, along with a few participants who were retired, associated with non-profit organizations, or working in smaller consulting firms. The event was framed as part of an ongoing needfinding process designed to identify specific opportunities for future "ethics R&D" initiatives, i.e., targeted efforts to generate new ethics content or interventions for engineering students and professionals. Through this event and other related activities, we more specifically aim to investigate what content (e.g., ethical issues and topics), pedagogies (e.g., instructional strategies and frameworks), and assessment approaches (e.g., measurement tools) are needed to advance ethics education for engineering students, practitioners, and researchers. In this paper we report on two major facets of the meeting. First, we summarize results from a pre-meeting survey that was developed by our leadership team and deployed to all invitees, resulting in 24 total responses. The survey included scaled and open-ended questions designed to gauge participants' perceptions of ethics codes, ethics education and ethical development, case studies, the ethics of AI/ML technologies, and related topics. Second, we report on our analysis of extensive notes taken during the meeting itself, including to synthesize participants' views regarding what stakeholders we should engage in future needfinding efforts and their awareness of contextual needs, concerns, and outlooks (e.g., across disciplines, sectors, etc.) that could inform future initiatives. We expect this paper will be of interest to engineering ethics scholars and educators who want to explore leading-edge directions for ethics R&D in engineering and related fields. The survey items presented in the paper may also be useful for those undertaking similar research and/or training efforts.

Introduction

Advancements in engineering and technology have always driven changes in human life and social behavior. These interactions continue to bring to light many questions related to social norms and human values, especially when their outcomes fall outside what is considered morally right, or in grey areas of what is viewed as ethical. Now more than ever, it is imperative that professionals in engineering and technology engage with the normative dimensions of their work and consider how to best uphold high ethical standards. Multiple ethical frameworks and guidelines have been promulgated to support such objectives in educating engineering students and guiding engineering professionals, including relevant professional codes (e.g., [1]), accreditation requirements (e.g., [2]), responsible conduct of research (RCR) guidelines [3], and corporate policies related to ethics, compliance, and social responsibility [4-5]. However, these and other elements constituting engineering ethics require frequent revision in consonance with the dynamic nature of technology. Indeed, the need for expanded and updated engineering ethics frameworks becomes more pressing every time a revolutionary technology emerges. such as nanotechnology over a decade ago [6] and AI more recently [7-8].

To enhance our understanding of emerging issues and challenges related to engineering ethics, with particular emphasis on research and development (R&D) activities where leading-edge engineered products and systems are initiated, we have launched a needfinding initiative to solicit input from a variety of key stakeholder groups. This research paper more specifically describes and reports on Horizons of Engineering Ethics Education (HEEE), a one-day kick-off event held in Indianpolis, IN on May 3, 2024 by the National Institute for Engineering Ethics (NIEE). HEEE involved 38 participants, some attending in-person and others online. Most attendees were affiliated with higher education institutions or private firms, along with a few additional participants who were retired, associated with non-profit organizations, or working in smaller consulting firms. The event was framed as part of an ongoing process designed to identify specific opportunities for future "ethics R&D" initiatives, i.e., targeted efforts to generate new ethics content or interventions for engineering students and professionals. Through this event and other related activities, we more specifically aim to investigate what content (e.g., ethical issues and topics), pedagogies (e.g., instructional strategies and frameworks), and assessment approaches (e.g., measurement tools) are needed to advance ethics education for engineering students, practitioners, and researchers.

We are not aware of many prior efforts to solicit input from diverse stakeholders regarding their perceptions of current needs for ethics education in engineering, technology, and related fields. Nonetheless, we draw some inspiration from previous National Academy of Engineering (NAE) efforts to identify leading-edge and "exemplar" approaches to engineering ethics education [9-10], as well as a more recent and wide-ranging initiative undertaken in the UK by the Royal Academy of Engineering's Engineering Ethics Reference Group (EERG) "to provide leadership and advice to help develop an enhanced culture of ethical behaviour in UK engineering" [11]. The latter initiative, in particular, included a large-scale study on views of ethics in engineering among engineers and technicians, private firms, and representatives of professional engineering institutions (or PEIs). In the future, we plan to expand our data collection efforts and more systematically compare our results with these prior works.

