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Incorporating Design Justice Activities in Engineering Courses

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Dr. Das has taught a variety of courses ranging from freshmen to advanced graduate level such as Mechanics of Materials, Introductory and Advanced Finite Element Method, Engineering Design, Introduction to Mechatronics, Mechatronic Modeling and Simulation, Mathematics for Engineers, Electric Drives and Electromechanical Energy Conversion. He led the effort in the college to start several successful programs: a graduate concentration in Mechatronics, an undergraduate major in Robotics and Mechatronic Systems Engineering, a graduate certificate in Advanced Electric Vehicles, and thriving partnerships for student exchange with several universities in China.

Dr. Das received many awards for teaching and research at Detroit Mercy as well as from organizations outside the university. His areas of research interest are modeling and simulation of multi-disciplinary engineering problems, engineering education, and curriculum reform. He has worked in areas ranging from mechatronics system simulation to multi-physics process simulation using CAE tools such as Finite Elements and Boundary Elements. He has authored or co-authored six published books on these topics.

Incorporating Design Justice Activities in Engineering Courses

Abstract

One of the primary tasks that engineers must undertake is design. Engineers design and develop solutions that are supposed to satisfy human needs. Engineers also, through their work, intend to change the life of everyone for the better. While all around us we see numerous examples of cases/design solutions that have improved our lives, there is also another side of this story. For example, development of nuclear weapons during the second world war led to its use to destroy cities and innocent lives, and a perpetual threat of the possibility of nuclear holocaust. Or, for example, how early in the US history the growth of the country from its coastal colonies into the heartland was achieved through the development of the railroad. These same railroad projects ended up destroying the lives and livelihood of the indigenous people.

Even today, when we are designing solutions, we quite often do not consider the possibilities of the harms that it may cause, and we often exclude the voices of the very people who are affected by our design. Smart algorithms that automate decision making using data also tend to marginalize communities who may already be living a marginalized existence. Data and mathematics has been used to "red-line" communities causing tremendous harm to many generations of people. The Design Justice movement is a network of design practitioners, design instructors and others from a variety of different backgrounds who want to change the design landscape into a more inclusive ecosystem [1,2]. And the Design Justice principles can be a concrete set of guidelines that can help teach engineering students how to integrate Diversity, Equity, and Inclusion (DEI) practices in their profession.

Research shows [3], while typical engineering programs have plenty of design content, the concepts of design justice are rarely taught. This paper talks about the experiences of introducing some of the concepts of design justice into several undergraduate courses. It was done through a case study of a section of an interstate that was built in the 1950s cutting across a thriving neighborhood that was eventually decimated. This case has been in recent news, since federal government money is being used to revive parts of the neighborhood. In the assignment, students were asked to review this case through the lens of design justice using the principles of design justice [2]. Also, they were then assigned to pick a design situation that they are familiar with and use the same set of guiding principles to analyze their chosen example. The lessons learned from this assignment are reported in this paper. Pointers are also offered for interested instructors who may wish to integrate Design Justice principles in their own teaching.

Introduction: What is Design Justice?

Design Justice is an emerging field that seeks to address the ways in which design practices and decisions can perpetuate or challenge systemic injustices. It is a lens through which we can examine the ways in which design shapes our built environment, the systems that govern it, and how those systems in turn shape our communities and individuals. This approach to design focuses on creating equitable outcomes for marginalized communities and centers the voices and perspectives of those who have been traditionally

underrepresented in design decision-making. Design Justice practitioners work to ensure that design is accessible, inclusive, and equitable for all.

