HOW AND WHY INSTRUCTORS INCLUDE AND EXCLUDE SOCIAL, POLICY, AND ETHICAL CONSIDERATIONS IN DESIGN EDUCATION

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ABSTRACT

Design and engineering are socio-technical enterprises used to solve real-world problems. However, students in these fields are often under-equipped to consider the ethical and societal implications of their work. Our prior work showed that these societal considerations are more consistently embedded in design pedagogy in non-engineering than in engineering courses at MIT. Here, we examine underlying causes for this through a survey of instructors (231 courses from 29 departments). The main contribution of this work is an analysis of whether and how instructors incorporate social, ethical, and policy considerations in design pedagogy. The majority of respondents (60.6%) included these topics in their courses, primarily through discussion of social justice, identity groups, and ethics. These concepts were included more in non-engineering courses (65.8%) than engineering courses (46.9%). Many instructors, especially in engineering, cited irrelevance as the reason for not engaging with these topics in their courses (86.1% compared to 44.2% in non-engineering). We suggest that instructors question this perception and use the examples provided as a starting point to explore integration of these concepts into their technical content.

Keywords: Design education, Social responsibility, Ethics, Equity, Justice

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1 INTRODUCTION

1.1 Background and motivation

There has been a growing focus on design at technology institutions and an added emphasis on design being a core part of the engineering curriculum (ABET, 2020; Dizikes, 2022). Traditionally, engineering design curricula focus on building analytical and technical expertise (Cross and Cross, 1998; Magney and Bucciarelli, 1995), and do not emphasize the social impacts and implications of engineering design work (Das, Ostrowski, et al., 2022; Rittel and Webber, 1973; Verma and Djokić, 2021). However, the goal of engineering design is to work on real world problems that often interface with people and/or the environment through the technology development and use process. As such, it is essential that engineers are trained to understand the societal and environmental implications of their work. This may include adopting a stance that prioritizes concepts such as ethics, equity, and justice, described here as social, policy, and ethical (SPE) considerations, in their design work. Some engineering educators have already been working on ways of meaningfully incorporating justice-based considerations into their coursework (Leydens and Lucena, 2014; Riley, 2008, 2012). Several frameworks such as Design Justice (Collins, 1990; Costanza-Chock, 2020) and human-centered design (Buchanan, 2001) can be used to incorporate social, policy, and ethical considerations in coursework to emphasize equitable and democratic design in coursework.

We build on our prior work that explores how SPE topics are included in engineering design research (Das, Roeder, et al., 2022; Ostrowski et al., 2022) and engineering design pedagogy (Das et al., 2022). In our previous work, we conducted a syllabus audit – the largest of its kind – to understand the extent to which SPE considerations are embedded in design pedagogy to provide students with training to think through SPE topics in their work (Das, Ostrowski, et al., 2022). In doing this work, we created a framework for assessing design pedagogy, drawing on the design justice principles and questions (Costanza-Chock, 2020), and used it to analyze syllabi from six departments at the Massachusetts Institute of Technology (MIT) over two academic years. This syllabus audit formed a baseline for understanding the current state of inclusion of SPE considerations in design pedagogy within the institution. We found that non-engineering design curricula were incorporating design justice content much more than engineering curricula. A limitation of this work was that syllabi do not represent the full scope of topics covered in a course. This study aims to address this limitation by understanding the enabling and constraining factors experienced by instructors when it comes to incorporating SPE considerations in course curricula. As such, we developed a survey to learn from instructors about their practices, what they want to do in future iterations of their courses, and whether or not their syllabi accurately reflect the SPE content in their course. Additionally, we hear directly from instructors on the reasons behind their decisions whether or not to engage with this material and investigate whether or not there is a difference in reasoning between engineering and non-engineering instructors.

1.2 Research Questions

RQ1: *How are engineering and non-engineering instructors including social, policy, and ethical considerations in their courses?*

This question explores both the portion of the course that includes this content along with the types of social, policy, and ethical consideration topics covered in the courses.

RQ2: *If instructors are excluding social, policy, and ethical considerations in their course, why are they excluding them?*

This research question seeks to understand the reasons why instructors choose not to include social, policy, and ethical considerations in their courses and whether or not there are differences in these reasons between engineering and non-engineering instructors.

