Expanding the Frontiers of Design: A Blessing or a Curse?

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Auditing design justice: The impact of social movements on design pedagogy at a technology institution

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Abstract. The purpose of engineering is to solve consequential, real-world problems in service of society. To be effective problem-solvers in societal contexts, engineers and designers ought to be trained to conceptualize and operationalize ethics, equity, and justice in their practice. Our work develops a methodology for an ethics, equity, and justice audit of design pedagogy that can also be extended to design practice. We develop this methodology by drawing on and extending the Design Justice framework, which we then use to assess design pedagogy at a technology institution – the Massachusetts Institute of Technology. In addition, we explore how design and critique courses engage with ethics, equity, and justice content in course syllabi and examine the impact of social and racial justice movements on design pedagogy. Our audit of design pedagogy, the largest such audit of its kind, serves as a proof of concept of how this methodology can be applied more broadly to design education and practice.

Keywords: design, equity, ethics justice, pedagogy

1 Introduction

Engineering design pedagogy largely focuses on building scientific, engineering, and design expertise in future engineers (Bucciarelli, 1996; Cross & Cross, 1998). This focus on analytical and technical rigor, while essential, does not generally take into consideration the vital and complex role of social context in the design of technology (Rittel & Webber, 1973), and imparts an incomplete understanding to future designers and technology inventors of the role and purpose of the engineer, and engineered artifacts and systems, in society (Verma & Djokic, 2021c). Given that the shared purpose of engineers and of engineering is to solve consequential, real-world problems, our research project takes as its starting point the need to train engineers to conceptualize and operationalize ethics, equity, and justice in their work, especially their design practice. To that end, through this paper, we explore whether engineering design pedagogy equips engineers with the necessary intellectual frameworks to consider questions of ethics, equity, and justice. Engineering education and design researchers generally agree that pedagogical innovations are needed in order to ensure that current and future technologies are imagined, designed, built, managed, and disposed of in equitable and just ways (Riley, 2008; Gallimore, 2021; Costanza-Chock, 2020). In this paper, we audit design pedagogy and the inclusion of ethics, equity, and justice therein to provide a baseline from which to commence pedagogical innovation and renewal to better prepare engineers of the future. In our work, we draw and build on the pivotal work of Sasha Costanza-Chock (2020) which proposes design justice as a “framework for analysis of how design distributes benefits and burdens between various groups of people.” Design justice researchers, such as Costanza-Chock (2020) and D’Ignazio & Klein (2020).
and practitioners urge designers to consider the ways in which design can perpetuate or challenge systems of oppression and discrimination in contemporary societies (Costanza-Chock, 2020; Collins, 2002). Doing so requires that designers explicitly consider design justice principles such as: which values are encoded in design work, who is paid to do design (and recognized as a designer), where design is done, and who the design work is done with and for (Costanza-Chock, 2018). The focus of our work is how the normative logics underpinning design are rationalized and perpetuated through pedagogy (Costanza-Chock, 2018), particularly in light of Black Lives Matter (BLM)-led social movements and an unprecedented amplification of justice in the social consciousness in the United States starting in 2020. We explore the impact of these rapidly mainstreaming social movements on design pedagogy at a technology institution—in this case, the Massachusetts Institute of Technology (MIT). Our audit of design pedagogy at MIT, our shared home institution, is carried out in the spirit of constructive critique and transparency, as a call to design instructors to reflect on the ways in which we can better train engineers of the future to serve society. The overarching aim of our research endeavor is to inform and stimulate the creation of design pedagogy that creates engineers who, through their design practice, aspire to advance equity and justice. We make the four following contributions through our paper: first, we extend the design justice paradigm for assessing design pedagogy; second, we explore which design justice paradigms are embedded in design pedagogy and how they engage with ethics, equity, and justice; third, we investigate what impact, if any, the social movements of 2020 have had on design pedagogy between Fall 2019 and Fall 2020 at MIT; and fourth, we demonstrate a proof of concept design justice syllabus audit methodology that can be used at institutions of higher education. Such periodic audits can be used to understand, measure, and orchestrate systemic and institutional shifts towards educating and training future designers and engineers who are better able to engage with ethics and justice. The first ever design justice audit of design pedagogy at MIT carried out in our work creates a baseline for comparing future pedagogical improvements and innovations.