In this paper we report on two major facets of our own HEEE meeting. First, we summarize results from a pre-meeting survey that was developed by our team and deployed to all invitees. The survey included both scaled and open-ended questions designed to gauge participants' perceptions of ethics codes, ethics education and ethical development, case studies, the ethics of AI/ML technologies, and related topics. Second, we report on an analysis of notes taken during the meeting itself, including to synthesize participants' views about stakeholders we should engage in future data collection efforts and their awareness of contextual needs, concerns, and outlooks (e.g., across disciplines, sectors, etc.) that could inform our future work. We expect this paper will be of interest to educators and scholars interested in exploring leading-edge directions for ethics R&D efforts in engineering and related fields. The survey items presented in the paper may also be useful for those undertaking similar kinds of research and/or training initiatives.

Background

The Horizons of Engineering Ethics Education (HEEE) event was held May 3, 2024 on the IUPUI campus in Indianapolis, IN. It was organized by the National Institute for Engineering Ethics (NIEE), with additional support from Purdue University's School of Engineering

Education and College of Engineering. HEEE was planned and facilitated by the NIEE leadership team, namely Drs. Brent Jesiek (Director), Justin Hess (Associate Director), Nail Barakat (Board Chair), and Sara Wilson (Board Vice Chair), all co-authors on this report. The meeting was envisioned as the first phase of a longer-term effort focused on addressing the following question:

> *What content (e.g., ethical issues and topics), pedagogies (e.g., instructional strategies and frameworks), and assessment approaches (e.g., measurement tools) are needed to advance ethics education for engineering practitioners and engineering researchers?*

In alignment with this overarching question, the primary objectives of the meeting were to:

a) better understand who (i.e., what key stakeholders) we should survey and interview to address our overarching question, and how to most effectively reach out to and engage with them,
b) identify specific questions we should ask stakeholders, including to capture contextualized needs, concerns, and future outlooks that will assist in guiding ethics-related learning and training goals, content, pedagogy, assessment, etc., and
c) identify specific opportunities for future "ethics R&D" efforts that may be worthy of further exploration.

To help prepare for the event and seed initial lines of discussion, a survey was developed by the leadership team and deployed to all invitees. More detailed information about our approach to survey data collection and analysis is presented below, followed by a summary of the findings. The HEEE event itself involved 38 participants joining in-person or online. Among this group, 27 were affiliated with higher education institutions in a variety of roles, including faculty, instructors, staff, and graduate students. Nine participants were employed in private-sector corporations or consulting firms, and two were working in the public sector. An agenda for the event is given in Appendix A, including a list of "lightning talk" topics.

Methods

Here we describe our approach to collecting and analyzing survey data and meeting notes from the HEEE event. Approval for exempt human subjects research was secured from Purdue University's IRB under protocol number IRB-2024-1704 to deidentify, analyze, and report on the data and notes.

Survey

To design the HEEE survey, the authors brainstormed potential queries and topics based on their own experiences and observations, including from the classroom, empirical research with students and practitioners, and prior conversations with other members of NIEE. The resulting HEEE pre-event survey was organized around the following four questions, each focused on a specific topic area or point of debate in the field of engineering ethics:

1. **Professional Codes of Ethics:** Ethics education in engineering and many other professional fields often includes considerable attention to codes of ethics. How important and relevant are such codes in real-world professional practice, and in preparation for such practice?
2. **Nature versus Nurture:** Ethics education and training initiatives engage with students and professionals at various stages of moral and ethical "formation." To what extent can we cultivate ethical growth and development among students and professionals, or are such efforts overshadowed by norms and values from earlier life stages and/or simply hardwired?
3. **Exceptional Case Studies:** Many case studies and examples used in ethics training involve exceptional situations (e.g., "big disasters") that most engineers will rarely or never encounter. How useful and important are such cases in ethics education, including in relation to more "everyday" types of ethical concerns?
4. **Artificial Intelligence and Machine Learning:** As discussion and use of artificial intelligence and machine learning (AI/ML) technologies continues to grow, so too have conversations around AI ethics. To what extent do we need to help students and professionals engage with the ethics of using AI/ML tools in their work?

For each of the above questions, we designed a four-point Likert-type scale (scale responses varied by item, as shown in Table 1). Each question also invited participants to explain their Likert-scale selections. Additionally, the second topic (Nature vs. Nurture) included a second scaled question, as shown in Figure 1, that was meant to generate more nuanced insights about perceptions of ethical development across education and career phases.

