Experiences of Engineering Students Participating in an Abolitionist Labor Strike

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Work-In-Progress: Experiences of Engineering Students Participating in an Abolitionist Labor Strike

Abstract

Labor unions have historically played a central role in workers' struggles against injustice, enabling social mobility while creating infrastructure for realizing social change. Engineering graduate students are not frequently given opportunities to interact with labor unions in their fields of study, despite facing a number of issues that labor unions have played significant roles in addressing. These can include issues relating to race, gender, dis/ability, socioeconomic status, mental health, and other power dynamics within workplaces. At a large public university that is a predominantly white institution (PWI), engineering student workers recently participated in a graduate student worker labor strike. A central component of the strike demands were non-reformist reforms toward the reduction of police power. These demands centered policing and police violence as a health and safety issue on campus and in society as a whole.

The present work-in-progress study seeks to use critical and intersectional lenses in an effort to identify and understand engineering graduate student motivations for participation in the labor strike. Graduate engineering students who participated in the strike engaged in semi-structured interviews, using the labor strike as a focal point for conversation topics, including students' experiences with participation, prior and current understandings of unions, and beliefs about relationships between unions and engineering. Common themes emerging from interviews provide insight into the relationships of participants to broader cultural ideologies within engineering and conflicts or tensions that can result from the interaction of social justice transformations with traditionally held beliefs underlying engineering ideologies. This paper explores the potential of labor activism as a site of further transdisciplinary learning and personal development.

Introduction

This exploratory work-in-progress paper presents intermediate results from a qualitative research project unpacking aspects of the participation of engineering graduate students in an abolitionist labor strike. The goal of this research project is to understand what motivated engineering graduate students to participate in this strike, what their strike participation encompassed, and what broader relationships they see between their position as engineering students, union organizing, and engineering as a discipline.

Members of the Graduate Employees' Organization, American Federation of Teachers local 3550 (GEO) engaged in a strike from September 8th to September 16th, 2020, striking for a safe and just pandemic response at a large public university [1]. Strike demands centered on safety and justice relating to both COVID-19 and policing. These demands centered common good elements around a universal right to work remotely during a pandemic, improvements to parent and caregiver accommodations, the waiving of fees levied on the international student community, extensions to degree timelines and funding in response to COVID-19, access to a disarmed and demilitarized workplace, the defunding of the campus police department by 50%, and breaking university ties with local police departments and Immigrations and Customs

Enforcement (ICE) [2]. The policing-related demands were rooted in an abolitionist strategy of non-reformist reforms [3, 4]. This concept of non-reformist reforms was articulated by Andre Gorz [4] as a means by which Labor is able,

> to fight for alternative solutions and for structural reforms (that is to say, for intermediate objectives) ... not ... improvements in the capitalist system; it is rather to break it up, to restrict it, to create counter-powers which, instead of creating a new equilibrium, undermine its very foundations [4, p. 181].

This strike took place during the COVID-19 pandemic and after the Black-led protest and rebellion wave in Summer 2020 brought on by police killings of Black people [5].

Engineering exists as a discipline that has been characterized as depoliticized and meritocratic, ideologies which run counter to those that typically undergird participation in labor unions and the undertaking of liberatory structural alterations [6-8]. Riley has discussed how prevailing forms of rigor in engineering, engineering education, and engineering education research reproduce inequality and function primarily to discipline, demarcate boundaries, and demonstrate white male heterosexual privilege, as well as the need to seek alternatives for evaluating knowledge [9]. Slaton and Pawley further demonstrate ways that prevailing standards for engineering education research are assembled from politics that run counter to and stigmatize qualitative and small-n studies [10]. Using analyses from intersectional, Queer, and Disabilities Studies theories, Slaton and Pawley assert that qualitative and small-n studies make space for epistemological shifts that position researchers to better confront structural inequities.