2 Related Works

Design justice is a framework of analysis as well as a community of practice that “ensure[s] a more equitable distribution of design’s benefits and burdens; meaningful participation in design decisions; and recognition of community-based, Indigenous, and diasporic design traditions, knowledge, and practices” (Costanza-Chock, 2018). A design justice analysis of technological design examines whether a particular technology challenges or reinforces existing and systemic forms of oppression and suppression or the matrix of domination (Collins, 1990). Costanza-Chock’s book on design justice proposes seven questions to critique existing technologies and institutional systems in which they operate, or to consider as part of the practice of designing new technologies. These questions include: (1) who gets to do design and whose work is recognized as design (Equity), (2) what users and communities do we design for and with (Beneficiaries), (3) what values are embedded implicitly or explicitly in technological artifacts and systems (Values), (4) how do we scope and frame design problems (Scope), (5) where is design work done and how does the location of the design work impact which sites are privileged whereas others are marginalized or ignored (Sites), (6) who receives the benefits of design work and how can the work be owned by communities instead of individuals (Ownership, Accountability, & Political Economy), (7) how do we rationalize and remember how and why technologies are designed as they are (Discourse) (Costanza-Chock 2018). In order to add greater granularity to our analysis and pay particular attention to discussion of past harms of technology, we separated “Discourse” into two distinct categories of “Discourse” and “Histories.” Universalist, standardized, and one-size-fits-all approaches to design are too often prescribed as part of engineering pedagogy. These methods overlook how the potential benefits, burdens, and harms
created by technologies are distributed on the basis of race, ethnicity, class, gender, disability and sexuality. While prior design epistemologies and paradigms—including (but not limited to) value sensitive design (Friedman, 1996), values in design (Knobel & Bowker, 2011), resource-constrained design (Anderson et. al., 2012), human-centered design (Buchanan, 2001) and others—have sought to center users and communities, none have aspired to achieve intersectional equity as part of design work, as design justice does. Examples of well-intentioned but flawed engineering efforts aimed towards development abound in engineering practice and pedagogy. In a critique of such engineering-for-development initiatives, Nieusma and Riley (2010) observe that these engineering initiatives often make inaccurate and problematic assumptions about the role technology can and should play in development. Technology-for-development efforts also frequently ignore the power relations they create or perpetuate and forsake meaningful community engagement. This ultimately privileges technical performance and functionality as an end rather than a means towards achieving development. Similarly, Schneider et al. (2008) critique the colonial undertones of university-led engineering development projects through which students from Global North universities seek to launch development initiatives in the Global South. Here too, because of the limitations of their own training and the constraints of the development initiative as undertaken in a pedagogical context, student engagement with communities is fleeting and lacking in depth. Communities are designed for, and not with, as advocated by the design justice framework.

These efforts by engineering educators and students to engage in development work can be situated in a broader movement within engineering that Mitcham and Munoz (2010) describe as humanitarian engineering. They write that humanitarian engineering can be described “as working to escape what has been called the ‘social captivity of engineering’ by capitalism or nationalism or some other form of wealth and power” (Mitcham & Munoz, 2010; Goldman, 1991). Indeed, a pursuit of humanitarian engineering, or more broadly, humanitarian design, calls not only for an examination of our current design curricula but also reckoning with problematic practices taught to prior generations of engineers which continue to inform our design current practice and pedagogy (Lucena & Schneider, 2007). Understanding and addressing the limitations of engineering pedagogy specifically and design pedagogy broadly requires that we examine it through new conceptual lenses that bring social scientific and humanist ways of knowing to bear on the role of science and technology in society (Verma, 2021a). Pritchard and Baillie (2006) carry out such an analysis through a survey of Science and Technology Studies (STS) faculty and identify participation, politics, and citizenship as key analytical themes. Our paper builds on this work and adds additional analytical themes from the design justice framework—such as Values, Scope, Discourse, and Histories—for analyzing design pedagogy.

While Costanza-Chock’s Design Justice scholarship (2018, 2020) was published relatively recently, it coalesces under one framework of ethics, equity, and justice considerations that have long been foregrounded by engineering ethics and engineering education researchers (Baillie and Pawley 2012; Riley 2008). For this reason, we believe that a 2019 and 2020 audit of design pedagogy using this framework is apt. Our work marks the first scholarly effort to extend the design justice framework for assessing design pedagogy. While no previous work has explored how design justice is embedded in design education, prior studies have developed methods of reviewing course syllabi to find patterns concerning how particular topics, such as ethics, are covered in curricula. Syllabus analysis is an established, useful method of identifying areas of emphasis in curricula (Chong, 2016). Fiesler et al. (2020) conducted an analysis of syllabi with a focus on ethics curricula in computing education. They investigated whether ethics courses were typically standalone or if the topics were being integrated into core computing curricula. Through their analysis of 115 syllabi, they found that there is a myriad of ways in which instructors are engaging with ethics topics in their curricula and with a variation in the depth of these engagements. Their recommendations for integrating ethics content into computing
courses include emphasizing the idea in introductory courses that even a small design artifact like code can have social consequences so that students understand the responsibility of working in computing early on in their education. We conducted an audit of design courses using a similar methodology to investigate the ways in which instructors engage with ethics, equity, and justice in design pedagogy in both engineering as well as non-engineering departments of a technology institution. The design justice audit was guided by the following research questions in our study:

**RQ1: How, if at all, are design classes engaging with equity, justice, and ethics considerations?**
We hypothesize that most design classes are not directly engaging with equity, justice, and ethics considerations. We expect to see wide variation across classes and departments in their levels of engagement with these topics: from no presence to integrating equity, justice, and ethics as main focuses of a course.

**RQ2: Which design justice paradigms are implicitly or explicitly embedded in design pedagogy?**
We hypothesize that each department will have different design justice paradigms embedded in their pedagogy based on the parts of design they naturally already engage with. For instance, Mechanical Engineering courses may include more Beneficiaries since engagement with users is a common part of design courses in the field. Similarly, Nuclear Science and Engineering courses may include more Histories since some design courses involve critique of historical nuclear failures.