"Design mediates so much of our realities and has tremendous impact on our lives, yet very few of us participate in design processes. In particular, the people who are most adversely affected by design decisions — about visual culture, new technologies, the planning of our communities, or the structure of our political and economic systems — tend to have the least influence on those decisions and how they are made. Design justice rethinks design processes, centers people who are normally marginalized by design, and uses collaborative, creative practices to address the deepest challenges our communities face." [1]. Two core tenets of the Design Justice movement are that "absolutely anyone can participate meaningfully in design," and "those who are directly affected by the issues a project aims to address must be at the center of the design process." [4]

Engineering education community and design researchers generally agree that pedagogical innovations are needed to ensure that current and future technologies are imagined, designed, built, managed, and disposed of in equitable and just ways [4,5,6]. In the current form, most engineering programs focus on teaching the engineering aspects of design, client-designer relationships, and design communication. However, societal impact, broader long-term effects, or inclusivity of the masses in the design process are mostly missing in typical design experiences in engineering curricula. In an extensive syllabus audit of over 250 courses with significant design content at MIT [3] the authors found some significant gaps. While design justice content can be found in close to 80% of Urban Studies design courses, it is only seen in about 10% of Mechanical Engineering courses and even less in Electrical Engineering courses.

Some may argue that in engineering, perhaps the same principles are discussed using different terminology, for example, engineering ethics. It is true that most engineering programs have some coverage of engineering ethics either as a stand-alone course or as content that is integrated with design projects and design activities in design-focused courses. This is a fair argument that needs to be explored further.

Design Justice principles and a code of ethics are both frameworks for guiding design practice, but they have some key differences. A code of ethics is a set of principles or guidelines that outline what is considered ethical behavior within a specific profession. In the field of design, a code of ethics may outline how designers should conduct themselves professionally, such as by avoiding conflicts of interest or protecting the confidentiality of clients.

Design Justice, on the other hand, is a broader framework that looks at ways in which design practices and decisions can perpetuate or challenge systemic injustices. It goes beyond the narrow scope of professional conduct and focuses on creating equitable outcomes for marginalized communities. Design Justice centers the voices and perspectives of those who have been traditionally underrepresented in design decision-making, and seeks to ensure that design is accessible, inclusive, and equitable for all, not just a typical user, an average user, or even majority of users.

In Table I we have compared the ten canons of ethics as defined by National Society of Professional Engineers [7] (also adopted by most other professional societies e.g., American Society of Mechanical Engineers [8]) and the ten design justice principles [1]. A close reading of the lists makes it clear that the ethics principles mainly talk about the personal and professional behavior and responsibilities of an engineer. But says very little about the need for inclusivity, social justice, or the broader and long-term impact of design solutions and the responsibility of the designer/engineer. Also, the tone and language of the code of ethics conveys several other messages. For instance, all the code of ethics items starts with "Engineers shall…," as if they are written by a higher authority who is laying down a set of rules that all engineers need to follow. Whereas the Design Justice principles make extensive use of "We," implying that we, the community of designers, collectively agree to follow these guidelines. This difference in language inherently sends a message of inclusivity or lack thereof. The code of ethics is written with an eye towards ensuring that the tasks of individuals do not tarnish the profession in any shape or form whereas the design justice principles encourage the user to think beyond the immediate circle of influence or just the client and consider the greater good of everyone, particularly all possible users of the product. Finally, the code of ethics is constricting, advising the engineers to "stay in their lane" or stay focused on one's area of expertise. While this is good professional advice, this also sends the message of not to delve into things that an engineer may not know enough about. One must wonder if such an advice encourages engineers to focus mostly on the technical aspect but not as much on social, political, and humanistic angles, and the broader impact of their decisions.

In summary, a code of ethics sets the standards of professional conduct for a design profession, while Design Justice is a broader framework that looks at the ways in which design can be used for the betterment of marginalized communities and to rectify structural inequalities.

Table I Comparison of NSPE code of ethics [7] and the Design Justice Principles [1]

NSPE Code of Ethics	Design Justice Principles
Engineers shall hold paramount the safety, health and welfare of the public in the performance of their professional duties.	We use design to **sustain, heal, and empower** our communities, as well as to seek liberation from exploitative and oppressive systems.
Engineers shall perform services only in the areas of their competence; they shall build their professional reputation on the merit of their services and shall not compete unfairly with others.	We **center the voices of those who are directly impacted** by the outcomes of the design process.
Engineers shall continue their professional development throughout their careers and shall provide opportunities for the professional and ethical development of those engineers under their supervision.	We **prioritize design's impact on the community** over the intentions of the designer.