Historically, participation of American engineers in labor unions has been low, reaching a high point of around 10% of American engineers during the 1940s-1950s [11]. Labor strikes that have included significant engineering participation have been a rare occurrence, with one of the most notable being the Boeing strike of 2000 [12]. Thus, the 2020 GEO strike provides a significant opportunity to deepen understandings of connections that exist between engineering and organized labor. This paper seeks to identify relationships between engineering and labor from the vantage point of graduate student engineers who participated in an abolitionist labor strike by considering the following question: *how do engineering strike participants position the role of union organizing and mobilization within their view of engineering?*

Theoretical frameworks

For this research, we utilized a concurrently developed engineering and labor theory of change [13]. Drawing on critical and liberatory frameworks, this engineering and labor theory of change leverages labor unions and labor organizing as a means by which engineers can engage in the notion advanced by Grace Lee Boggs, leveraging a dialectic of "two-sided transformation, both of ourselves and of our institutions" [14, p. 100]. This theory of change posits that through forms of labor organizing that center community organizing, and specifically whole worker organizing [15], engineers are able to shift their engineering labor to benefit the broader community. According to McAlevey,

"whole worker organizing … demonstrates that where unions understand their members and unorganized workers to be class actors in their communities, and when the workers systematically bring their own preexisting community networks into their workplace fights, workers still win, and their wins produce a transformational change in consciousness" [15, p. 24].

Related to McAlevey's whole worker organizing, the engineering and labor theory of change also makes use of la paperson's concept of scyborg. la paperson envisions a decolonizing university emerging from within the present colonizing and colonized one. The agent of this revolution, building on the legacies of Donna Haraway and Roderick Ferguson, is the scyborg,

reorganizer of institutional machinery; it subverts machinery against the master code of its makers; it rewires machinery to its own intentions. It's that elliptical gear that makes the machine work (for freedom sometimes) by helping the machine (of unfreedom) break down. The lopsided bot, the scyborg, the queer gear with a g-limp—if there is anything to fear and to hope for in the university, it could be you, and it could be me [16, p. 55].

The leveraging of whole worker organizing as a means for engineers to engage their preexisting community networks and scyborg as a means of reorganizing the function of those networks toward social change through the proposed engineering and labor theory of change [13] allows for the learning to be experiential through community organizing, including through engaging in a labor strike. Concurrently, several of the authors have developed a liberatory engineering education model as a template for engaging theories of change within engineering education research [13]. Figure 1 leverages this model to show how the engineering and labor theory of change fits into this study of engineering graduate students engaging in a strike. The model connects Mejia et al.'s critical consciousness model [17], which engages Freire's principles of critical pedagogy [18], with Hassan's model of learning-assessment interactions [19]. "Mejia et al.'s model is represented in the center of this model, showing relationships between theory, action, reflection, and concepts of scholarship, praxis, concientização, and liberation that result from their overlap. Hassan's model of learning-assessment interactions is overlaid, with the overlap taking the form of reflection as an assessment method and action as a learning method" [13, p. 11]. Circle overlaps and connections via solid black lines and dotted thin blue lines represent dialectic relationships between concepts. The dotted thin blue lines are also representative of constructed barriers across domains of power, where barrier (and thus opening) size is a function of overall approach, constraining or creating opportunities to navigate toward liberation. As such, the action of engineering graduate students engaging in the strike as a learning method becomes a focal point for this research, where this research study provides participants with a reflective space for their own critical consciousness raising around the interconnections between engineering and labor. Simultaneously, their reflections allow the research team to produce scholarship linking their experiences to broader cultural phenomena around engineering and labor, further shaping a theory of change.