**RQ3: What impact, if any, have the BLM-led social movements of 2020 had on design pedagogy?**
We hypothesize that the BLM-led social movements of 2020 will have minimal impacts on design pedagogy. We expect that due to the COVID-19 pandemic, courses may incorporate more practices that indicate social mindedness (such as extension policies, explicit disability accommodations, etc.) but we do not expect this to permeate into pedagogy.

### 3 Methodology
To answer our research questions, we analyzed the design courses and the design principles (Fu et al. 2016) embedded therein at a technology institution (MIT) through a novel design justice centered syllabus auditing methodology that we developed.

#### 3.1 Syllabus Auditing Process
Our initial approach included performing a keyword search of “design” in the course catalog for Fall 2020 after the BLM-led social movements of winter, spring, and summer 2020. However, initial results (1006 courses for Fall 2020) did not comprehensively encompass design pedagogy at MIT. Recognizing the importance of design and critique as part of a reflective design practice (Verma, 2021b; Bardzell, 2010), we were interested in identifying not only design courses but also courses which taught the students to think critically of design. In our analysis, we refer to these as “critique” courses. In order to capture design justice considerations as they appear in both design and critique courses, we extended the design justice framework and developed elaborations of the design justice questions as they apply in the context of a design and critique course respectively. These elaborations of the design justice questions in design and critique pedagogical contexts, which we refer to as the design justice and pedagogy framework, are shown in Table 1.
### Table 1. Design justice questions: Examples in the context of design and critique

<table>
<thead>
<tr>
<th>Question</th>
<th>Design example</th>
<th>Critique example</th>
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</thead>
<tbody>
<tr>
<td><strong>Equity: Who gets to do design?</strong></td>
<td>The course considers how identity and background (race, class, ethnicity, gender, disability, and sexuality) shape who is able to do design and be recognized as a designer, or the course explicitly treats users and communities potentially impacted by a technology as its designers.</td>
<td>The course critiques how identity and background shape who is able to do design and recognized as a designer. The syllabus critiques design practices that do or do not view users and impacted communities as co-designers.</td>
</tr>
<tr>
<td><strong>Beneficiaries: Who do we design for or with?</strong></td>
<td>The course considers how designers identify users and whether user identity and background impact who is considered as a potential user for a new design and whose preferences and needs are accounted for as part of the design work.</td>
<td>The course includes theoretical or methodological resources or itself critiques design processes that give differential access to individuals (who is designed for and with), or individual preferences, based on their identity and background.</td>
</tr>
<tr>
<td><strong>Values: What values do we encode and reproduce in the objects and systems that we design?</strong></td>
<td>The course teaches student designers to reflect on their own biases, assumptions, and values and how these might become embedded in the artifacts or systems they design.</td>
<td>The course includes theoretical or methodological resources that students can use to examine or critique the values that are implicitly or explicitly encoded in technologies, and/or the course itself includes this critique.</td>
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<tr>
<td><strong>Scope: How do we scope and frame design problems?</strong></td>
<td>The course teaches students to pay attention to the ways in which design problems are framed and the extent to which justice, equity, and ethics considerations shape those framings.</td>
<td>The course includes theoretical or methodological resources that students may use to examine and critique the framing of design problems—focusing on whether those framings are attentive to justice, equity, and ethics,—and/or the course itself includes this critique.</td>
</tr>
<tr>
<td><strong>Sites: Where do we do design? What design sites are privileged? Which sides are ignored or marginalized? How do we make design sites accessible to those who will be most impacted?</strong></td>
<td>The course asks students to consider as part of their design work how their own design site may be privileged whereas others are overlooked or marginalized.</td>
<td>The course includes theoretical and methodological resources that enable the students to critically examine and interpret how the site of the design work shapes the designed artifact, and/or the course itself includes this critique.</td>
</tr>
<tr>
<td><strong>Ownership, Accountability, &amp; Political Economy: Who owns and profits from design outcomes? What social relationships are reproduced by design? How do we move towards community control of design processes?</strong></td>
<td>The course asks students to reflect on who may ultimately own the artifact or system being designed, what social and power relationships the designed artifact may either reproduced or create anew, or how the ownership of the artifact or system being designed can, over its full lifecycle, be held by communities instead of by individuals.</td>
<td>The course includes theoretical or methodological resources that enable students to critique the designed artifact or system and its maintenance, by examining its ownership structures and social and power relationships created or reproduced by the design, and/or the course itself includes this critique.</td>
</tr>
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</table>
**Discourse:** What stories do we tell about how things are designed?

The course asks students to consider how the technology or artifact being designed may be interpreted and/or rationalized, and it’s raison d’être described by future users.

The course includes theoretical and methodological resources that enable students to critically examine how and why prior or current technologies are interpreted, rationalized and the raison d’être described by past, current or future users, and/or the course itself includes this critique.

**Histories:** Acknowledging unequal histories and/or historical harms arising from technology design, use, or diffusion.

The course asks students to consider the historical harms that may have arisen from prior versions of the technology being designed.

The course includes theoretical and methodological resources that students can use to examine the historical harms that have arisen current, prior, or future technologies, and/or the course itself includes this critique.