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2 METHODS

2.1 Survey design

Through our survey of instructors, we aim to understand what topics around SPE content are currently being included in design courses and the possible reasons for their inclusion and exclusion. The survey, which was disseminated to all instructors within the institution, also aims to understand how accurately syllabi reflect course goals and outcomes related to SPE topics in order to better contextualize our prior work on syllabi analysis.

To test how instructors would respond to our survey, we piloted a draft of the survey with three MIT faculty in both engineering and non-engineering departments and conducted 30 to 45-minute interviews with them to discuss the survey and receive feedback. We were particularly focused on how to refer to the social elements of design we have been considering. For preliminary iterations of the survey, we referred to them as *ethics, equity, and justice,* but our pilot interviews indicated that some instructors found that language confusing, inaccessible, or intimidating. Based on that feedback, we decided to incorporate existing language from MIT's Social and Ethical Responsibilities of Computing (SERC) group that instructors may be more familiar with. This included the use of terms such as "social, ethical, and policy considerations." We made a specific note in the text of the survey that these considerations can include justice and equity.

We also updated the survey to ensure that instructors could answer every question for each course that they taught in a given year and edited the length and clarity to increase responsiveness. Our goal was to have the survey take around 10-15 minutes to complete in total. Once the changes regarding the structure, length, and content of the survey were complete, the research team tested the survey in the online Qualtrics portal in order to ensure there were no mistakes or errors in the final survey (which was disseminated through Qualtrics). Our analysis for this paper focuses on the questions in the survey regarding the inclusion or exclusion of SPE considerations in the courses and their syllabi. The five relevant questions from the survey are included in Table 1 below. Each question is asked for every course that the instructor has indicated that they teach as indicated by their survey response. Note that for question 1, which asks about "mentions" of SPE considerations, the question was open to interpretation by the person filling out the survey. They were not restricted to only counting instances of the terms "social," "policy," or "ethics." Further discussion of what topics respondents considered to be relevant to these considerations is found in Section 3.3. Additionally, "Justice statement" in question 2 refers to a statement in the course syllabus that is related to SPE content such as the MIT Land Acknowledgement (discussed further in Section 3.3).

Table 1. List of questions from the survey that were included in this analysis

1	For the [selected] course, **do you mention** social, policy, and/or ethical considerations **in your syllabus?** [Y/N]
2	**In what manner** are those considerations included in your syllabus for the [selected] course? Please select all that apply. [select all that apply: Lecture topics, Readings, Projects, Papers, Presentations, Assessments, Justice statement, Other (please specify)]
3	Do you think that your syllabus for **your** [selected] **course is an accurate reflection** of the social, policy, and/or ethics course content that you instruct? [select one: N/A (I don't include social, policy, and/or ethical considerations in my course), Yes, No, Maybe (please specify)]
4	If so, which social, policy, and/or ethical considerations do you **include in your course** content and syllabi for your [selected] course? [write in]
5	If not, **why do you exclude** those considerations in your syllabus for your [selected] course? [write in]

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2.2 Data collection

We began distribution of the survey at the end of the academic year (May 2022) and the survey remained open for three months until July 2022. At the beginning of the three month period, our survey was sent to 24 academic officers, academic administrators, or department heads for education across all departments to disseminate to instructors and teaching assistants at MIT. No incentives were offered for filling out the survey at any time. At the end of June 2022, the survey was also sent directly to an email list that reaches all faculty and instructors (estimated at around 2000 people) at MIT. As such, every person at the university who teaches a class was given the opportunity to fill out the survey. Some respondents received reminders through their departments if the departments chose to send out our email, but some only received the survey once through the email to all faculty.