Engineers shall act in professional matters for each employer or client as faithful agents or trustees and shall avoid conflicts of interest or the appearance of conflicts of interest.	We view **change as emergent from an accountable, accessible, and collaborative process**, rather than as a point at the end of a process.
Engineers shall respect the proprietary information and intellectual property rights of others, including charitable organizations and professional societies in the engineering field.	We see the role of the **designer as a facilitator rather than an expert**.
Engineers shall associate only with reputable persons or organizations.	We believe that **everyone is an expert based on their own lived experience**, and that we all have unique and brilliant contributions to bring to a design process.
Engineers shall issue public statements only in an objective and truthful manner and shall avoid any conduct which brings discredit upon the profession.	We **share design knowledge and tools** with our communities.
Engineers shall consider environmental impact and sustainable development in the performance of their professional duties.	We work towards **sustainable, community-led and -controlled** outcomes.
Engineers shall not seek ethical sanction against another engineer unless there is good reason to do so under the relevant codes, policies and procedures governing that engineer's ethical conduct.	We work towards **non-exploitative solutions** that reconnect us to the earth and to each other.
Engineers who are members of the Society shall endeavor to abide by the Constitution, By-Laws and Policies of the Society, and they shall disclose knowledge of any matter involving another member's alleged violation of this Code of Ethics or the Society's Conflicts of Interest Policy in a prompt, complete and truthful manner to the chair of the Ethics Committee.	Before seeking new design solutions, **we look for what is already working** at the community level. We honor and uplift traditional, indigenous, and local knowledge and practices.

Introducing Design Justice in Engineering Classes

At University of Detroit Mercy (UDM), students work on many design projects throughout the engineering program including a two-semester senior design sequence. There is also a separate course on engineering ethics where students get to consider many well-known design cases and analyze them using the principles of ethics. The senior design course follows the theme of designing of assistive technologies for disabled individuals, where students are introduced to a patient/client who has some form of disability. Students go through the entire design process starting with problem identification and ending with delivery of a usable prototype to their client. Throughout the process the client remains a partner of the design team. Assistive technology design as a theme of the senior design course has been going on for over ten years and has been a very invigorating and satisfying experience for the seniors. In a way, students in this course get a

hands-on exposure to inclusive or user-centered design. They learn by doing it. However, these students have not been exposed to the concept of Design Justice or the Design Justice principles, so they do not have the linguistic framework to center this practice.

I do not teach the senior design sequence but teach several courses such as Statics, Mechanics of Materials and others that prepare students with many of the fundamentals needed to carry out technical design tasks. In these courses, that deal with fundamental concepts in engineering, we also discuss design and how the concepts learned in these classes impact the design process. To provide early exposure to students in these classes an exercise on Design Justice was designed and introduced. Slightly different versions of this exercise were administered in three different courses (Statics, Mechanics of Materials, and a technical elective course on Introduction to Electric Vehicle Modeling). Relevant details of the exercise and the results are discussed here.

Exercise Details
Problem Statement: I-375 is a section of the I-75 freeway that runs from the south side of Detroit to downtown. I-375 was built in 1956 under the federal highway act to provide residents from Detroit suburbs a faster access to the city center. However, it was built through some thriving African American neighborhoods (Black Bottom and Paradise Valley). The highway effectively cut the neighborhoods into half and decimated the social, cultural and music scene that existed there. Many residents were forced to move out and the entire infrastructure of these neighborhoods moved towards dilapidation. Although this history is well documented [9-13], even many locals do not know much about it. Recently, this project was in the news again; under the newly approved federal infrastructure bill money has been set aside to build a people-friendly boulevard in place of the section of I-375 that ran through the Black Bottom district with the hope that some of the harms caused many years ago can be corrected and urban renewal can happen here again.

In the assignment students were asked to read up on publicly available resources on the history of I-375 and analyze the original project through the lens of Design Justice by answering the following questions:
- Who do you think created the original design?
- Who benefitted from it?
- Who were harmed from it?
- What design justice principles were violated, if any?