All 38 HEEE invitees were asked to complete the pre-event survey, and we received 24 responses, reflecting a response rate of about 63%. Given the nature of the event and invitation list, all participants had some level of interest or experience related to promoting or studying engineering ethics in university or workplace settings. Of the 24 respondents, 14 were mainly affiliated with academic institutions, including faculty, instructors, staff, and graduate students. Another seven were employed in or recently retired from the private sector, and two held positions in the public sector. Disciplinary backgrounds and affiliations ranged widely among this group, including individuals with engineering and non-engineering degrees. Career stage also varied, ranging from graduate students and early career professionals to late career professionals and retirees. Many survey participants also had records of past or current leadership in engineering professional societies, or were current members of the NIEE board. Nearly every respondent completed each Likert-scale question, and a large majority also added open-ended explanations, varying in length from short sentences to paragraph-length statements.

To analyze the survey data, we first engaged in a descriptive analysis to ascertain the frequency of responses to each response option for each item and then calculate the mean (M) and standard deviation (SD) for these responses. Second, we engaged in a thematic analysis wherein we categorized written explanations provided for each of the primary questions. The results section that follows includes a summary of both the descriptive results and emergent codes and themes.

Figure 1. Follow-on Survey Item for Q2, "Nature versus Nurture"

Breakout Sessions

Throughout the meeting, members of the organizing team and various participants took notes and posted them to a shared notebook in Microsoft OneNote. Detailed notes were taken by at least one participant in every breakout group, and multiple individuals took notes during group report-outs and other discussions. In reviewing the notes, the lead author identified and clustered relevant topics and themes within and across breakout groups, which was in turn used to draft this summary report. This process involved attention to both analysis (i.e., seeking a deeper understanding of specific ideas and concepts) and synthesis (i.e., connecting and relating disparate ideas and concepts). All co-authors then reviewed the summary report for completeness and accuracy based on their own notes and recollections from participating in the original event.

Findings

Pre-Event Survey – Quantitative Results

For each major section of the survey, participants first responded to an overarching question on a Likert-type scale. Table 1 summarizes responses to these items for the four main questions. Presenting results in one table affords comparing across item responses. The scales for each question are provided as a footnote to Table 1. Importantly, the Likert-type scales for each survey item varied. As a result, we cannot directly compare scores across items, but we can discern a few patterns. First, participants tended to respond positively to questions: all responses (24/24) to Questions 1 and 2 were positive, 22/24 participants responded positively to Question 3, and 17/24 participants responded positively to Question 4. Thus, participants exhibited the highest levels of agreement that: 1) it is possible to nurture or promote ethical growth among engineers, and 2) professional codes of ethics are important in engineering ethics teaching and training. More participants questioned the utility (or at least universal applicability) of exceptional case studies for ethics training. Participants had a range of perspectives on AI/ML from those feeling that it was one of many important topics to those who felt it was a very important and urgent topic.

Table 1. Frequency of Responses to Likert-Scale Items and Numerical Representation (n = 24)

Survey Question	1	2	3	4	*M*	*SD*
Q1: Professional Codes of Ethics: Ethics education in engineering and many other professional fields often includes considerable attention to codes of ethics. How important and relevant are such codes in real-world professional practice, and in preparation for such practice?[1]	-	-	13	11	3.46	0.51
Q2: Nature versus Nurture: Ethics education and training initiatives engage with students and professionals at various stages of moral and ethical "formation." To what extent can we cultivate ethical growth and development among students and professionals, or are such efforts overshadowed by norms and values from earlier life stages and/or simply hardwired?[2]	-	-	9	15	3.63	0.49
Q3: Exceptional Case Studies: Many case studies and examples used in ethics training involve exceptional situations (e.g., "big disasters") that most engineers will rarely or never encounter. How useful and important are such cases in ethics education, including in relation to more "everyday" types of ethical concerns?[3]	-	2	12	10	3.33	0.64
Q4: Artificial Intelligence and Machine Learning: As discussion and use of artificial intelligence and machine learning (AI/ML) technologies continues to grow, so too have conversations around AI ethics. To what extent do we need to help students and professionals engage with the ethics of using AI/ML tools in their work?	-	7	9	8	3.04	0.81

