OPINION: "Asking questions, we walk": How should engineering education address equity, the climate crisis, and its own moral infrastructure?

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ABSTRACT

There are similarities between engineering education's intransigence on diversity and equity issues and its lack of adequate response regarding the global climate crisis. Scholars in linguistics, education, sociology, and critical race studies, and journalists writing about the climate crisis can help us see how both are related to a moral discussion rather than the techno-rational one that engineers and engineering educators seem most equipped to have. This piece calls for the development of a moral infrastructure to address both engineering education's demographic homogeneity, and its global obligation to halt the anthropogenic climate crisis.

Key words: critical theory, sustainability, ethics, diversity

I research gender and race in engineering education. Recent events have prompted me to new forms of scholarly action (including through this opinion piece): notably, the election of Donald Trump as US president in 2016 and the ensuing increase in visible bigotry against immigrants, Muslims, Jews, people of colour, people with disabilities, women, LGBTQ folks, simultaneously with increasingly dire warnings about the climate crisis being at best ignored and at worst denied by many lawmakers. These events spur me to join my efforts with others against what may remain as inevitable political and environmental crises.

At the same time, as a White scholar I acknowledge the problematic condition of "White saviorism." This occurs when White people act as though they alone have the solution to social problems,

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even though, first, they may be a large part of the problems, and second, people of colour are already working to solve them. Instead, Aura Bogado (2017) encourages White folks to think about the Zapatista saying "preguntando caminamos," which she translates as "asking questions, we walk." So, I write as a White person occupying many majority positions, taking part in a conversation, but not with all the answers.

Here I make two main points: First, demographic equity and diversity are fundamental to thinking about engineering, and are related to other big issues such as the climate crisis. Second, engineering has profoundly moral consequences, but the stories we engineers tell ourselves about what we do mostly disregard this moral role. In developing these two points I am indebted to four scholars: George Lakoff, Gert Biesta, Dorothy Smith, and Derrick Bell. I introduce each scholar's relevant arguments, then illustrate the two points.

George Lakoff shows how framing influences the brain's cognitive structures to explain how much more successful conservatives have been than progressives at communicating their moral value system in the United States. In *Don't Think of an Elephant* (2004), Lakoff argues that people are very good at understanding direct causation, but less good at thinking about systemic causation. Lakoff introduced me to the term "enlightenment reason," (Morrison, 2018): the belief that presenting a rational argument based on data and evidence leads people to act rationally. But, he points out, people frequently don't act in their own interests, and political progressives rely on enlightenment reason to their own detriment. So, for example, to counter the climate crisis, progressives describe its ill effects, but their well-reasoned and scientifically-supported arguments about impending catastrophe fail to mobilize a large fraction of political actors (Lakoff, 2004; Sarewitz, 2004).

Lakoff might have us question, on diversity, how much data university administrators need to recognize the enormous problems with how we systematically recruit and retain minoritized students, staff, and faculty, and then to change the system. How much data do White people need to comprehend how institutional structures are biased against people of colour? But I hazard that their failure to understand is not actually about the data. What could it be about instead?

Gert Biesta lays out a careful yet devastating argument against basing all educational policy on what we call "evidence-based research," (2007) meaning not only empirical research, but experimental-based research following the model of randomized controlled field trials of research-based medicine. He argues such a reliance fails to consider questions that can't be answered empirically, but which are nonetheless crucially important, such as discussing the purpose of engineering education. Others (e.g., Riley, 2017) see this same tendency in engineering education research. But Biesta asks, how can empirical research answer vital *moral and political* questions about the purpose of

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engineering education or who should be educated as engineers and why? Who should pay for it and why? Yet such questions lie at the heart of our democracy:

> "A democratic society is precisely one in which the purpose of education is not given but is a constant topic for discussion and deliberation . . . [T]he current political climate in many Western countries has made it increasingly difficult to have a democratic discussion about the purposes of education." (p. 18)

Biesta recommends that we consider the interrelations between policy, practice, and research to remind ourselves that *education is a moral and political practice.* We should be talking about this constantly, but in engineering education, where are the fora to do that? In most of our conversations about improving engineering education, even at ASEE, we fail to seriously discuss what the purpose of engineering education is, for whom (outside conversations about broadening participation), and who should decide. While these are questions for everyone to consider, they instead remain as blind spots of our profession.