Positionality

The first and third authors, Valle and Bowen, are labor organizers with the American Federation
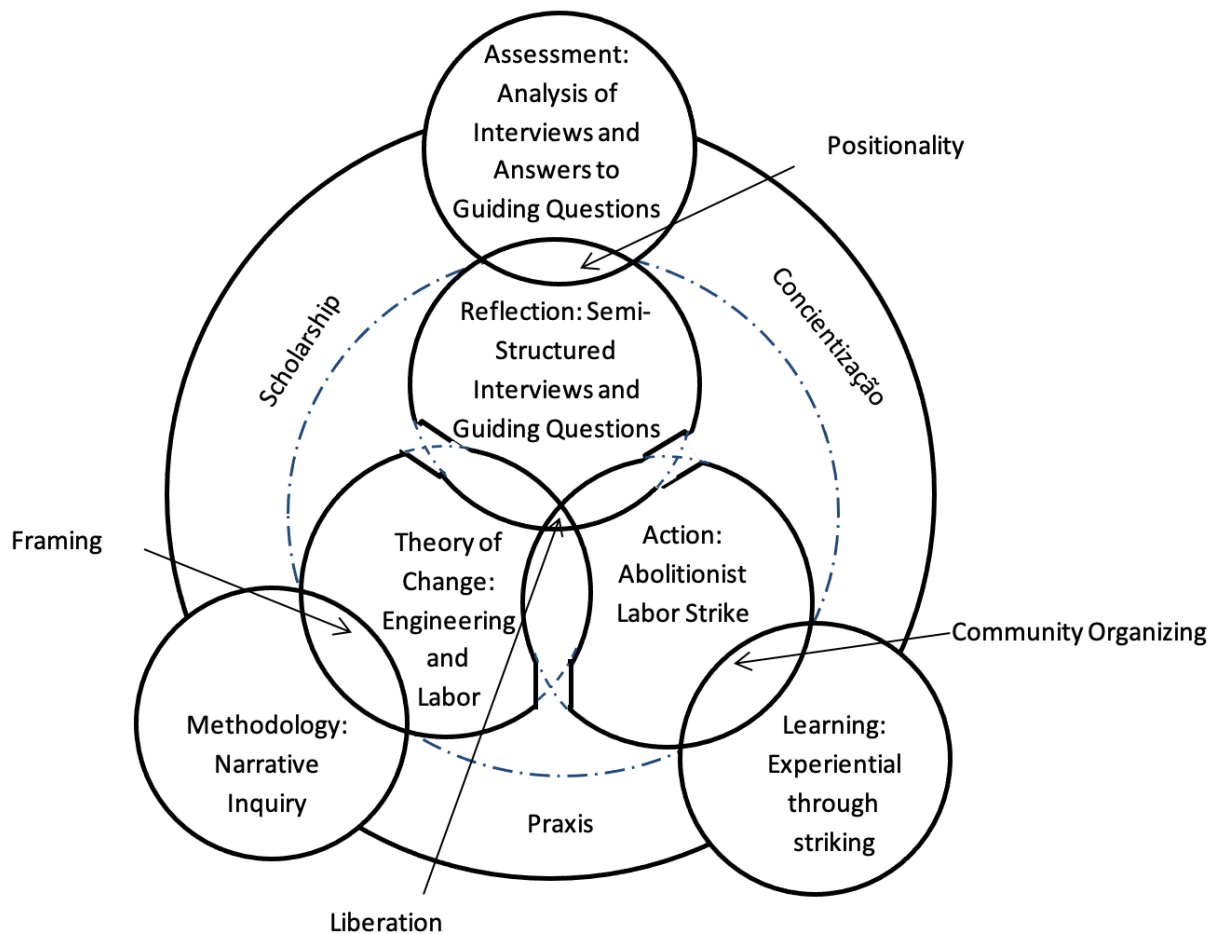
Figure 1: Mapping of the components of this study to the liberatory engineering education model proposed in [13].

of Teachers (AFT) local GEO-3550, marginalized engineers, graduate student workers, children of union members, and participants within this study. As engineering graduate students whose primary fields of study are not engineering education, this work represents a departure from the technical scholarship of our fields. As early career scholars, we recognize forms of political risk inherent to incorporating labor into the scholarly field of engineering education. Pawley, Cech, Riley, and Farrell have discussed their experiences of targeted harassment resulting from visibilizing facets of engineering education that counter hegemonic understandings of STEM education in response to their scholarship [20]. Owing to this state of academia and the field of engineering education, we sought to heed the advice Liboiron [21] gave for interventionist research in science and technology studies and establish intentional networks of care and solidarity prior to engaging in this research. Due to the relative newness of our engineering education program, the availability of the researchers at our own institution, and the inherently conflictual nature of this scholarship with the institution we are situated in, we sought external collaborations for this work that could simultaneously assist in scholarly research and in building networks of solidarity and care.