Statics and Strength of Materials
For the Statics and Mechanics of Materials class the next question asked was to consider any current project, design task, or any product of interest to the student. Analyze it using the same principles and answer the same questions: Who do you think created the original design? Who benefitted/benefits from it? Who were/would be harmed from it? What design justice principles are being violated, if any?

Introduction to Electric Vehicle Modeling
For the course on Introduction to Electric Vehicle Modeling the follow-up question was more specific. Since this course is all about vehicle electrification, students were asked to consider the current effort at electrifying the automobile. Tesla is a leading contender in this marketplace. While they are being hailed as an innovator, there have been many problems reported in the press

about Tesla. These are not just technical issues, but ethical violations have been reported as well. A simple Google search can help one find these news items. Students were asked to research some of these articles and analyze Tesla's vehicle electrification effort through the Design Justice lens using answers to the following questions as guides: Who do you think created the original design? Who benefitted/benefits from it? Who were/would be harmed from it? What design justice principles are being violated, if any?

Upon completion of the above tasks, all students were asked to reflect on what they learned by answering the questions:
        a. What are some things you learned about Design Justice?
        b. Name at least three new things you learned through this assignment.
        c. Will you approach design problems differently now? How?

Written response of the students was collected and graded using a rubric. The rubric is included in an appendix to this paper. In the next section we have included some excerpts of the answers provided by students to the questions posed in this assignment. The initials of the quoted student is also listed next to the quote.

Sample Student Responses

In this section we have included excerpts of some of the responses from students.

Response to the question on I-375 project
"This design furthered oppression of black neighborhoods, did not take into account those who would be directly impacted nor share the knowledge and tools with the community, was not collaborative with the community, treated the designers as experts without treating the community as experts themselves, was not sustainable nor community-led, and definitely did not uplift the traditional, indigenous, and local knowledge and practices of the area." -A.P.

"This correlates to principle 8 on the design justice list, promoting community based and focused outcomes. This principle was most definitely ignored from the perspective of the thousands of primarily black families who lived in the Black Bottom district of Detroit." -J.P.

"Principle 1: "We use design to sustain, heal, and empower our communities, as well as to seek liberation from exploitative and oppressive systems." Principle 2: "We center the voices of those who are directly impacted by the outcomes of the design process." Principle 3: "We prioritize design's impact on the community over the intentions of the designer." And Principle 10 "Before seeking new design solutions, we look for what is already working at the community level. All of these were clearly violated." - P.S.

"In terms of how the highways creation relates to the 10 principles created by Design Justice, I found that I-375 strictly conflicts with principles 1,2,3,8,9,10. These principles are violated mostly under two arguments. The first being that the highway disrupted a living community and its unique culture which violates principles 1,3,9,10. The second argument is that no consideration was given to the community on their wellbeing or opinion: "Relocation assistance was minimal, and many

former Black Bottom and Paradise Valley residents were given 30 days' notice to vacate." (Detroit Historical Society), which defies principles 2,8."-B.S.

Response to the question on analyzing another project of their choice
Students in two of the three courses were asked to pick a design/product that they are interested in and analyze its origin from the design justice perspective. Here are some of the topics that were picked:

(a) Apple Products
(b) Bicycle
(c) Nuclear Fusion
(d) Electric Vehicles
(e) Detroit Riverfront development
(f) Gardie Howe International Bridge
(g) Love Canal
(h) Real Estate/House Flipping
(i) Local Construction Project
(j) Wind Turbine
(k) Uptown Houston's Post Oak Boulevard
(l) Boring Company for building Hyperloop
(m) Nike Shoes
(n) Dodge Charger Daytona SRT EV

Here are some example quotes from students discussing some of the above projects.

"Apple utilizes contract manufacturers in China, Foxconn and Inventec which operated factories that produced the iPod using sweatshop conditions. Hence, thousands of workers were overworked in unsuitable working and living conditions for more than 60 hours per week while earning meagre salaries. To date, Apple still benefits directly or indirectly from forced labor such as that of the Uyghur labor force in China as reported by the Australian Strategic Policy Institute. This violates Principle 9 of the Design Justice Network Principles as Apple is making use of exploitative measures to profit from the products it sells. Thousands of people work in bad conditions and earn little wages while Apple's profit thrives. This is not good. Although Apple has made efforts in severing ties with companies that engage in exploitative labor, much still needs to be done as such issues persist which resulted in suicides by some persons working for Foxconn in 2010." – O.A.