Q1 Scale: ***1*** *= not at all useful, relevant, or important;* ***2*** *= Not very useful, relevant, or important;* ***3*** *= Somewhat useful, relevant, and important;* ***4*** *= Very useful, relevant, and important*

Q2 Scale: ***1*** *= (Nature) No, such growth rarely happens and is not easy to cultivate or encourage; 2 = Maybe, such growth might be possible but tends to be rare or exceptional; 3 = "Yes, such growth is possible but is not given, can happen in the right conditions; 4 = (Nurture) Yes, such growth is possible and should be both encouraged and expected*

Q3 Scale: ***1*** *= Exceptional ethics cases are not at all useful or important;* ***2*** *= Exceptional Ethics Cases are not very useful or important;* ***3*** *= Exceptional ethics cases are somewhat useful and important;* ***4*** *= Exceptional ethics cases are very useful and important*

Q4 Scale: ***1*** *= (Big Yawn) No, focused attention on the topic is not necessary;* ***2*** *= Somewhat, but this is one among many important topics;* ***3*** *= Yes, this is an important topic that deserves attention;* ***4*** *= (Big Deal!) Yes, this is a very important and urgent topic*

Next, we provide descriptive responses to a follow-on prompt associated with Q2: “In your view, how important is it to actively promote ethical growth and development during each stage of an engineer's education and career?” We asked participants this question to discern *where* it may be

most appropriate to focus engineering ethics teaching and training efforts given the "nature versus nurture" debate. Figure 2 provides a summary of participant responses.

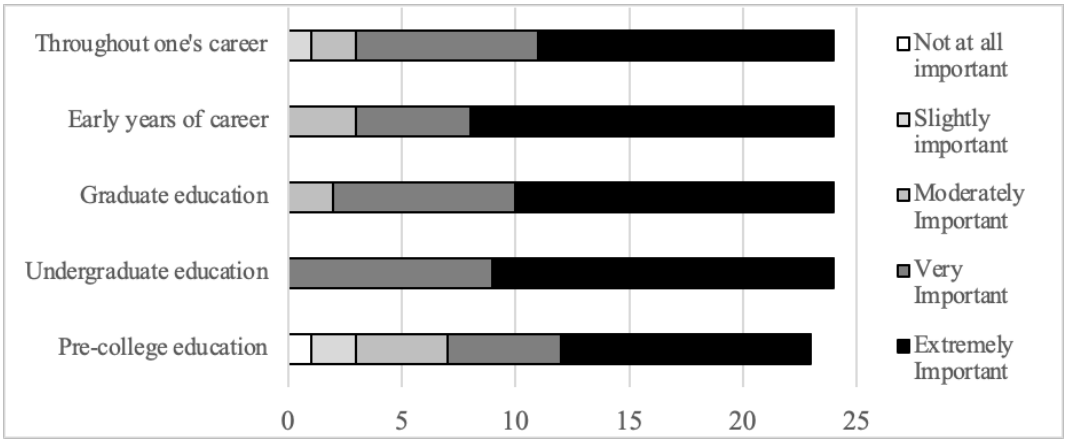

Figure 2. Stacked Bar Chart Showing Participants' Views Regarding the Import of Promoting Engineers' Ethical Growth across Education/Career Levels

As Figure 2 indicates, participants tended to view promoting ethical growth as very important or extremely important for all education levels. Responses were most favorable regarding the importance of promoting ethical growth among engineers during their undergraduate education ($M = 4.63$, $SD = .49$), followed by the early years of their career ($M = 4.54$, $SD = .72$), graduate education ($M = 4.50$, $SD = .66$), and throughout one's career ($M = 4.38$, $SD = .82$). The least favorable responses were regarding pre-college education ($M = 4.00$) but this item also had the highest standard deviation ($SD = 1.21$) and an average value in the "Very Important" range.

Pre-Event Survey – Qualitative Results

Based on the written responses, we developed four themes associated with each question by grouping responses. Table 2 summarizes all themes associated with each survey category, along with exemplary or example responses for each theme. For example, for the first survey question on professional codes of ethics, we categorized participant responses to develop four themes which suggest that professional codes of ethics: 1) inform or direct engineers' ethical actions, 2) provide common language or vocabulary for engineering ethics, 3) lead to or ensure positive engineering outcomes, and 4) have limitations and should not be the sole ethics guidance.