Though we initially started with a keyword search for “design” in course descriptions, in order to capture the broadest possible range of design and critique courses at MIT, we developed a more thorough approach that consisted of reviewing course listings across six departments. The departments chosen for our analysis are representative of our (authors’) expertise and are known for their emphasis on design at MIT: Mechanical Engineering (MechE), Electrical Engineering & Computer Science (EECS), Nuclear Science & Engineering (NSE), Architecture, Urban Studies & Planning (DUSP), and Media Arts & Sciences (MAS). Across these departments, we logged courses for Fall 2019 and Fall 2020, collecting the course descriptions, syllabi, and any additional course materials available. Additionally, we identified courses taught in both Fall 2019 and Fall 2020 for comparison. We iteratively identified and agreed (two coders per course description) upon which courses were design and/or critique courses that included aspects of ethics, equity, or justice to include for further analysis. We engaged in this form of “purposeful” sampling (Patton, 1990) in our qualitative research approach to ensure we captured the variation of design courses at MIT and to test developing ideas of the presence of Design Justice at MIT. This approach in turn helped create a valid dataset with the potential for generalizability and expansion to other pedagogical contexts (Maxwell, 1992). This detailed approach enabled us to gather all course syllabi that had a design or critique component across the six departments. We gathered 121 course syllabi from Fall 2019 and 119 syllabi from Fall 2020—a total of 240 unique course syllabi. Of these, 65 were courses offered in both semesters and thus could be directly compared. Table 2 depicts the course distribution across departments and the corresponding number of syllabi that were analyzed.

**Table 2:** Number of total classes in each department of interest in Fall 2019 and Fall 2020 along with number of syllabi requested and number of syllabi analyzed for each department of interest

<table>
<thead>
<tr>
<th>Department</th>
<th>Fall 2020</th>
<th>Fall 2019</th>
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<tbody>
<tr>
<td>MechE</td>
<td>130</td>
<td>128</td>
</tr>
<tr>
<td>EECS</td>
<td>161</td>
<td>152</td>
</tr>
<tr>
<td>NSE</td>
<td>41</td>
<td>38</td>
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</tbody>
</table>

<table>
<thead>
<tr>
<th>Number of classes</th>
<th>Number of syllabi requested</th>
<th>Number of syllabi analyzed</th>
<th>Number of classes</th>
<th>Number of syllabi requested</th>
<th>Number of syllabi analyzed</th>
</tr>
</thead>
<tbody>
<tr>
<td>MechE</td>
<td>89</td>
<td>34</td>
<td>83</td>
<td>28</td>
<td></td>
</tr>
<tr>
<td>EECS</td>
<td>48</td>
<td>26</td>
<td>46</td>
<td>22</td>
<td></td>
</tr>
<tr>
<td>NSE</td>
<td>9</td>
<td>6</td>
<td>6</td>
<td>5</td>
<td></td>
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</tbody>
</table>
### 3.2 Analysis

We analyzed all course descriptions and syllabi to identify the inclusion of ethics, equity, and/or justice content within design and critique courses. Each syllabus was analyzed comparatively by two coders using an iteratively developed rubric, similar to the rubric development process in Das (2021). A draft of the rubric was created after the research team conducted a preliminary review of the dataset across the departments to gain an initial understanding of syllabi organization and content styles. The rubric was then iterated upon four times and piloted on a subset of the syllabus dataset including nine syllabi gathered from across four of the departments (NSE, MechE MAS, and EECS). The rubric is composed of four sections: (1) Introduction, (2) Course Description from Course Catalog, (3) Syllabus, and (4) Summary.

The Introduction section of the rubric gathers background information (i.e., year course was taught, name of the course, department, etc.). This section also asks about whether the course syllabus features any statements related to justice, ethics, and equity, including land acknowledgments (statements recognizing Indigenous Peoples as traditional stewards of the land) and statements concerning mental health and disability accommodations. The Course Description section uses a Python script to read the course description and record the presence of 26 terms that relate to design justice themes (e.g., “stakeholder,” “participatory,” “inclusive,” “intersectionality”), gathered from our rubric development process. The Syllabus section’s questions examine the implicit or explicit presence of the design justice questions and design paradigms included in the syllabus (e.g., human-centered design, complex system design, value centered design, etc.). The Summary section of the rubric records whether external community partners are involved in the course, the core learning methods employed, whether and how the design course is designing and/or critiquing a design topic and/or object, and an overview of whether and how design justice principles are explicitly/implicitly and meaningfully/superficially incorporated into the course. We define “implicitly” as a consideration of design justice questions but without labeling them as such and without any inclusion of theoretical and methodological resources. “Explicitly” is defined as direct mentions and considerations of design justice questions with exposure to theoretical and methodological resources. “Meaningfully” and “superficially” were defined across a range from “no mention in the syllabus” to “a cursory one-liner in the syllabus” (superficially) to the course being “focused on design justice” (meaningfully). The coding using the rubric was completed by two team members for each course syllabus. Each team member coded each syllabus independently using the rubric in the format of a Qualtrics survey. Researchers discussed the results and resolved any disagreements, similar to Daly et al.’s (2012) coding approaches. After all syllabi were coded through the rubric, we analyzed the results in several stages. The first stage involved aggregating numerical data from each department to track how many syllabi in each department were addressing each design justice question. We also recorded the implicit/explicit engagement levels, meaningful/superficial attention to design justice principles, and where design justice principles and questions were an afterthought vs. where they were thoughtfully integrated in the course syllabus. A final question on the rubric asked the respondent to reflect on opportunities for the inclusion of design justice considerations in the course being analyzed. Responses to this question were used to identify exemplary courses described in Section 4.2. These