"Currently Michigan and Canada are in the works of building the Gordie Howe International Bridge, a six-lane crossing of the Detroit River connecting the City of Detroit with Windsor, Ontario. The bridge will also feature a 12-feet-wide pedestrian/cycling path. The project also includes building new ports of entry that will connect to both the American and Canadian bridge termini, as well as onward connections to I-75 in southwest Detroit. This project will benefit both Michigan and Canadian residents who often commute back and forth to work and to those who like to frequent Detroit and Ontario for tourism reasons. With this project being linked to existing structures there will not be any demolition to surrounding neighborhoods which would preserve Design Justice principles 1-3."-M.W.

"One product that I am interested in are shoes, specifically Nike. They are sadly very infamous for their working conditions, more specifically the conditions in which the workers are put in when they enter these shoe producing factories. It is hard to find who created these conditions, as they can only be traced to Nike in allowing them to happen. Nike benefits from these horrendous working conditions and penny wages, allowing them to make shoes for mere cents and sell them for hundreds of dollars. The harm comes to the workers, who make these expensive items for wages that are not even livable. Although it is sad to say, it seems that just about every single design justice principle is being broken with the creations and running of these sweatshops. The community is not heard and instead put to work for mere cents. No one is put to the center and listened to, except for the upper-level workers that oversee these horrendous practices. This can be applied to any principle and prove how they are all being broken even to this day." - O.F.

Responses to the electric vehicle question
"The electric vehicle design harms a few communities, however. Firstly, the mining of precious materials used to produce the batteries of electric vehicles is exploitative and harmful to the regions where the mining occurs. Choosing electric vehicles as the main method to curb vehicle emissions rather than investing in better public transportation systems creates a further reliance on cars as a means of travel, harming impoverished communities who cannot afford cars. While it is possible to fund electric cars and public infrastructures, the focus is currently on personal electric vehicles rather than eliminating the need for cars in the first place through upgraded infrastructure." – A.P.

"Tesla was more focused on producing vehicles and maintaining their public image than creating a safe, road-ready product. Releasing non-prototyped and prototype components on production vehicles raises massive safety concerns. This violates principle 3 of the list, as Tesla failed to prioritize the needs of the community over their design intentions. This was needed for a safe and carbon efficient vehicle."-J.P.

"Principle 7 speaks on sharing knowledge with the surrounding community, Tesla has much of their software and some of their hardware components / information as free knowledge for the public. This open-source information has been utilized by many companies and individuals to help build a safer and stronger community. Tesla has also promoted a huge wave of domestic employment within the United States. Many of the people who see the impact of these vehicles can also be employed by the company who makes them. Tesla's deep research in batteries proves to be very useful for the future of the automotive industry. Current research and plans for sodium-based battery cells within their vehicles of the future will help end the monopoly of lithium, a volatile and dangerous recourse used in most of today's EV's."-J.P.

"Electric car manufacturer uses cobalt in their batteries to increase power and stability. The problem with this lies in where cobalt is sourced from. The Democratic Republic of Congo (DRC) produces 70% of the world's supply of cobalt. The problem with this is that a large chunk of the cobalt mining is done by "artisanal miners", basically slave labor. Giant mining corporations come in and destroy neighborhoods, not all that dissimilar to I-375.The worst part is that this isn't the first time the Congo has been exploited for the automotive industry. When the Congo was colonized by Belgium in the late 1800s, the people of the Congo were forced to collect rubber. Much of that exported rubber was used to create tires for cars. The cobalt mining in the DRC violates many of the same design principles as the I-375 project. Both projects destroyed

communities and displaced people without giving the people there really any say in the matter. The difference between the two is that the cobalt mining used the displaced people for what is basically slave labor, whereas those behind the I-375 project did not seem to care about the fate of those displaced. The cobalt mining in the DRC violates Principle 9 which states "We work towards non-exploitative solutions that reconnect us to the earth and to each other."-P.S.