Like Q1, themes associated with other questions show variability in responses. For example, in response to Q1, themes represent positive features or outcomes of engineering codes, coupled with a limitation. Themes associated with Q2 together suggest that both nature and nurture are important to consider in engineering ethics education, coupled with cultural and contextual considerations for promoting ethical formation. Themes associated with Q3 suggest that exceptional case studies can promote learning and stick with learners but should not be the sole guidance nor substitutes for everyday ethical cases. Finally, themes associated with Q4 suggest that AI ethics is an important topic but should not be the sole focus; rather, the foundation and key theories, principles, and codes of engineering ethics should guide student learning.

Table 2. Thematic Analysis Results for Qualitative Survey Data

Category	Theme	Example Response
(Q1) Professional codes of ethics…	…inform or direct engineers' ethical actions.	Codes express the collective consensus about the values of a profession.
	…provide common language or vocabulary for engineering ethics.	Codes provide helpful frames of reference and a common language/vocabulary to communities of practitioners who are working in specific professional fields.
	…lead to or ensure positive engineering outcomes.	Adherence to a code of ethics in business is not only the morally correct thing to do but is actually critical to achieving a competitive advantage in the marketplace.
	…have limitations and should not be the sole ethics guidance.	They are less useful to employed, practicing engineers who are more influenced by their employment context.
(Q2) Engineering ethical formation…	…requires attending to both nature and nurture.	I believe that the ethical growth and development of engineering professionals is a combination of both nature and nurture.
	…occurs over time and throughout life.	Ethical formation typically takes place over many years and is built on many compounding experiences.
	…depends on training, workplace culture, and context.	The culture of engineering education and then culture of practice (and employer) are critical.
	…is not solely grounded in one's nature.	It would be far too depressing to believe that this type of growth is NOT possible.
(Q3) Exceptional case studies…	…provide powerful examples of ethical mishaps.	Exceptional cases help illustrate the power of ethical lapses.
	…can encourage engineers to prioritize ethics.	I find exceptional cases instructive for preparing students to forestall disasters years in advance by -- routinely -- correcting minor and mundane problems.
	…should be integrated alongside non-exceptional cases.	Exceptional cases when combined with ordinary cases provide varying perspectives of the extreme results as well as smaller, incremental situations that set the stage for all ethical dilemmas.
	…may be less relevant than everyday ethics cases.	Most moral and ethical dilemmas that present themselves in the business environment are subtle in nature, rather than extraordinary.
(Q4) Artificial Intelligence/ Machine Learning…	…present many opportunities for ethical use and misuse.	AI presents so many opportunities for ethics violations based upon the very nature of how data is collected and used to create content.
	…elevate the importance of engineering ethics education.	As the use of artificial intelligence and machine learning (AI/ML) technologies grows, the need to incorporate ethics into engineering education and professional development becomes more critical.
	…should not replace other ethical issues or considerations.	It's a big deal -- and I think a fundamental shift in how we work -- but questions about how to interact with AI are answered like any other ethical questions. Those foundational values that we hold are what matter in these situations.
	…are less important than what constitutes engineering ethics at a more practical or theoretical level.	If [we] teach students ethical foundations and reasoning, it can be applied to everything. AI/ML can be one among many applications

Breakout Sessions – Summary and Highlights

A summary of the HEEE agenda is provided in Appendix A. Here, we present key findings based on analysis and synthesis of session notes, particularly for the two breakout sessions and associated report-out and discussion periods.