We reached out to the fourth author, Riley, as she is a major figure advancing social justice and one of the few professors discussing unions in the engineering education research space. She works at a different institution and is thus removed from any involvement in the strike and free from any judgment that might follow from such involvement. Her institution does not presently have a union, so her collaboration here does not threaten current political conditions on her campus. She is a tenured professor, and thus is afforded the privileges of academic freedom and job security, among others, enabling her to provide strategic guidance in navigating this kind of work in academic engineering settings. At the same time, she serves as a department head, which entails some political precarity, even as it carries certain power and visibility. While acutely aware that this collaboration may represent some kind of transgression of expectations related to her role (to not question or challenge institutional systems of power), she frankly sees her role quite differently.

Many of the participants in this study are friends and colleagues of the first and third authors, further emphasizing a need to distance ourselves from the data collection process and strive to preserve the authenticity of their voices. After establishing a collaboration with the fourth author and thinking through potential ramifications for this work, we reached out to the second author, Ali, who is an undergraduate student in the engineering college. She is not in the union nor taught a course at the university. These factors allowed her to reduce biasing within the data collection process. This author was present on campus as the pandemic and policing crisis unfolded and therefore experienced the events mentioned in this paper firsthand. Additionally, this project was unique to typical aerospace engineering work but she chose to get involved because of its impact.

Methodology

Our study is utilizing a narrative analysis methodology based on the work of Pawley and Phillips [22]. As outlined by Pawley and Phillips, Mauthner and Doucet [23] proposed a voice-centered approach of conducting four specific readings of each transcript:

> • Reading 1: The researcher reads the data for the overall plot and story with attention paid to respondent's identification of critical developments, important characters, and side stories. (p. 126)
> • Reading 2: The researcher focuses their attention on the way the speaker feels and speaks about herself. The researcher studies how and when the speaker used the active voice, in what situations, with whom, and furthermore, when the active voice shifted to a passive one. The goal is to see "how she speaks of herself before we speak of her." (p. 128)
> • Reading 3: The investigator studies the "interpersonal relationships" in the speaker's life by identifying how the respondent spoke about the relationships within their homes and workplaces to both people and institutions. (p. 131)
> • Reading 4: The researcher codes for the macro-structures in the life of the respondent, i.e. the disembodied social, political, and cultural forces that reify themselves in the life of the speaker through the critical developments and nature of relationships in the speaker's story.

When all the readings are taken together, Mauthner & Doucet's voice-centered approach allows for sociological analysis without neglecting either the co-construction of the interview made through the prompts of the interview questions, or the voice of the respondent [22, p. 7].

Clair et al. also outlined the concept of The Collective Story, which allows for the telling of a story of a "social category rather than … a particular individual's story" [24, p. 250], while providing anonymity at the expense of authenticity in connecting the researchers, who serve as storytellers, with the participants. The individual participants are decentered as the main constructors of the narrative that is told. The Collective Story was chosen as our approach as a structural means to reduce potential forms of retaliation participants could experience in their career trajectories.

Methods

Recruitment

This study focused on graduate engineering students who participated in the 2020 GEO strike. Our study was approved by the Institutional Review Board at the University of Michigan (IRB). Participants were recruited using a sampling method that was informed by author involvement and purposeful in order to get a range of perspectives from varying levels of involvement in the strike and in the union. 15 participants were interviewed as a part of this study. Participants were asked to fill out a demographics form to provide self-described information about their Ph.D. program, race and ethnicity, gender, sexual orientation, and estimated family income prior to enrollment in an undergraduate program. They were also asked to provide a pseudonym for use in the study.

Interviews

Semi-structured interviews were conducted over the virtual meeting platform Zoom. Interviews were conducted by the second author, an undergraduate student, so as to reduce the impact of pre-existing relationships among participants and researchers within the interview setting. Audio and video were recorded during each interview, along with live auto-transcriptions using a feature in Zoom. Interview times ranged from 16 to 50 minutes in length. Interview questions revolved around:

- motivation for participation in the strike,
- descriptions of what participant involvement in the strike looked like,
- what they and their engineering peers thought about the abolitionist policing demands,
- any connections they understood to exist between engineering and labor, and
- whether and why they believed their peers also understood the connections they understood to exist between engineering and labor.