Self-reflection on the learning question
"From this exercise I learned justice can be applied in areas I otherwise would not have thought. I learned justice can be applied to design and engineering, I learned that the I-375 project affected the local communities more than I originally thought and that my demographic was the main benefactor from this design, and I learned Tesla causes more harm than I originally realized. After completing this exercise, I will approach design differently. I have been aware that design can cause unintended harm but have never had a list of principles to reference when creating a design. I can now use this list to create just designs in my life." – A.P.

"The real lesson of the exercise though is just how big of an impact design can have on people and how long that the impact can be felt even generations later. On top of that, through this assignment I was also able to learn about both the history of I-375 and Black Bottom, which despite driving through a couple times, was a subject I knew nothing about. I had no idea Black Bottom existed until now, or how its history was as rich as the soil it was named after. In engineering there's a lot of talk about how we need to "think about the user" but this exercise opened my eyes that we really need to think beyond that. We need to consider everyone that'll be impacted by implementing our designs and how that impact will last as time goes on."-P.S.

"Yes, my approach to design problems will be different. I will consider all possible parties that will be impacted by my designs and endeavors and put them into focus in my decision-making processes. I will seek more innovative, inclusive, and sustainable processes and means for achieving my objectives when developing ideas and embarking on design projects." – O.A.

"Something that I learned about design justice is that there are many different aspects that are involved in the design process besides just how efficiently the design will work, but also how it will impact the people around the project, and those that are using it. Even if a design (such as the I-375 project) is efficient in what it does, there are other ramifications to consider when in the design process (how will this impact the surrounding communities, black bottom specifically). Three new things I learned from this assignment are how the I-375 project was constructed and all of the negative impacts that came along with it, how the job of an engineer and a designer is a lot more complex than just making an efficient design, but also considering the consequences and impacts of that design, and lastly, how to make sure that I am following the design justice principles in my future engineering endeavors. I will most certainly be approaching design problems differently after this assignment. I will consider the impacts that my design will have, and if the negative impacts are too drastic, then I will redesign until I find a suitable design that finds the best middle ground for an efficient design that also has a positive effect on those impacted by it."-J.R.

Summary and Conclusions
The principles of Design Justice go beyond a typical professional code of ethics and provides the designer a framework to think of the broader, hidden, and long-term impact of design decisions as well as all the possible communities who are impacted. Most engineering programs do very little to introduce these concepts in the context of the design activities that engineering students undertake. By including these concepts, the design process will go beyond just solving technical problems and consider real-life situations where technical issues are connected to various human interests. This way, the students' experience will be much closer to reality.

There is serious ongoing effort in the world of engineering education to make programs more diverse and inclusive. Simultaneously, efforts are also ongoing to integrate lessons of Diversity, Equity, and Inclusion (DEI) within the curriculum. We all want our students to be well equipped to thrive in a world where diversity is embraced, equity is cherished, and everyone is included. The Design Justice principles provide a framework (at the minimum, a list) to introduce DEI concepts in the thought process of budding designers. As per current practice, engineering ethics principles are taught in most engineering programs but as was discussed in this paper, the design justice principles go far beyond the ethics guidelines for engineers. Design Justice principles should perhaps become part of design lessons as well. As was reported in [3], very few traditional design courses in engineering consider the design justice issues. In many design projects students get a chance to interact with real clients and include them in the design process and decision making. Even in those cases, formal inclusion of the design justice principles will provide an organized set of principles that the students can turn to as they are going through an inclusive design process.

At UDM we introduced a simple exercise in three classes, Statics, Mechanics of Materials, and Introduction to Electric Vehicle Modeling. In this exercise, students had to analyze a well-known and historically relevant project using the principles of Design Justice and then analyze another design case of their choice using the same principles. They were also asked to reflect on the assignment and comment on anything new they learned and how this might affect their attitude when they work on a new design project. From the responses to the reflection questions, it is clear that the students had not heard of Design Justice prior to this assignment, and they clearly have formed some understanding and appreciation of the principles when they learned about them. They expect to use these principles to think about the broader impact of design decisions as well as inclusion of the person or communities that will potentially be impacted by their work.