2.3 Data analysis

The results of the five survey questions discussed in this paper followed two formats: multiple choice (questions 1-3) and write-in (questions 4 & 5). The frequency of selected choices in the multiple choice options was tallied for questions 1, 2, and 3. Qualitative open coding (Saldaña, 2021) was used to analyze the write-in responses for the topics of social, policy, and/or ethical considerations covered in each course, and the possible reasons for the exclusion of these topics (questions 4 and 5 respectively). The responses were descriptively coded to determine an overall categorization scheme that represents common themes present in the responses by a total of three researchers, with two researchers per question. The categories were created independently by two researchers, agreed upon through discussions, and modified through iteration. The final list of topics is described in Sections 3.3 and 3.4. Once the final set of categories were created, two raters independently sorted the responses into the determined categories for each question. Responses with multiple sentences discussing different topics were split up and categorized independently. Cohen's Kappa for the raters' categorizations of the responses was calculated for each question to assess the inter-rater reliability. Since the Cohen's Kappa coefficient for both questions demonstrated significant agreement between the raters (κ = 0.90 and κ = 0.86 for question 4 and 5 respectively), the average ratings is reported. Instructors' designation as "engineering " or "non-engineering" was done based on their self-reported home department. Responses from departments that are included in MIT's School of Engineering were classified as "engineering" and all other instructors were classified as "non-engineering."

3 RESULTS

3.1 Survey completion

To encourage completion of the survey, only the multiple choice questions were required while open-ended follow-up responses were encouraged but not required for survey completion. Additionally, survey respondents could answer every question multiple times based on the number of courses they taught in a given year. In total, we received complete responses from 103 instructors, providing responses regarding 231 unique courses (64 engineering and 167 non-engineering) taught across 29 institutional departments. Of these responses, we collected write-in responses on topics of SPE considerations (question 4) from 145 courses. We also received responses from 108 courses on the reasons instructors exclude those topics from their coursework (question 5). Overall, around 5% of those who received the survey completed it. Similarly, there are around 2000 courses at the institution, so this represents about 11% of the courses offered. We expect that instructors including SPE considerations in their courses will be overrepresented in this sample as those who do not include these considerations may not have perceived the survey as relevant to them.

3.2 Inclusion of content & accuracy of syllabi

Respondents were first asked whether they included SPE considerations in their syllabus. A slight majority of respondents (60.6%) reported mentions of these topics in their syllabus (question 1). Of those that reported including mentions of these topics in their syllabus, 80.0% considered their syllabus to be an accurate representation of their course. These topics were considered in several formats in the course, largely through the lecture topics (117 mentions) and course readings (103 mentions). Figure 1 shows the distribution of respondents reporting mentions of SPE considerations in their syllabi. Within engineering, 30 courses included SPE content in their syllabi and 34 courses did

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not (46.9% inclusion). Within non-engineering courses, a much larger fraction of courses included SPE content: 110 courses included this content in their syllabi whereas 57 did not (65.9% inclusion).

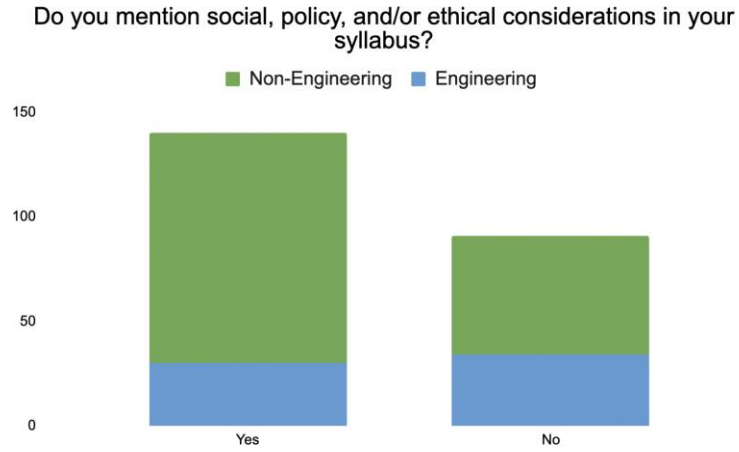

Figure 1. Distribution of respondents between engineering and non-engineering departments that included SPE considerations in their syllabus (46.9% and 65.9%, respectively)

3.3 Topics of inclusion

Respondents of the survey were asked to write-in the specific topics of SPE considerations they include in their coursework. The responses indicating that no topics of SPE are included in the coursework were removed (29 total). The themes and frequency of mentions are listed in Table 2.