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<tr>
<td>MAS</td>
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<td>16</td>
<td>17</td>
<td>20</td>
<td>14</td>
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</tr>
<tr>
<td>Architecture</td>
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<td>61</td>
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<td>DUSP</td>
<td>64</td>
<td>34</td>
<td>19</td>
<td>65</td>
<td>33</td>
<td>29</td>
</tr>
<tr>
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<td>248</td>
<td>119</td>
<td>487</td>
<td>243</td>
<td>121</td>
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</table>
results were aggregated in the same way as the data from the design justice questions. We also compared the courses between Fall 2019 and Fall 2020 (61 courses) documenting changes in presence of design justice.

The syllabi ranged from course schedules and lists of topics covered in the year to in-depth descriptions of course policies and grading to slides in the presentation from the first class of the semester to pages on websites. We obtained syllabi through consulting the archives of MIT’s course management system and working with professors and departmental instructors and administrators. All syllabi that we gathered from the course management system were publicly available to the MIT community. We also reached out directly to professors and departmental administrators—an approach that posed its own challenges. We sent up to two emails requesting syllabi, but only 44% of emails yielded a syllabus of interest. We experienced several challenges and limitations with regards to gathering syllabi including the variety of dispersed locations that syllabi were stored (i.e., course management system, instructors, websites), low availability of syllabi if they were not posted online, only syllabi from one semester being available (often the most recent semester), and incorrect listing of instructors on the course website.

Another limitation of this work has to do with the descriptiveness and level of detail contained in course syllabi. Course syllabi are intended to provide an overview of the course; however, they may not capture all strategies that instructors use to incorporate design justice into their curriculum. For example, depending on the detail provided in the syllabi, it can be difficult to gauge if assignments engage with design justice material in the course in ways that may be student-directed and otherwise not captured in the course description or syllabus (e.g., projects could be creating a space for students to explore design justice principles that are not reflected in the syllabi). Our approaches for addressing these methodological limitations are described in the Future Work section.

4 Results

A total of 505 classes were logged for Fall 2020 across these six departments. Among these, 368 classes were identified as classes of interest (design or other ethics/justice/equity-focused critique) for syllabi gathering. Our analysis of the syllabi from these departments and courses, which forms a baseline against which future curriculum development can be assessed, reveals that design justice is grossly underemphasized in design pedagogy. This is despite increased discussion around diversity, equity, and inclusion in academic spaces, including calls from engineering leadership to center equity in undergraduate curricula (Gallimore, 2020; ABET, 2021), particularly in light of the recent social movements. Coursework continues to be more focused on the design process and design outcomes without detailed consideration of societal implications of technology development and use. Principles of equity, justice, and engagement with user populations and impacted communities, when present, are more commonly treated as one-off engagements instead of sustained community partnerships, which have been shown to be more impactful (Ostrowski et al., 2021). We observe some positive movement with classes discussing topics such as sustainability in engineering contexts. However, discussions around ethics, justice, and equity are more commonly found in classes that do not have design components or are outside of engineering disciplines, such as in DUSP or MAS. Though the COVID-19 pandemic and the social movements of 2020 served as catalysts for adapting courses for remote learning, there has not yet been a corresponding reform towards embedding design justice values in design courses, though it is possible that such changes are being planned. Though more time is necessary to determine a representative trend, we now have a critical first data point.
4.1 Design Justice in Department Courses

We compared the courses from across departments to understand how various fields were integrating design justice into their courses. We compared the percentage of classes across each department that had any design justice component. As shown in Figure 1, DUSP courses had the highest prevalence of design justice (97.7%). NSE had the next highest (66.7%) followed by Architecture (54.3%), MAS (42.4%), and MechE (29.0%). EECS had by far the least prevalence of design justice themes, with only 4.3% of classes mentioning any design justice-related topic in the syllabus.

As shown in Figure 2, courses in non-engineering departments such as architecture, DUSP, and MAS consistently included design justice considerations at a much higher rate than courses in engineering departments. Courses in engineering departments performed especially poorly along the Equity, Sites, Values, and Discourse dimensions—categories that are no less applicable in an engineering context than a non-engineering one. Figure 3 provides an additional way to view the data along the dimensions of explicit/implicit and meaningful/superficial engagement with design justice. DUSP had the highest prevalence of design justice with most of the courses exhibiting some emphasis on design justice in the curriculum. MechE and EECS had the least presence of design justice and, correspondingly, on average, the principles were not included or not mentioned. MAS, Architecture, and NSE clustered together with having some design justice presence, but the overall average was a cursory one-liner in the syllabus without implicit or explicit mention of design justice, though the middle two quartiles demonstrate that there is a small range toward low implicit or explicit mentions in these departments.
4.2 Exemplar Courses

Despite the relatively low emphasis on design justice considerations across departments, our syllabus analysis did reveal a number of exemplary pedagogical practices. In this section, we explicitly identify these courses as exemplars that other instructors could emulate in the future.