Dorothy Smith (1990, 2005) introduced me to "ruling relations"—the ways in which people and texts coordinate social relations to enact the interests of a ruling group, sometimes over their own interests. But how does this actually happen? Investigating how ruling relations work allows us to analytically connect the "macro" dimensions of gender, race and class to the "micro" experiences of individuals via the "meso" level of institutions. Smith's work helps avoid blaming individuals for the fact of their marginalization and instead focuses on institutional structure as a place where gender and race are so perfectly baked in that it all looks completely neutral and fair.

Derrick Bell's work on critical race theory and interest convergence (1987, 1992) showed me how race relations change only when it is in White people's interests. Bell talks about the common mistaken belief, particularly of liberal White folks, that racism is a blot on the face of democracy that we just need to scrub off. Instead, he argues that racism is built into democracy; to remove it, we must reconceptualize what democracy looks like without it.

How does this work relate to the first of my two points: that demographic equity and diversity are fundamental to thinking about engineering, and related to other big issues like the climate crisis? Currently we collectively act as though that bias in engineering is the bad apple in the barrel that just needs to be thrown away and then all will be well. But critical scholars like Bell tell us that racial bias in American founding documents can't just be excised. Scholars in engineering education (e.g. Cech & Waidzunas, 2011; Slaton, 2010) show that gender, race, sexuality, and ability status, are baked into engineering through a persistent belief that engineering is meritocratic, and that numbers or

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engineered objects or thermodynamic laws are politically neutral, despite much evidence to the contrary (e.g. Winner, 1980; Zuberi & Bonilla-Silva, 2008).

Professional engineering in the US began in a profoundly raced, colonized and gendered context. One origin story tells of the (White, male) apprenticeships for Erie Canal builders beginning in 1817. The Canal was built in part through the Mohawk River Valley, on land appropriated from the Mohawk people despite their alliance with the US government. The canal also ran through Haudenosaunee territory. Its construction required a certain kind of clay to plaster the canal's sides to prevent water seeping out. The canal constructors found this clay because the Haudenosaunee told them where to look. This was true also for other natural resources in Western New York, an area populated by northern farmers who were explicit about creating a White republic (Hauptman, 1999). Settler colonialism was literally built into the origin story of U.S. engineering, yet appears little in mainstream accounts.

Never has the engineering profession existed at a time when engineers haven't also been engaging with social structures of gender and race, along with colonialism, sexuality, ability/disability and more. But despite its embeddedness in a society fundamentally organized by gender and race and colonialism and so on, our profession acts as though engineering has escaped this truth's consequences, and can exist in a neutral and unbiased state, simply because it focuses on math, science, and technology. Persisting in this unfounded belief exposes our naïveté as a profession. Instead, we need to grapple with what it could mean to be an engineer if engineering no longer relied on gendered and raced logics about our fundamental values regarding truth, science, large-scale change, and progress.

This first point raises a second issue: the fundamental place of gender and race in engineering is related to other big questions, like the climate crisis. I've heard climate activists argue that this crisis is so urgent that we don't have time to deal with issues of social inequality. I hear the merit in that argument: to cut global emissions by 50% in 11 years, we will need "all hands on deck." But arguing that action on social inequality is a distraction from the climate crisis is a form of wedge politics. Like others, I believe the two issues are related—that the logics that keep us hurtling towards climate catastrophe are related to the logics that maintain the hierarchical subordination of various groups (who, of course, will also disproportionately suffer climate catastrophe; Carrington, 2019)

Feminist scholars have argued for decades (e.g. Merchant, 1983; Mies & Shiva, 1993) that environmental devastation wrought by humanity stems in part from a belief that humans can triumph over nature, and that this belief is related to the same kind of logic that makes people believe in a racial hierarchy or a gender hierarchy. Gender and race (in context-specific patterns) are fundamental dimensions for organizing society, and the resulting hegemonic masculinity and White supremacy construct logics of domination. This domination is what lies behind our collective inertia in dealing with the climate crisis.