Table 2. Summary of topics of social, policy, and or ethical considerations included in the coursework. Frequency of mentions is the average frequency count coded between two raters.

Topic	**Frequency of Mentions (Average Count Between Raters)**	**Theme Description**
Social Justice	54.0	Justice and fairness in society, including equality in economic, political, and social rights
Identity Groups	52.5	Unique experiences of a group of people with a common identity (such as gender, race, LGBTQIA+ status, etc) in social, policy, and/or ethical considerations
Ethics	43.0	Moral principles and responsibilities of individuals to judge right and wrong
DEI	24.0	Diversity, Equity and Inclusion, including any policies or practices that encourage the representation and participation of different groups of people.
Policy	20.0	Enactment of change through legislation, public policy or governance at the state, federal, and intergovernmental levels
Environment	16.0	Topics of social, policy, and/or ethical considerations as it related to the climate
Histories	13.5	Unequal histories and/or historical harms arising from technology design, use, or diffusion

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Public Participation	10.5	Engagement with communities
Personal Reflection	4.0	Student reflection on social, policy, and ethics related to the course content

While these topics are not mutually exclusive, the responses were categorized into the most relevant topic. For instance, the response "gender, race, and social justice in relation to land use and transportation" indicates a discussion of identity groups with respect to social justice, and was therefore categorized under the topics of identity groups.

Social Justice The most common topic included in the coursework is social justice, with 54 mentions. This included topics involving equity such as social equity, income equality, health equity, resource equity, equality of opportunities, and global inequalities. Some courses also included discussions around the social context of design, biases in design and technology, and their impact on social equity.

Identity Groups This topic was almost equally prevalent in coursework with 52.5 mentions and encompasses several groups (listed from most to fewest mentions): race, gender and LGBTQIA+, cultural, Indigenous, disability, age, and veteran groups. Only 2 respondents adopted intersectional considerations to assess how multiple identities interact to produce distinct forms of oppression.

Ethics There were 43 total mentions of ethics in the coursework, which involved discussion on moral principles and responsibilities to judge right and wrong. Many of these discussions were in the context of research and scientific knowledge, such as the choice of research question and the integrity of the research process to avoid bias and maintain participant confidentiality. Ethics in design spaces were also common, such as in game design, design of medical devices, infrastructure, transportation, education spaces, and artificial intelligence and machine learning systems and materials.

DEI Within this category, diversity emphasized the presence of differences, including race, gender, religion, sexual orientation, ethnicity, language and more. Equity highlighted equal access, distribution of resources and opportunities, especially for those that are historically marginalized and underrepresented. Inclusion highlighted active and intentional engagement with diversity that makes individuals feel respected and included. DEI was mentioned most frequently in relation to other topics (such as equity among race and gender in society), and therefore most responses that touched upon DEI were rated into another category. Most of the responses reported in this category were those that simply stated 'DEI' or 'Diversity, equity and inclusion' (16 out of 24 responses) without elaborating on the ways in which they are incorporated in course content, class practices or assignment structure. Seven respondents also mentioned DEI within their classroom setting, fostering respect for others' opinion or incorporating MIT conversation agreement for constructive, productive discourse.

Policy Mentioned an average of 20 times, policy involved discussions over a variety of applications such as legislation, research, design, and economic and social sectors such as agriculture and finance. However, around half of the responses in this category stated the word "policy" without specifying whether the content involves policy-making, policy implementation, assessment of policies' impact (i.e. which part of the policy cycle) or all. Therefore, it is difficult to assess how meaningfully these respondents considered policy in their course content.

Environment The topic of environment, reported an average of 16 times, encompasses discussions on environmental sustainability, environmental/climate justice, and technologies pertaining to climate change, such as alternative energy sources. This was largely in the context of the effects of technologies and products on the environment, and how new technologies can be used to tackle climate change. Some respondents also mentioned the role of environmental policies to enact change.