Design justice and related concepts as main learning objectives. Some courses had topics that were very aligned with design justice with an additional emphasis on technology. For instance, one way that design justice was incorporated into courses was having a focus and main objective of the course related to social justice and incorporating certain technologies into the course to facilitate discussions.
on how technologies can enable or prevent justice and perpetuate or help fix social inequalities. One course of this type in MAS began with an in-depth examination of racism and social injustice in the United States with readings and discussion focused on these and other justice-related topics. The course then introduced a technical foundation that merged technology applications with social justice. Students produced a proposal and/or research project that they worked on over the course of the semester that combined their interests and learning objectives of the course related to design justice.

**Design justice concepts incorporated into technical pedagogy.** One type of exemplar was a course that not only emphasized technical rigor, but also centered design justice considerations in the context of tool use and development. For example, a course on Geographic Information System (GIS) mapping offered in DUSP, in addition to emphasizing technical knowledge, also acknowledges the political significance of maps while critiquing associated historically oppressive practices. Specifically, it analyzes the use of maps and seeks to position map-making as a tool of empowerment for communities and activists that enables them to tell their own stories. The course achieves these learning objectives by interspersing technical readings on GIS with readings on power, colonialism, and the politics of maps such that students learn to critique GIS techniques and their potential uses even as they continue to acquire expertise in the area. This practice of foregrounding social context and interspersing ethics, equity, and justice considerations with technical expertise is a practice that could usefully be emulated in the context of any course similarly built around teaching the use or development of an analytical tool.

**Emphasis on community engagement.** Some courses incorporated external groups relevant to the design topic into their pedagogy, like clients, experts, and community members. Select courses in sustainability in Mechanical Engineering and DUSP took students on field trips and met with local experts to better understand the leading factors and first-hand insights related to a specific environmental issue. The hands-on engagements that centered around different aspects of the problem—from health (of humans and ecosystems) to economic security—promoted a more well-rounded problem-solving approach. Similarly, a design-for-the-developing-world social impact course in Mechanical Engineering had community partners evaluate the proposed technologies as part of the course’s evaluation process of whether or not the device would actually be useful to the community partners. Though these community members were not treated or identified as co-designers, they gave input throughout the design process in a formalized way. By collaborating with those who would be affected by design decisions, these classes in Mechanical Engineering and DUSP allowed students to better understand the social nuances of building technologies and/or designing urban infrastructures.

Just as the courses described above represent exemplary pedagogical practices, several other courses as depicted in syllabi we analyzed, offer opportunities for learning lessons from prior pedagogical practices that have incorporated ethics, equity, and justice content in design pedagogy with limited success. In general, these course fall into one of three categories:

1. One set of courses tends to over-intellectualize ethics, equity, and justice as conceptual categories through the use of theories and frameworks that are far removed from the lived experiences of communities and individuals who actually experience inequities. This approach to the treatment of ethics, equity, and justice content was especially apparent in departments that deal with the designs of large sociotechnical systems. Because of the size and scope of such systems and their architecture of systems made up of several systems, questions of equity, ethics, and justice are easily overlooked. Instead, they ought to be integrated into every level of scale and technology design (Turner et al., 2021).

2. A second set of courses that are a study in how not to teach ethics, equity, and justice are those that seek to develop products or systems for underserved communities, without directly engaging with those communities during any stage of the design process. Such approaches to design, if normalized
as part of the pedagogical practice at leading institutions of higher learning, are likely to be amplified and perpetuated in design practice when students enter the workforce.

(3) A third set of courses are those that treat ethics, equity, and justice in cursory and inconsistent ways across course offerings. Several course syllabi we reviewed included ethics, equity, and justice content but did not show students how to operationalize it in design or critique work. Overall, exemplar courses demonstrate a variety of ways to integrate design justice concepts into both engineering and non-engineering pedagogy, with several examples of exemplary pedagogical practices transcending specific departments. For example, both engineering and non-engineering departments could benefit from greater community engagement as part of teaching design or critique. Similarly, these departments could benefit equally from including reflections on, and critiques of, the analytical tools being developed in the course. Conversely, several courses whose syllabi we analyzed contain examples of how not to teach ethics, equity, and justice content. While our list of exemplary and non-exemplary pedagogical practices is not exhaustive, we recommend that instructors of design courses reference these examples, the exemplars in particular, to identify ways they might incorporate design justice into their own curricula. Instructors may also wish to consider and reflect on other novel pedagogical approaches that are not yet in practice.

4.3 Changes in Courses between Fall 2019 and Fall 2020

The majority of courses (80%) that were taught in both Fall 2019 and Fall 2020 had no change in their inclusion of design justice questions. Figure 4 reveals the positive and negative changes that occurred between semesters with respect to design justice areas. DUSP exhibited the most change between Fall 2019 and Fall 2020; DUSP increased design justice in its syllabi in all areas except Equity. MAS, MechE, EECS, and NSE saw some change, though to a lesser degree than DUSP. Architecture showed no change between semesters.

