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THOUGHT PROVOKING IDEAS OF THE GLOBAL ESSAY COMPETITION 2022

Engineering Climate Justice - Rethinking the Roles of Scientists and Engineers in Activism

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Introduction

In 2016, Dr. David Sedlak, editor of Environmental Science and Technology, published an article titled "Crossing the Imaginary Line" where he argued an imaginary line separates dispassionate research scientists and engineers from the activist. Dr. Sedlak, a professor of environmental engineering at UC Berkeley, argued that researchers erode the trust of the public when they cross the line from academics into activism. For him and generations of researchers before him, crossing the invisible line is an act of last resort, with a clear potential to destroy trust.

Dr. Sedlak's argument was certainly compelling. For me, a first-year at Berkeley and aspiring environmental engineer, a separation of the political and scientific seemed obvious. Despite the scientific consensus, the fight to mitigate and adapt to climate change continued to be challenged by climate change denial. Even today, hesitancy to vaccinate drives the continued presence of the COVID-19 pandemic throughout the world.

As science and technology becomes more and more complex, its ubiquity also seems to inspire more and more doubt. Shouldn't we protect objective science and engineering from the subjective whims of society?

Yet this idea of the "objective" scientist and engineer is built on a fundamental misunderstanding that science can be apolitical. Throughout the 20th century, we perpetuated the idea that science was something that could be apolitical and detached from its societal implications. Time after time, those in power for generations before us used arguments of "objective science" to shape injustice, deny climate change, and extract wealth from the most vulnerable. Furthermore, by declaring an objective scientific process, we discount those most impacted by climate change and other forms of injustice by declaring their first-hand experiences "unscientific" activism.

We must write an intergenerational contract acknowledging that engineering is intertwined with our society and systems of power and that scientific and engineering achievements have been integral to the deepening of injustice. I will required present a paradigm shift in our engineering ethics – that understanding the impacts of engineering choices on injustice must be prioritized in engineering education. Finally, it will highlight one subclause in that paradigm shift –how the co-production of scientific information by non-scientific communities can be integral in healing injustices.

Climate Injustice was Engineerd

Climate change will have a disproportionate impact on disadvantaged groups globally through increased exposure to climate hazards, increased susceptibility to damage from those hazards, and a decreased ability to cope with and recover from the damage. As Neil Smith argues in his 2006 essay, 'There's No Such Thing as a Natural Disaster', who lives and who dies in a disaster is the result of a social calculus that also informs how we prioritize certain engineering improvements, who we prioritize our responses, and how we decide to rebuild. The roots of injustice have, quite literally, been engineered into concrete and hardened into steel. The engineering choices in the mid-19th century that drove the transition of coal-based energy economies into oil-dependent modern societies have also driven a massive accumulation in wealth and political power by centralizing control over the physical infrastructure that powers our economy. Even in developed countries, systematic incentives to financial benefits and economic efficiency over climate resilience can have huge financial and human health impacts. The generations that left us with the climate disaster will not be the ones who will face the brunt of its burdens.

Building infrastructure through foreign loans has been a way to force policy-conditions onto developing economies, kicking away the ladder western nations used to develop their wealth, and enabling the extraction of wealth from the Global South. When engineers build coal-fired power plants or highways in low-income countries, we become complicit in a system that uses the infrastructure financing to force countries to open their borders to corporations with the scale to outcompete nascent businesses, enable foreign companies to extract resources, and disproportionately place the costs of climate change on the next generation. Engineering climate injustice happens even on an urban scale. Racial Redlining has physically cut highways and roads through cities and placed the most vulnerable in hotter areas with less vegetation and less climate-resilient housing, while systemic environmental injustice has led urban planners to put cancer-causing oil refineries in poorer areas. Our built infrastructure defines our societies today, but engineers often don't take responsibility for the public and social policy issues of the injustice.

Engineering and the Urge to Technofix

How do we enable engineers to build unjust projects? Over the past year, I've had the opportunity to judge a national science competition and interact with hundreds of middle school and high school students from around the United States. When I speak to these aspiring engineers and scientists, they are motivated to pursue Science, Technology, Engineering and Mathematics (STEM) because they want to help others – they want to cure cancers, provide clean water, and build apps to help families get healthcare. Yet, public welfare commitments and students' public welfare concerns decline significantly over the course of engineering educations.These students, who were so passionate about STEM they were willing to spend their Saturdays competing against other students, come into our programs wanting to do social good but leave with those aspirations dulled.