Data cleaning and de-identification process

A data cleaning method similar to that outlined by Pawley [25] was used. Transcripts generated using Zoom live auto-transcriptions were reviewed along with audio recordings to check for accuracy of the transcript. We then created a pseudonymized transcript, which included generalized demographics information of the participant and suggested alterations to anonymize information we believed to be identifiable. Member-checking was employed; copies of the audio recording and the original transcript along with an editable version of the pseudonymized transcript were sent to the participants. Participants were then asked to review their pseudonymized transcript for inaccuracies, anything they regretted saying, or information they believed to be identifying. Suggested edits by the researchers were also member-checked by the participants. Any changes suggested by the participants were accepted by the researchers. The research team then made a copy of the member-checked pseudonymized transcript to erase edit history on the document and deleted archived email correspondence with participants, records of audio recordings, video recordings, demographics form responses, and prior versions of the transcript, leaving the research team with only the de-identified, member-checked version of the transcript.

Analysis

The research team used Mauthner and Doucet's "voice-centered" approach [23] to analyze the de-identified transcripts. Performing the four specific readings allowed for identification of major themes as macro-structures through the fourth reading, including those aligned with the engineering and labor theory of change for each interview [13]. Clair et al.'s Collective Story method [24] was then used to combine themes that emerged across different interviews. Analysis was performed on the de-identified transcripts generated from interviews with 7 of the participants for this work-in-progress paper.

As part of our analysis, we used the guiding questions for researchers posed by Mejia et al. [17] as an assessment method (reflection) to consider processes we were using and how we were contextualizing this study. This assessment is provided in the Appendix Table A1.

Results to Date

Our summary of results identified 4 major themes, each with several sub-themes. The four major themes that emerged across multiple interviews in the analysis process were *perceptions of depoliticization, meritocracy, and majorism, labor as a vehicle for change, engineers being community organizers, and strikes as opportunities for liberatory pedagogy within engineering.*

Perceptions of depoliticization, meritocracy, and majorism were believed to reduce strike participation from engineers (theme 1)

Cech [6] described ways in which prominent ideologies within engineering culture negatively impact the ability of engineers to think about social injustices. These ideologies include depoliticization, the belief that social and political issues are tangential to engineering labor, and meritocracy, the belief that the social system functions properly and rewards the talented and hard-working. Additionally, Carrigan and Bardini discussed majorism,

an emic term undergraduates used [in the authors' study] to describe a value system that maintains and reproduces preferential treatment of science and technological fields and their practitioners. Majorism is a cultural outcome of the neoliberal system that prioritizes economic output broadly within society and, in particular, in higher education. This political economic phenomenon grafts onto other forms of discrimination—homophobia, racism, sexism—aiming to quash potentially transformative social movements and reproduce the institutional power of dominant groups, especially those aligned with globalization and corporate activism (Duggan, 2003 [26]) [27, p. 3].

Participants noted disconnections between engineers and labor education (subtheme 1a). They discussed that labor education was not a part of their engineering education, making it difficult for themselves and their peers to make contact with the union, understand the strike and labor organizing more broadly, and process their positionality in relation to the strike. Some participants mentioned how their engineering departments operated as if a strike was not even occurring.

Engineering as a professional sector in the U.S. has historically had comparatively low rates of unionization [7]. Aster described prevalent engineering culture as exhibiting a dichotomous, depoliticized understanding of engineering work and life:

"… we're … kind of drilled into us that like, just culturally engineers kind of keep their heads down and so it's easier just to like, 'okay, I'm going to do my work. And then I'm going to go home and have my weekend.' So I think that it's also, like the softer sciences are, are often looked down upon, it's like, 'Oh, you're a liberal arts major. Like what are you going to do with that.'"

Aster also describes a key component of majorism, the stereotyping liberal arts degrees as inferior [27].