Breakout Session #1: Icebreakers and Ideation for Needfinding

For the first breakout session, titled "Icebreakers and Ideation," participants were asked to do a round of introductions and then discuss the following main topics: a) general reactions to the pre-event survey results, with particular attention to how the participants' views on ethics are shaped by their different settings, contexts, professional roles, etc., and b) generating ideas for future needfinding and "ethics R&D" efforts. Notes from these discussions (in six breakout groups total, four in-person and two online) and a subsequent report-out and discussion session revealed five main themes. First, there were numerous comments regarding a need to better understand and engage with variations in what counts as ethics across settings, contexts, and roles, e.g., by industry sector, country/region, engineering field/discipline, type of degree, job title and responsibilities, and licensure status. This in turn led to comments about the importance of "ethics transfer," i.e., being able to apply ethical principles and reasoning in a wide variety of settings and situations. A second theme focused more specifically on professional codes as valuable but limited sources of insight regarding ethical principles for engineers. Participants more specifically observed that such codes are typically not legally enforceable or binding, and do not provide much guidance on ethical decision-making processes. Further, it was observed that the relevance and utility of the codes in professional practice is often unknown or unclear. A third cluster of comments centered on AI, with some participants arguing that such tools should be viewed as "new iterations of old problems" that could benefit from a much longer history of critical engagement with the "ethics of emerging technologies." Participants also variously referred to general ethical principles and concerns that are likely relevant for AI and related tools, e.g., safety, bias, accountability, etc. A fourth theme centered on ethics instruction, particularly in higher education settings. This included comments advocating for more ethics across the engineering curriculum, promoting established and emerging pedagogies (e.g., case studies, role play activities, etc.), and encouraging more faculty members to engage with ethics in the classroom. Fifth and finally, one group discussed the importance of engaging with and impacting legislation, albeit without much further elaboration.

Breakout Session #2: Stakeholders and Needfinding Strategies

A second breakout session was on the topic of "Stakeholders and Needfinding," with the goal of generating more nuanced insights related to the three meeting objectives. More specific topics of directions for the breakout groups were proposed by participants, with most discussions centered on narrower stakeholder groups to engage in future research efforts (the "who") and ideas for questions that could be posed to particular groups (the "what"). As noted below, one group additionally spent some time discussing a possible "ethics R&D" initiative.

Across groups, varying attention was directed to stakeholder groups across sectors of interest: private/corporate, public/government, non-profit, and higher education. Regarding the private sector, multiple groups discussed the importance of identifying and seeking input from practicing technical professionals, as well as staff in ethics/compliance and corporate security roles. Soliciting input from corporate organizations of varying size was also noted. One group generated an especially rich set of topics and questions to explore, including: examples of ethical failures, including frequency of occurrence, root causes, and types of responses or remediations; most common kinds of disagreements and challenges related to upholding ethical standards; trust

in peers and superiors; and identifying corporate training programs and continuing education opportunities focused on ethics, compliance, and related topics, including duration, goals, content, and gaps. Additionally, this same group suggested exploring how ethics and related concerns are defined or understood by different individuals and groups, and to investigate perceptions of preparedness when encountering ethical issues or challenges. Yet participants also noted likely barriers to accessing such perspectives in the private sector, especially when employees may be reluctant to share negative examples and incidents, and when proprietary information, legal liabilities, non-disclosure agreements (NDAs), and similar considerations are involved.

Stakeholders in the academic sector were discussed by multiple groups. Students were of particular interest, with one group especially focused on better understanding the perspectives of the "social media" generation. More specifically, this group suggested asking current engineering students about ethical issues and concerns in areas such as: climate change and sustainability; development and use of social media platforms; job choice, company loyalty, and work-life balance; cross-cultural conflicts and understanding; accessibility; conflicts of interest; and the role of professionals and perceptions of professionalism, more generally. This group also generated some specific questions related to how student engagement with social media shapes or could shape ethical awareness and perspectives, and how to encourage more dialog and debate among engineering students. Interestingly, participants did not dedicate much attention to discussing faculty, instructors, and/or administrators as stakeholders. However, at least one participant advocated for engaging with individuals, including from both inside and outside of engineering and from within and beyond the academy, who are known for their more critical perspectives on engineering ethics, professional responsibility, and related concerns.

Directly engaging with the users or consumers of engineering products and solutions was also discussed extensively by one group. They specifically called for engaging with the "users of technology," including to better understand how perceptions of risk differ between lay and expert groups, and to elicit and understand public skepticism toward science and technology. This same group also discussed the need for more engagement in the other direction, namely by helping students and professionals learn how to more effectively communicate with the public. They noted that engineers are often reluctant to speak or post publicly about their work and its impacts and discussed how additional training might improve their willingness and ability to do so.

Non-profit/professional organizations and the public/government sector were also mentioned in breakout discussions but not discussed at length. One group underscored the importance of engaging with and impacting ABET, NCEES, and other disciplinary engineering professional societies, with particular attention to ethics codes, professional licensure regulations, and accreditation requirements and processes. Government agencies and employees were mentioned, on the other hand, as being potentially difficult to access, survey, and report on.