STEM work claims to be objective and rational. We codify this into language that attempts to separate ourselves from the political world. “Data Driven” and “backed by science” seem to be pervasive in our built worlds today. There are so many value judgments that engineers make on a day-to-day basis that become embedded social and ethical values into the choices we make. In engineering, control volumes define the space we study – literally drawing boxes around the problems we attempt to solve. Engineers are trained to abstract components in the process of creating mathematical models of the real world by determining what is and isn’t considered. This can be seen in our engineering educations. Courses are often labeled as “technical” or “non-technical”, and social skills are often labeled as “soft”-skills. Even when ethics courses are required for certification, engineering departments will often outsource the teaching of these courses to other departments. Our educations have codified to the next generation of engineers that concerns about injustice are irrelevant to the work of engineering. We aren’t trained to challenge the problem statements given to us by policymakers or businesses. For example, the Leadership in Energy and Environmental Design (LEED) program, a green building certification program used worldwide, certified numerous prisons under the program. Engineering curriculums teach us to build greener buildings but not question if prison systems, which are disproportionately used to incarcerate persons of color in the United States, should be built at all. Preventing the next generation of engineers from making the same mistakes that brought about our current climate disaster requires entirely reframing how we draw those boxes. The climate crisis necessitates engineers who think critically about who they work for, who they are accountable to, what historical conditions and ideologies underpin the current engineering choices, and who benefits from their work. Engineers need to work collaboratively with the activists who have been actively working to fight climate change, social scientists who have actively worked to understand how decisions are made, and political economics who study how the systems of power inform those decisions.

Engineering Ethics as the New Hippocratic Oath

Engineers need to develop their own version of the Hippocratic Oath. The Hippocratic Oath, an oath of ethics historically taken by physicians, not only codifies the creed of doctors to “first, do no harm”, but sets a foundation for the importance of the ethical practice of medicine. The concept is engrained in the education of doctors from the start of their educational systems. By contrast, engineering has no such historically engrained ethical expressions. One of the few historical motivations to emphasize a standard of ethics for engineers is the Ritual of the Calling of an Engineer. The ceremony is meant to be a private, secretive affair. We need to seriously consider whether this exclusionary ritual, which is not an oath but a solemn expression of intention, and which is authored by Rudyard Kipling – the same author of the imperialism glorifying poem “White Man’s Burden” – should be the flagship model for ethical engineering education. Many codes of ethics, such as those from the American Society of Civil Engineers, provide requirements for engineers to act in honor, integrity, and dignity, to never allow bribery, fraud or corruption, and even to treat all persons fairly and encourage equitable participation without regard to racial, gender, religious or other differences. Yet these points of view still don’t acknowledge the fact that when we do not actively work to fight inequity; we default to supporting the same systems of power that drive disproportionate climate change impacts. Our intergenerational contract between engineers and society must codify that engineers can cause injustice and that we actively have to understand how our projects may exacerbate potential inequities.

Co-developing Knowledge

The question remains, what does engineering for social justice look like? How do engineers engage in communities outside of the traditional areas of practice? Throughout the COVID-19 pandemic, I supported the U.S. Army Corp of Engineers to inform how we recover from the pandemic. I worked to produce tools and write reports to inform policymakers about the disproportionate impact that certain communities were facing with regard to food insecurity and vaccinations. Yet the physical realities we heard by our partners working on the ground – the lack of testing access by persons of color, the distrust in medicine by those traditionally disenfranchised from medical access, or the dire need for food aid – were hard to help because the data did not exist. When we strive for "data-driven" policies to combat the COVID-19 pandemic, we often forget to ask who collects this data, and who gets to decide what information is accurate or relevant. While community members may see clear evidence of climate and environmental hazards, they often are unable to communicate with those in power because they lack formalized evidence. Actively supporting community members to translate their own lived experiences into data can be one way to ameliorate this gap. LeeAnne Walters could only translate her yellow and foul-smelling water in Flint, Michigan into irrefutable evidence and national attention, with the aid of Marc Edwards, the scientist who "crossed the imaginary line" to inspire the article by David Sedlak. Edward's work and Walter's Struggle also speak to a broader shift in the way we view authority and validity in our modern world. Is it acceptable for engineers and scientists to hold the keys to determine whether a problem exists or not? We need to think critically about the metrics we use for success, and whether we are making space for non-scientists to shape their world as well. This co□production can be a complex issue.

For example, when pollution and public health experts talk with subsistence anglers, scientists find both strong local knowledge of waterways and their pollution conditions but potentially dangerous behaviors by anglers such as thinking they can cook away dangerous pollutants or that by fishing in specific areas, they get cleaner fish. While we cannot romanticize community knowledge, we have to make space for others in what we define as science. By reducing the accessibility of our research to non-scientists, engineers and scientists have fomented a lack of trust. Recently, science communication has been a point of emphasis for many institutions around the world. Science communication usually seems to focus on prescriptivist metrics to show the results of science. Whereas big discoveries and huge infrastructure projects are often highlighted, the processes by which those discoveries are made are not. If the currency of knowledge in our largest research institutions is peer-reviewed journal articles and citations, this knowledge should be public knowledge. When freshman students, and even graduate students, enter university, many do not have a strong understanding of peer review. Establishing the epistemological-based communication strategies – getting non-scientists to understand the scientific process, problem□solving, and peer review – may help to start a more honest conversation about how scientific knowledge is developed.

Conclusion

We often speak about training the next generation of engineers and scientists to solve the problems of today. Yet we saddle them with engineered global climate change and inequality that past generations have reaped the benefits from and those in the power of the current generation. To solve the climate crisis, we must first acknowledge our role in constructing these unjust problems. Then, we can begin to ameliorate these injustices by redrawing the boxes that we use to define technical problems, establishing strong ethical frameworks for solutions, and co-developing knowledge with community activists.

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