Figure 4. Changes in courses between Fall 2019 and Fall 2020 across the design justice areas. Bars above the zero axis indicate that courses in that department incorporated more design justice areas into their courses. Bars below the zero axis indicate that courses removed areas of design justice from the courses.
In addition to comparing the design justice areas between semesters, we also explored how design justice emphasis changed between semesters by analyzing how implicitly or explicitly the design justice questions and principles were addressed in the course and how meaningfully or superficially they were incorporated. Figure 5 depicts the results from 10 courses across the departments that exhibited change along these dimensions. There are three general trends that were identified from this subset of courses: (1) courses trend from being low implicit or no mention at all to explicitly incorporating design justice into the course with more meaningfulness; (2) courses move from having no mention at all to implicitly incorporating design injustice into the course with some curriculum emphasis; and (3) courses move from incorporating design justice explicitly to incorporating it implicitly. For example, courses that moved from low implicit or no mention to low or high explicit reshaped the course to include design justice or added design justice case studies to complement technical material. Courses that moved from having no mention to implicitly incorporating design justice added limited readings around the topic area without specifically categorizing them as “design justice focused” whereas, courses that moved the opposite direction from explicit to implicit, though few, often removed readings or focus on design justice to prioritize other materials.

![Figure 5. Plot demonstrating how classes shifted emphasis in design justice focus between Fall 2019 and Fall 2020. The open point represents Fall 2019 and the solid point following the arrow represents Fall 2020. The points are color coded by department. No changes were observed in Mechanical Engineering courses.](image)

The changes we saw were incorporated into courses in a variety of ways. Some courses restructured lectures and curriculum materials to reframe the course more around social justice. Some courses completely redesigned the course to have a more even balance between technical material and case studies on design justice related areas. A few courses also removed course work, such as an inclusive design lecture, that decreased the emphasis of design justice in the course. Overall, the majority of courses held in both Fall 2019 and Fall 2020 did not change with regards to design justice areas or its emphasis. Those that did change generally changed positively, incorporating more design justice into the content and/or increasing emphasis on design justice through the methods described previously. One of the courses exhibiting positive changes was transformed into what we have called an “exemplar.” It is noteworthy that such a transformation occurred after a change of instructor. This
suggests that courses lacking design justice content might not falter from lack of potential or irrelevance to course content; it simply takes someone with an eye and intention for justice—a skill that can be learned by engineering and non-engineering course instructors—to redesign curricula. Ultimately, however, even the majority of courses with positive improvement could be considerably further improved through more explicit, meaningful, and intentional inclusion of design justice considerations.

5 Discussion

Overall, the results of this study indicate that design justice themes are, for the most part, not being prioritized in engineering courses. There is much room for improvement, especially in the engineering courses that are more focused on technology development for its own sake rather than viewing technology as a means to an end. Some courses are prioritizing this content through one-off lectures on ethics-related topics or short modules on relevant design justice-adjacent material, such as sustainability. However, most technology-design focused classes have little to no focus on ethics, equity, nor justice. This is a glaring gap in engineering design education that must be addressed. Non-engineering departments had a much more meaningful focus on design justice related topics. Although some non-engineering departments have a stronger focus on these topics, they are often not integrated throughout the entire curriculum and are not the main focus of the design process. Notably, the departments with the largest design justice focus tended to have the smallest number of students, so the overall reach of this content is very limited. At technology-focused institutions, these smaller departments often have less respect, power, and funding than engineering departments, which further limits their sphere of influence. Some possibilities for pedagogical reform may include engineering instructors learning from approaches adopted by colleagues, partnering with colleagues in other departments to develop novel cross-departmental course offerings, and urging their engineering students to take non-engineering courses as a way of improving their engineering practice through the development of intellectual breadth.

In addition to analyzing the department courses, we also examined changes between courses that were taught in both Fall 2019 and Fall 2020. In general, there were few changes in the inclusion of design justice questions addressed between Fall 2019 and Fall 2020. Though there were 17 examples of reform with respect to certain design justice paradigms, there were also five cases of courses reducing the presence of design justice related principles between the two years. While most courses did not change their overall explicit/implicit or meaningful/superficial engagement with design justice, those that did often incorporated more design justice aspects into their curricula, though this was done both implicitly and explicitly. Ideally, we would like to see courses consistently engage with design justice explicitly as demonstrated by the exemplars.

It is also important to note that the events of 2020, namely the COVID-19 pandemic and subsequent transition to virtual teaching, added stress and labor on educators that may have prevented them from embedding these values, as they focused more time on student wellbeing and acknowledging the emotional turmoil that students were facing in the context of the pandemic and the increasing visibility of police brutality and racism in the United States (Park et al., 2020). Virtual teaching and the added toll on educators may have limited instructors from experimenting with content: as such, we may expect to see more of the changes described added into 2021 syllabi when many courses reverted to the in-person format. Regardless, it is crucial that design justice paradigms be incorporated into design courses directly, so that students see them as fundamental components of the design process. Students who do not learn and practice these concepts will become design practitioners who do not have experience with considering the implications of their work and may become more disengaged
with these principles (Cech, 2013). Justice, ethics, and equity cannot be afterthoughts and must be foregrounded in design pedagogy.