Histories Around 14 responses included content on historical context, such as discussions on colonialism, hegemony, and euro-centricism. Three responses specifically included the unofficial MIT Land Acknowledgement. A Land Acknowledgement is a "formal statement that recognizes the unique and enduring relationship that exists between Indigenous Peoples and their traditional territories" ((LSPIRG), n.d.). The goal of this statement is to honor the Indigenous people who have been "living and working on the land… [and] to understand the long standing history that has brought you to reside

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on the land, and to seek to understand your place within that history" ((LSPIRG), n.d.). MIT has an unofficial Land Acknowledgment posted online that instructors are able to copy and modify for use. It is important to note here that simply including a Land Acknowledgement may not actually be an indication of positive action and could instead be virtue signaling without any concrete action.

Public Participation Public participation, mentioned an average of 10.5 times, focuses on engagement with communities as part of the co-design process or participatory design tradition and includes considerations of power dynamics, inclusion and exclusion.

Personal Reflection A few courses adopted a more personal stance by encouraging students to assess their motivations and to reflect on SPE considerations as it related to the course content.

Other Many (23.5) of these responses did not have enough context to be categorized. For instance, one response listed "family" but did not provide further details as to how that was used to include SPE considerations. Additionally, 7 responses stated that there were too many SPE related topics to list.

3.4 Reasons for exclusion

Several reasons for excluding topics of SPE considerations in coursework were reported in the survey as shown in Figure 2. Note that these are all the explicitly mentioned reasons for excluding this content. It is possible that some instructors did not have a reason, and in those cases they may have left this answer blank. The responses stating that SPE considerations are not excluded from the coursework were removed (52 total). The average percentages for topics were normalized based on the number of responses received from engineering (18) and non-engineering (39) courses for this question.

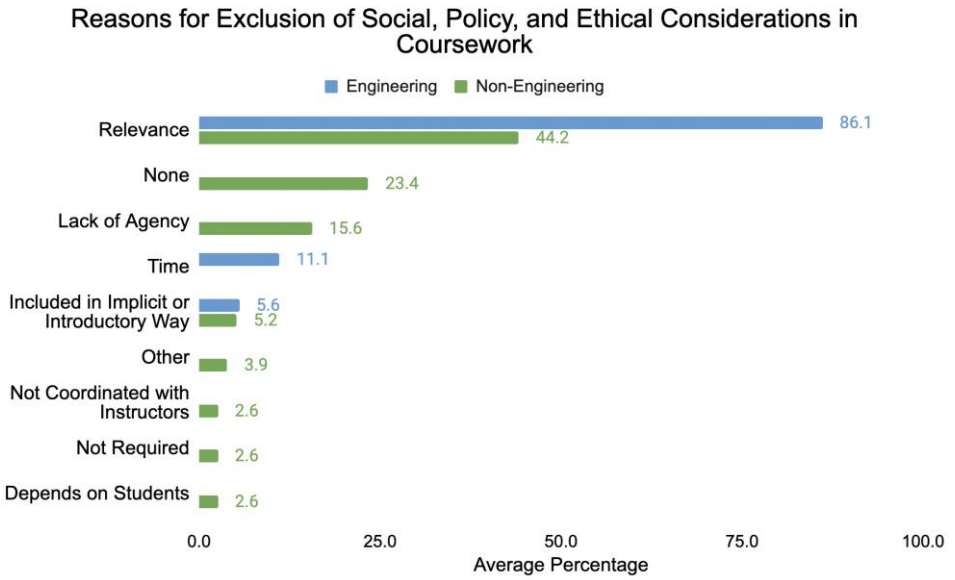

Figure 2. Average percentages of the two raters for reasons to exclude social, policy, and or ethical considerations from the coursework (question 5) in engineering and non-engineering courses.

The main reason for exclusion reported was relevance of those topics to the course content. This reason was much more commonly referenced in engineering courses (86.1%) than in non-engineering courses (44.2%). Additionally, 23.4% of non-engineering respondents stated that they did not include these topics in their coursework but had no specific reason not to include them. This may indicate that this is not a topic that these respondents have thought in depth about in the context of their courses. Respondents in non-engineering departments also mentioned a lack of agency to change the course content, either due to the departments' restrictions or lack of influence amidst the more senior teaching staff (15.6%). Some responses in both engineering (5.6%) and non-engineering (5.2%) departments indicated that SPE considerations are often not explicitly included in the coursework but often arise through discussions implicitly. Engineering instructors also mentioned the lack of time in the semester to cover additional topics and/or a shortage of time to prepare for the course (11.1%). No non-engineering instructors mentioned a lack of time as a reason for excluding SPE considerations.