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Here we can connect the argument to my second main point. To escape this hierarchical thinking, we need a social theory to consider equity, and new logics to question humans' dominion over nature. We as engineers need to recognize how these logics embody a morality about the world, and that there exist ways of thinking about the world outside of logics of domination and hierarchy.

Martin Lukacs (2017) argues that individual exhortations to recycle, eat less meat, or more dramatically, limit your number of children, is like rearranging the chairs on the Titanic. He blames reliance on such inadequate solutions on neoliberalism, which has sold us a bill of goods by persuading us that we can address climate change through individual acts of conservation. He points out that 71% of global carbon emissions since 1988 are the responsibility of only 100 companies. Yet instead of holding those companies accountable, independent individuals are instead urged to stop having children. Lukacs argues that the Reagan-Thatcher political project of neoliberalism has pursued two main aims: first to "*dismantle* [...] barriers to the exercise of unaccountable private power", and second "to *erect* barriers to the exercise of [...] democratic public will." It has done this through "privatization, deregulation, tax cuts and free trade deals, [...which] have allowed corporations to accumulate enormous profits and treat the atmosphere like a sewage dump, [...while deterring planning] for our collective welfare." To respond to the climate crisis, he says, "we need to overcome all neoliberalism's free-market mantras: reassert public control of energy grids; require corporations to phase out fossil fuels; and raise taxes to pay for massive investment in climate-ready infrastructure and renewable energy." But neoliberalism "has not merely ensured this agenda is politically unrealistic," says Lukacs, "it has also tried to make it culturally unthinkable. Its celebration of competitive self-interest and hyper-individualism, its stigmatization of compassion and solidarity, has frayed our collective bonds."

How are we educating engineers to think about these problematic logics? While there have been NSF investments, from IEECI to the NAE Climate Change Educational Partnership (2014), and some places have transformed curricula, on the whole, little evidence exists that engineering educators are adequately responding to the climate crisis. Rather, by failing to provide students with a moral language to think about engineers' responsibility for climate change, we are making things worse. We have failed to frame for students that our preparing them for seemingly inevitable employment in private industry results from a choice of logics, and that this could be otherwise. This failure forms a devastating hidden curriculum (Jackson, 1968; Mejia, Revelo, Villanueva, & Mejia, 2018). How do we help students see that social constructions like market behavior continue to drive political decisions, as we careen towards climate catastrophe? How do we produce engineers to design a world with 50% fewer climate emissions in 11 years?

I suspect that, instead, most of us unwittingly indoctrinate students into neoliberalism as the only possible mode of economic development. Their job will be to work in an industrial machine; we

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don't articulate alternative modes of thought or help students develop cognitive lenses to conceive of a way of being outside this neoliberal worldview. Fish is fish (Lionni, 1970).

We also teach students that their role in the economic production system will be as management not labour, effectively hamstringing their education in collective organizing. As a result, because it probably won't cross most engineers' minds that organizing across employment levels, from line worker to management, to pressure company bosses to cut carbon emissions might actually work, they won't bother with it – a convenience to the corporate owners, for sure. Let's recall Smith's ruling relations theory, where people activate texts that work to structure social relations in the interests of a ruling group rather than in their own.

To return to my first main point about diversity and social inequality: Lakoff contrasts individual and systemic causality, arguing that people are ill prepared to think of systemic causality. The climate crisis is created by systemic causality, as is engineering's demographic homogeneity, but engineering ethics education overfocuses on individual causality. Just as it is comforting to conclude that the Challenger explosion resulted from a few bad apples, it is similarly comforting to think that engineering's homogeneity results from bias that can be excised like a tumor. Comforting, and inaccurate. As Lakoff shows, enlightenment reason is a form of techno-rationality. For people in power, using the metaphor of homogeneity as tumor doesn't actually threaten their position in power, so it is not in their interest to see it otherwise, as Bell might suggest.