Closing Discussion

This paper summarizes efforts and outcomes associated with a Horizons of Engineering Ethics Education (HEEE) meeting organized and hosted by NIEE in May of 2024. The summit represents a step toward fostering dialogue and ideation among stakeholder groups to facilitate a

better understanding of needs for ethics R&D training and development across engineering contexts. Participants primarily represented academic and industry perspectives.

We first presented findings from 24 pre-event survey responses. Quantitative findings revealed that all participants felt codes of ethics, "exceptional" or "disaster" cases, and AI/ML were important aspects of engineering ethics education to varying extents. Moreover, quantitative findings suggested that participants felt ethics training was important (and possible) throughout all aspects of engineers' ethical formation. Given the small sample, we did not compare responses by stakeholder group, but future work should aim to explore such patterns.

Written response data revealed potentially competing views or tensions among responses. First, while codes of ethics were viewed as positive influences on engineers' ethical actions, codes were also viewed as limited sources of ethical guidance. Second, ethical formation was viewed as occurring throughout an engineer's life and career, influenced by both nature and nurture, and a product of training, culture, and context. Third, participants felt that exceptional case studies can provide powerful learning opportunities, but also potentially misleading examples of the types of ethical issues engineers will encounter in their careers. Finally, participants felt that AI/ML was a critical area of need for engineering ethics training. but with some participants suggesting that a focus on AI should not circumvent or displace attention to established and more general ethics codes and principles in engineering ethics training and education efforts.

In addition to survey data, we presented an analysis of notes recorded during the summit itself, involving 38 total participants. In alignment with our guiding objectives, the HEEE summit participants provided needfinding guidance and strategies. First, the findings provide guidance on *who* should be included in future needfinding efforts, including: 1) the private/corporate sector, 2) academic stakeholders, including instructors and students alike, 3) consumers or users of technology, 4) non-profit organizations, and 5) the public policy and government sectors. Second, our findings suggest what might be included in future efforts. The "what" varied widely and included understanding variation across contexts. Some notable possibilities include the need to better understand: 1) ethical expectations and goals across settings, contexts, and diverse stakeholders, 2) the relation between ethical and legal requirements or proprietary concerns, 3) ways to connect ethics training with organizational needs (e.g., compliance), 4) ethics engagement among learners (participants primarily discussed students and technology users), and 5) communication modalities between groups (e.g., engineers and the public).

This study provides initial guidance and support on emergent and challenging ethical issues based on perspectives from industry and academic stakeholders. Findings from this study can guide future efforts to develop a more comprehensive understanding of engineering ethics training and development needs, including strategies to guide such efforts. We also plan to build on the work presented here by carrying out a national study of stakeholder perspectives, namely through deployment of a more comprehensive survey and undertaking needfinding interviews.

Acknowledgments

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Appendix A: HEEE Agenda and Schedule

Time (EDT)	Description
9:00-9:30 AM	Informal gathering and networking
9:30-10:00 AM	Opening: Welcome, about NIEE, project background/objectives
10:00-10:15 AM	Summary of pre-event survey results
10:15-10:45 AM	Breakout session #1 (exploratory)
10:45-11:00 AM	Breakout reports, identifying interest clusters
11:00 AM-12:00 PM	Lightning talks, Q&A, and discussion (see titles below)
12:00-12:30 PM	Lunch break (lunch provided for in-person attendees)
12:30-1:00 PM	Breakout session #2 (interest clusters)
1:00-1:30 PM	Closing: Breakout reports, next steps and timeline

Lightning Talk Presentation Titles

- Diverging Ethical Norms Among Engineering Disciplines?
- Aristotle and Civil Engineering: Using the Nicomachean Ethics in the Classroom
- Role-Play Case Studies to Teach Technology Ethics
- NSPE BER Case 22-10 “Sustainability-Lawn Irrigation System Design”
- Preparing Engineers to Navigate Ethical Dilemmas: Thoughts from the Field
- Conversations on Generative AI and Engineering Ethics
- Better Alignment of Ethics Training with Ethical Practices in Industry
- Understanding and Evaluating Ethical Engineering Practice