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4 DISCUSSION

A survey of 103 instructors/professors, lab instructors, and teaching assistants provided insight into the inclusion of SPE considerations in coursework across engineering and non-engineering departments at MIT. A slight majority of instructors overall (60.6%) reported engaging with various topics of SPE considerations in their coursework, and this engagement was more prevalent in non-engineering courses (65.9%) compared to engineering courses (46.9%). This is more than we found in our syllabus analysis, where 39.8% of courses we analyzed engaged with design justice principles and questions (Das, Ostrowski, et al., 2022). However, some of this difference is likely due to response bias of instructors who prioritize engaging with this content being more willing to fill out the survey. This is a key limitation of the survey format of the study and interpretation of the results should take this limitation into consideration. Similarly, it would be interesting to further investigate why participants didn't fill out the survey: is it a lack of interest in SPE considerations, a lack of time, or even a feeling of inadequacy or shame for not including these topics?

RQ1: *How are engineering and non-engineering instructors including social, policy, and ethical considerations in their courses?*
Social justice and topics of race dominated the coursework as reported by instructors. This is likely due to the social movements around racial injustice which rose to prominence in the United States in 2020. Even though the topic of identity groups was widely discussed overall, only 1 or 2 instructors stated that they approached it from an intersectional lens (3.4%), reconceptualizing race, class and gender as an interlocking system. This indicated a possible preference for single-axis analysis of identity groups. Even so, some identity groups, such as aging communities, veterans, and people with disabilities, were very rarely mentioned despite their prevalence and importance in society. While Indigenous groups were mentioned more frequently, one third of the mentions (3 of 9) were through the unofficial MIT Land Acknowledgement. Honoring and uplifting of traditional, Indigenous, and local knowledge and practices should be incorporated more frequently and meaningfully in course content beyond the unofficial Land Acknowledgement. Many instructors also mentioned DEI as a topic of inclusion but did not elaborate further on how it was included. As such, there may be additional topics related to SPE that instructors include that were not captured in the survey responses.

SPE considerations in coursework are largely included through lecture topics and readings. It is unclear from the responses the level of engagement students have with these topics since lectures and readings can be very passive activities. Courses that include these considerations in projects, papers, presentations, and assessments may find more meaningful engagement and reflection with the topic.

There are also simple ways in which instructors can include SPE considerations in their coursework. For example, one instructor mentioned including the unofficial MIT Land Acknowledgement clause in three of their courses. This is a small addition to the syllabus and coursework that can initiate further conversations around these issues. Still, care must be taken to do it carefully rather than as a token gesture, though the level of intention used is not something that we can assess solely from the survey responses. Similarly, incorporating time for personal reflection during lectures and homeworks can encourage students to pause and reflect meaningfully on SPE considerations within their course topics.

RQ2: *If instructors are excluding social, policy, and ethical considerations in their course, why are they excluding them?*

Not all survey respondents included SPE topics in their coursework (39.4% of all responses). The main reason to exclude these topics was the relevance of the discussion to the coursework. Interestingly, this reason was cited much more often in engineering courses (88.1%) than in non-engineering courses (44.2%). This is troubling, yet unsurprising as engineering has often been painted as an "objective" field with less of a focus on the people that are being affected (often in disproportionate ways) by engineered artifacts and systems (Cross and Cross, 1998; Magney and Bucciarelli, 1995; Verma and Djokić, 2021). This mirrors the result of our syllabus audit, which found that engineering courses were less likely to engage with these kinds of considerations than non-engineering courses (Das, Ostrowski, et al., 2022). However, our prior work also shows that SPE considerations can be effectively incorporated into a variety of different courses across disciplines. For example, a course on Geographic Information System (GIS) mapping emphasized the technical knowledge of creating and analyzing maps while also critiquing the historically oppressive practices