Luckily, Lakoff offers a way out of this mess. He advocates giving up on enlightenment reason, and instead suggests thinking about morality and values. As my second main point maintains, there are profoundly moral consequences to engineering, but the stories engineers tell themselves about their professional role in society pay little attention to their *moral* role. Neoliberalism abdicates engineering's moral choices to the market, but as economists have articulated, the market is distorted in many ways. Similarly, moral consequences result from defining our profession in terms of power relations built into White supremacy, patriarchy, capitalism, and heteronormativity, and doing it in such a way that professionals don't have the intellectual skills and language to critique this definition.

However, following Lakoff's recommendation that we should think about morality and values presents engineers with a challenge, because we don't have adequate structures or training to do this. We are accustomed to thinking about ethics in engineering but mainly in terms of individual accountability, micro-ethics, and direct (not systemic) causality. Moreover, as Biesta points out, relying on evidence-based research diverts us from even considering questions that can't be answered empirically, but are nevertheless crucially important, like What is the purpose of engineering education, and Who should decide.

As we have seen, our normal neoliberal mindset makes it unthinkable even to ask the right kinds of questions with respect to the climate crisis. Thinking about diversity and equity in engineering

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presents us with the same kind of challenge. In the US we act collectively as though diversity and equity issues can be treated in isolation, a kind of bias tumor that we can cut out without affecting the body as a whole. We tell ourselves that through techno-rational arguments we can persuade people in power to make whatever limited changes are needed to excise discrimination and marginalization without touching the rest of the system. It is unthinkable that what constitutes engineering itself must change. Put this way, our ostrich approach to addressing diversity and equity is clearly inadequate, so we may simply feel helpless to do anything at all. But just as thinking seriously about the climate crisis requires us to radically confront our collective choices about our way of life, so thinking seriously about equity and diversity requires us to acknowledge the moral, value-laden base of engineering, and to do so out loud, for everyone to hear. It is through such audible conversations about morality that we may more successfully advocate for change in both equity and the climate crisis within our engineering system.

So, what do we do with all this? I don't believe this discussion leads to easy answers, but that more questions arise from it, and that this process helps us choose what is important.

First, let us be aware of this extraordinary moment in time, one that calls into question behaviours like sexual harassment (from daily indignities to assault); a moment when unprecedented numbers of youth strike from school to highlight the climate crisis; where thousands demonstrate in the streets for myriad causes. Let us ask, Can we also exploit this moment with critique and action to consider different approaches to broadening participation in engineering, and to climate change?

At the same time, let us note that increased visibility for dissent brings increased risk of targeted harassment. Scholars studying broadening participation in engineering education, particularly minoritized scholars, find their work drawing attention from people who have time and inclination to harass them about it with emails and phone calls (Pawley, Cech, Riley, & Farrell, 2019). These acts attempt to silence scholars, and threaten academic freedom—the right of scholarship to be judged by the standards of the field. These are attacks on all our work as academics doing research as a common good. My second question, then, is How shall we visibly commit to reasserting our academic freedom in the face of these threats?

Next I want to call attention to a common reaction by engineers when confronted with a problem. Often when I give talks about on my gender and race research, people ask how to make the biggest impact. And inside our techno-rational logic, that makes sense. Engineers seek answers to practical questions of "where do we start," and "how do we get the biggest bang for our buck." But this approach raises at least two problems. Answering the "impact" question implies firstly that you don't have to deal with the smaller stuff – after all, maybe the biggest intervention will work enough that we can ignore the rest — and secondly, that

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we should wait to do anything at all on both equity and climate change until we've found the biggest thing to start with.