To introduce the concepts of Design Justice in their courses, faculty members can start by reading the Design Justice book [4], which contains many examples throughout the text. A case study could be a good starting point, especially one that students can easily relate to. For example, the case about the Spirometer, a device used to measure lung capacity. This was invented at a time when it was believed that race determined lung capacity, so the device was built with a race correction factor. When employers were sued for asbestos related lung-diseases caused due to long exposure, Black employees would have to demonstrate worse lung function than their white colleagues due to this biased machine setting. There are many modern cases in software engineering where machine learning applications or models that try to predict human behavior, e.g., to identify possible security risks or to predict who is more likely to pay back bank loans, are designed with built-in bias because of the inherent bias in how population groups are chosen to

train the tools. Almost always, these products are detrimental for Blacks and other minorities, as well as women. Apparently, the automatic water dispensers in public restrooms that are activated by moving a hand in front of a sensor have a different rate of malfunction occurrences for different skin colors. This could be worth exploring.   Or one may consider how non-binary individuals navigate through public life: e.g., a transgender person going through airport security or trying to use public services where declaration of sexual orientation is a necessity, is often forced to make a binary choice to move forward or receive service.   It is common in product design education to teach students to design for an average user or a typical user. Once again, by deciding to design for a typical user we exclude some of the same marginalized groups. Exceptionally tall individuals are painfully reminded how being left out of design decisions feel every time they must take a seat in an economy section on a flight. It could also be interesting to use the Design Justice principles to critique events or decisions of historical importance. When the founding fathers wrote the US Constitution (a marvelous exercise in design) they started with the famous phrase, "We the people."   And we know all too well they did not really mean all the people. They were only referring to rich white men.

Those who want to do even more should integrate Design Justice principles into the entire design process.   Some of the core principles that ought to be considered are: (a) involving the would-be users in the entire design process, (b) actively considering the effects of the design on all possible users, and (c) actively trying to counter collective disadvantage and discrimination. One way to work towards this could be to partner with community groups, activists or local people who are already engaged in an issue or a project that would benefit from a technological solution.

Considering the divergence between the code of ethics and the design justice principles, it is probably necessary to re-consider and revise the code of ethics to be more expansive and include the design justice concepts. Inclusion of the design justice principles and their practice will be a worthwhile effort for NSPE and ABET to undertake and will be an important step on the path to making the engineering education system more diverse, equitable and inclusive.

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Appendix: Grading Rubric for Assignment

Criteria	Unacceptable	Acceptable	Exemplary	% 0f total grade
Identifies Problem	Does not understand or has a vague idea of the problem. 0 – 2 points	Identifies the problem and refers to the Design Justice Principles 3 – 6 points	Clearly identifies the problem with appropriate references to the specific Design Justice principles that were violated. 7-10 points	30%
Identifies Roles of Main Characters	Is unsure about who was involved in or who were affected by the decision-making process. 0 – 2 points	Identifies at least a few appropriate participants/stakeholders who were decision makers, were affected, and benefitted or harmed. 3 – 6 points	Accurately identifies all the participants/stakeholders who were decision makers, were affected, and benefitted or harmed. 7 – 10 points	20%
Analysis of a Chosen Design Case	Fails to identify the characters involved or the design justice principles affected. 0 – 2 points	Identifies the main characters involved and links the case to the design justice principles. 3 – 6 points	Thoroughly analyzes the case with appropriate references to the specific Design justice Principles that were affected and with clear identification of the roles played by the different characters involved. 7 – 10 points	30%
Self-reflection	Generic statements and lack of clear understanding of the lessons learned. 0 – 2 points	Can list at least two new things learned about Design Justice and can identify some of the personal actions that one could take. 3 – 6 points	Can list more than two new things learned from the exercise about Design Justice and can clearly chart a course of action that can be taken as a designer. 7 – 10 points	20%