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associated with map-making (Das, Ostrowski, et al., 2022). Another course in Media Arts and Sciences included readings and discussions regarding justice before introducing technical foundations for a design project so that students could create projects combining their areas of technical expertise with design justice principles (Das, Ostrowski, et al., 2022). Some courses in Mechanical Engineering engaged with community members throughout the process as experts who provided feedback and context for projects (Das, Ostrowski, et al., 2022). Different disciplines have different entry points for engagement with SPE considerations whether they involve incorporating short assignments or reworking the fundamentals of how a course is taught. In engineering fields in particular, researchers such as Donna Riley have been creating new texts that link traditional engineering topics such as thermodynamics with relevant SPE considerations in order to better train students to be engineers in the 21st century (Riley, 2008, 2012). We also found that lack of time was cited by 11.1% of instructors in engineering departments, though it was not at all mentioned by those in non-engineering departments. This may even be related to the value placed on efficiency in engineering contexts (rather than spending time on understanding social or contextual nuances of a problem statement) (Gelles et al., 2021). This could point to a difference in values and priorities across disciplines (such as an overall focus on developing solutions vs. understanding contexts) that could be investigated further.

5 CONCLUSIONS

A survey of 103 instructors/professors, teaching assistants, and lab instructors allowed for a deeper understanding of the inclusion of SPE considerations in their coursework as well as the reasons for excluding these topics. The survey responses reflecting 231 unique courses taught across 29 institutional departments showcased the variety of topics around social, policy and ethical considerations. Several topics of discussion emerged from the responses (listed in order of prevalence): social justice, identity groups (largely related to race and gender), ethics, DEI, policy, environmental sustainability, historical injustices, public participation, and personal reflections. The main reason instructors, particularly in engineering fields, did not include these topics in their coursework was due to their relevance to the coursework as perceived by the instructors. We suggest that instructors challenge the idea that SPE considerations are not relevant to their area of study. We recommend that instructors explore the ways in which others are incorporating these topics into their courses, illustrated in part through the survey responses, as examples for how SPE considerations can be included meaningfully in their courses with great relevance to the technical content they are teaching.

6 LIMITATIONS

One major limitation of this study is that it focuses on a single institution. A broader study could help provide a greater understanding of how SPE topics are integrated in engineering and non engineering curricula across the field. Potential limitations of this study include the response rate and the quality of the instructors' self-reported data. There is a possibility that some instructors may not open or complete the survey altogether, which could contribute to a suboptimal sample size. In particular, there is a strong likelihood that there is a response bias with instructors who already engage with SPE topics being more likely to fill out the survey. The quality of responses also varied, with some responses remaining ambiguous. For instance, many respondents simply stated that they included "DEI" in their coursework, without elaborating on the extent it was included or how the students engaged with the topic. We hoped that making the survey anonymous and brief encouraged as many instructors as possible to engage with our work honestly. Additionally, since we are relying on instructors to evaluate themselves we may be missing some key data that only students of the class could provide.

7 FUTURE WORK

One way to extend the current work is to look at a more granular split of themes that emerged from engineering and non engineering departments. For instance, it is possible that engineering departments have different SPE topics present than non-engineering departments. These differences could even point to different sets of core values across disciplines. After we have completed further instructor survey analysis on the questions not included in this study (those regarding topics other than inclusion and exclusion of

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SPE topics), we hope to conduct similar surveys and interviews with students at MIT in order to get the most accurate data regarding how SPE topics are being taught in design courses. Student input via interviews and surveys is imperative to receive the most accurate insight into the general atmosphere of different departments. Student responses may be more objective and may demonstrate which topics were actually retained by students in courses. We also have additional data from the survey that is currently being analyzed in order to make comparisons between different disciplines (engineering, science, humanities, business, etc.) and their approaches to including SPE content in courses. We hope to use this in order to create guidelines and recommendations for how to incorporate SPE considerations into coursework. Additionally, we are interested in determining how these topics are included in courses outside of MIT to provide a broader context for these topics' prevalence in curricula. Finally, we are developing classroom interventions to determine whether or not embedding these topics throughout a curriculum results in students being more able and likely to apply SPE considerations to their design work.

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