Now, the normal engineering response to a problem might be to use our expertise to propose a solution. But in this case, we need to set aside this taken-for granted mindset. I don't have the answers for how to create an infrastructure for us to talk about values and morality. Indeed, seeking an answer from a central figure is itself problematic. Rather, I think we should go back to that Zapatista saying, "Asking questions, we walk."

Here too we need to lay bare our assumptions. Who is the "we" asking questions and walking? The glib answer would be "everyone" but the tougher answer focuses on majority people. Many of us engineering educators inhabit some kind of significant majority position, whether along dimensions of race, gender, class, sexuality, ability status, nationality, or immigrant status. White people, men, straight people, cis-gendered people, able-bodied people, with settler mindsets are systematically powerful people in engineering.

We need to recognize that just because we (certainly I; perhaps you), are in a systematically powerful position we may not feel we personally have power; as Lakoff points out, we are not trained to think about systemic causality. As individuals we can feel overwhelmed by the questions, let alone potential answers. Dan Zak (2019) acknowledges our overwhelmedness as well as the danger of the resulting paralysis; "But here's where you stop reading, because you have a mortgage payment to scrape together. You have a kid to pick up from school. You have a migraine. The U.S. government is in shambles. You're sitting at your desk, or on the subway, and deep in the southern Indian Ocean, blue whales are calling to each other at higher pitches, to be heard over the crack and whoosh of melting polar ice. What do you even do with that?"

Indeed.

But Zak gives us important advice too: "Hold the problem in your mind. Freak out, but don't put it down. Give it a quarter-turn. See it like a scientist, and as a poet. As a descendant. As an ancestor."

Let us think, then, as ancestors. Throughout history, there have always been (sometimes only a few) people in majority, privileged positions looking for equality. Ibram Kendi (2016) tells us how, during Puritan times, some White people realized slavery was wrong, knew that the massacre of Native peoples was wrong, who recognized that their relative ease rested on the backs of miserable others, and that it was wrong. Similarly, here and now, we engineering educators can choose which stance to take with respect to these two great moral questions that we are discussing here.

Ultimately, this thing called engineering — what it is, how it thinks about what it means for something to be true, or real — is socially constructed. By this, I mean the most "true" answer for what it means to be an engineer, or to participate in engineering, is not written in some book somewhere

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up in the sky, and that if you somehow figure it out before you die, you "win". "Socially constructed" means there is not one most right and perfect definition. Instead, it means that what engineering is is defined in our collective minds, our action and practice, our texts, and as Dorothy Smith puts it, our textually-mediated social relations (1990). It is in our relationships as engineers with each other, with non-engineers, and with the land (Latour, 2018). Engineering's socially constructed nature is massive and seemingly immutable, but in fact also affords us opportunity for change. After all, it's not gravity we're problematizing—just this thing with hundreds if not thousands of years of history.

So, these two ideas are now loose in the world. As Native author Thomas King (2003) might say, Do with them what you will. Tell them to friends. Wrestle with them in a peer-reviewed article. Trash them online. Forget them. But don't say in the years to come that you would have lived your life differently if only you had heard them. You're reading them now.

We confront an existential question: how we decide to be, to think, to act, having heard these ideas, says something about the mettle of our souls as engineers, because we're deciding how we're going to perform this thing called engineering. We're deciding, now, both individually, and together, and indeed have been all along.

For myself, I am focused on helping us develop our moral infrastructure around both equity and the climate crisis. I'm going to keep coming for my people (Grenell, 2018): those of us in majority social positions need to position ourselves in a visible, audible, and functional coalition with broader equity efforts and movements in order to disrupt the dominant logic that functions in engineering, engineering education, and broader life, to maintain minoritized groups in an oppressed position while simultaneously blaming them for their oppression. Because for me, at the end of the day, we are on this earth to be in community with one another, and what would it say about the mettle of our souls if we acted in ways that continued to stay silent on issues of inequality and injustice in engineering, when we have heard stories that mean we know better?

These are moral questions. We as engineers need to engage in moral discussions about them. And as we ask those questions, we must walk.

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