We firmly believe that ethics, equity, and justice are fundamental components of engineering and must be incorporated into engineering education. Our results demonstrate that traditional engineering departments engaged much less with design justice than non-engineering departments. We are at a critical juncture to address the lack of design justice in engineering design pedagogy, and we are beginning to see commitments in the field to address this. Recently, the deans of multiple engineering departments nationwide jointly authored a letter to The Accreditation Board for Engineering and Technology, Inc. (ABET) emphasizing the need for implementing a Diversity, Equity, and Inclusion requirement in engineering curricula (ABET, 2021). Some universities have already embarked on significant programs of curricular reform. For example, the University of Michigan has begun incorporating these topics into their engineering education already to work towards “equity-centered engineering” (Gallimore, 2021). At MIT, the Social and Ethical Responsibilities of Computing (SERC), has been working towards centering on social, ethical, and policy considerations in computing pedagogy (MIT SERC 2021). In addition to these advancements, there are opportunities and methods for including design justice in future course offerings—as we’ve seen in our syllabus analysis—such as the inclusion of ethics and equity considerations in courses built around analysis tools and techniques. Courses can also include curriculum components that investigate and discuss the social implications of technology by questioning who has access to the technology, who benefits from it, and who designs it.

While our focus in this paper is on undergraduate and graduate courses, we believe that our work provides contributions and extensions to design practice as well. The training that designers and engineers receive in their coursework in undergraduate and graduate schooling is essential to shaping how these students will develop future technologies. Our work here also provides emphasis on Design Justice that can be translated to corporate and industrial design projects. The audit we’ve done in this work can be expanded to examining corporate and industrial design projects, encouraging professional designers and engineers to embed Design Justice principles in practice. It could also be used as a benchmark or assessment of corporate attention to Design Justice principles. This extension also provides future work directions for the interface and impact of Design Justice grounded coursework for design in practice.

5.1 Future Work

As previously acknowledged, syllabi are not a complete representation of the full pedagogical and learning experience imparted and experienced in a course. Future work will explore additional ways to understand how instructors include design justice considerations in their courses apart from the material listed on the syllabus. To this end, we have developed a survey that will allow course instructors to articulate how they incorporate design justice principles into their courses to build a more complete picture of how design justice is integrated into pedagogy. We also plan to interview instructors of the courses to understand why and when they incorporate design justice in pedagogy, in addition to any institutional incentives or barriers they encounter while doing so. We expect that this future research will be able to offer recommendations not only for curricular reform but also educational policy reform at institutions of higher learning as well as through accreditation organizations such as ABET.

In our ongoing work, we have already begun collecting syllabi from other departments and additional years to extend this investigation further. We also plan to conduct a comprehensive analysis of our recommendations that we noted when we were completing the syllabus coding. These recommendations will be used to inform how design justice could be incorporated into courses more
specifically (i.e., case studies, section of project, etc.). We have also developed a Python script that reads each syllabus and identifies the design justice related keywords within it. We plan to elaborate on this analysis in a future publication to show which terms appear in syllabi across various departments.

6 Conclusion

RQ1: How, if at all, are design classes engaging with equity, justice, and ethics considerations? Most design courses are not engaging with equity, justice, and ethics considerations. In particular, there is a large gap in the level of engagement with these topics in engineering design courses compared to design courses outside of the engineering departments. This is a troubling finding and suggests that engineering design curricula could be reformed to meaningfully engage with equity, justice, and ethics considerations.

RQ2: Which design justice paradigms are implicitly or explicitly embedded in design pedagogy? The design justice paradigms embedded in design pedagogy varied widely across departments. Urban Studies & Planning and Media Arts & Sciences tended to have a similarly high rate of all the design justice questions present in their courses and Electrical Engineering & Computer Science tended to have little to no design justice questions present in their courses. Mechanical Engineering and Nuclear Engineering courses both had a higher presence of Beneficiaries and Scope, but Nuclear Engineering also had a clearer focus on Histories, likely because of the presence of many critique courses that addressed past disasters. Architecture courses had a higher presence of Beneficiaries, Values, and Sites. We also found that some courses included topics adjacent to design justice that did not fit one of the explicit design justice paradigms. For instance, sustainability and climate change were focus areas for several engineering design courses.

RQ3: What impact, if any, have the BLM-led social movements of 2020 had on design pedagogy? We found that the majority of courses had no significant changes between 2019 and 2020. It is possible that this is too short of a time frame to see any significant changes, so we plan to continue this research in the future to determine how long it takes to see meaningful changes in the curriculum.

Our paper highlights the notable absence of design justice principles in design and design critique courses, especially in engineering departments, at a technology institution, despite the BLM-led social movements of 2020. We call for a stronger emphasis of ethics, equity, and justice in design pedagogy. While these principles may be found in non-design courses and non-engineering departments, it is important for future developers and designers to responsibly engage with the social contexts and implications of their work, which is emphasized through incorporation of design justice principles in design education—both engineering and non-engineering. Several recommendations emerge from our work for how to include design justice principles. Our work develops a methodology for launching design justice audits as an ongoing process at technology institutions and identifying needs for institutional support for justice-, ethics-, and equity-minded work and education. Through these measures, we expand the epistemic scope of design education to holistically support a more socially minded design education centered on equity, justice, and ethics that empowers future designers to question and consider the societal impacts of technological designs from the earliest stages of ideation.

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References