Maria described frustration with her wealthier peers' detachment from issues the union was striking over:

"… I'm sorry but like engineering students are benefiting [from the union] … if we didn't get [the union-won benefits], … (sigh) It's frustrating. Like, I remember talking to one person and he's like, 'I don't see why we need an emergency check, it would just sit in my bank account' and like you are so fucking detached from the reality of most students that I just can't speak to you right now. Like you're just so detached."

The individualistic understanding exhibited by Maria's peer, who questioned why graduate students might need emergency funding during a global pandemic, is indicative of a form of depoliticization around class. This form of depoliticization can indicate an uncritical reflection of positionality in relation to the class status of other graduate students.

Mobilizing strategies were not particularly effective (subtheme 1b). Participants described the general ineffectiveness of strategies geared toward turnout and mobilization instead of political education and relationship development. McAlevey discussed the mobilizing model of unionism as a form of pragmatic, business unionism in which the purpose of the union is solely to improve material conditions [15]. This model seeks to bring high numbers of people to the fight, often without their communities along with them, in a way that does not center power in worker agency.

For example, Jon David discussed structural barriers that functioned to obscure connections between the realities of engineering graduate students and the strike demands:

> "… engineering grad students … are really very isolated from the rest of campus. Um, and especially a lot of that has to do with the physical separation, but a lot of that also has to do with like … these GSI [graduate student instructor] demands don't necessarily apply that often. So we all have GSRAs [graduate student research assistant positions], and some of the demands … I don't think they got why they were being advocated for."

In doing so, he identified a need for a greater connection between engineering graduate students and the social justice demands being advanced by the union to counter the depoliticization that can cause this disconnection. This connecting work is made difficult by the use of mobilizing strategies, which do not always center political education.

Maria likewise expressed that, without relationship building over time, the amount of political education required to overcome depoliticization in the engineering context can be overwhelming. She described the need to have conversations to develop understanding, but also the difficulty of doing so when someone's first interaction with the union is during a strike:

> "… I think one of the hardest things about the strike is the information and setting it up, of the context and there's just so much to unload at first that it's just … It's just too intimidating. It's too much up front. It just, it comes off as like the university's an asshole and we have to like be justice and like … That tone in any conversation when you're just initially talking with people, it's just, it doesn't go well."

The lack of diversity in engineering impacts how issues are understood and addressed (subtheme 1c). Participants discussed the disproportionately low representation of marginalized students within the engineering college as a reason why many engineers could not contextualize the conditions and motivations behind the strike through their own lived experiences or the experiences of engineers with whom they were in contact [27, 28]. Aster, for example, described impacts of the predominance of whiteness in the engineering college on students' ability to understand the strike demands:

> "I think … the engineering [college] is, probably whiter than some of the other [college]s on campus. … I think we have an abysmal amount of Black students in the engineering [college] … Just because the students aren't there to serve either

as examples of people who are experiencing these prejudiced environments or being able to see people actively being prejudiced against these students because they just aren't in the [college]. … The entire absence of [the Black] community [in the engineering college] makes it hard to see the necessity of such like, the things we were fighting for this strike."

Aster thus recognized engineering to be a prejudiced environment. Her connection of identity and the under-representation of Black communities in the engineering college to the lack of ability to understand the necessity of the strike demands indicates that a lack of representation can drive depoliticization. Richard echoed this connection by describing how a lack of lived experience with police violence can limit support for racial justice to conceptual support rather than material:

"… I feel like there's a lot just around, um, disconnects between people's lived experiences that haven't necessarily had to coincide with police violence and tactics to support people whose experiences have … had to coincide with police violence. … So like I think … there's like the abstract support of like racial justice and stuff like that. But then in terms of like actually turning that into concrete steps, um, I think that's where a lot of, I want to say, especially engineers um, can get tripped up."

Participants also recognized the impacts of power dynamics between students and professors, the latter of whom are frequently more conservative (subtheme 1d). Participants discussed difficulties they and their peers faced in navigating their relationships with faculty members, who have more institutional power than the graduate student participants. Aster, for example, discussed power dynamics at play in engineering Ph.D. advising relationships:

"… in an engineering Ph.D., we are very closely tied to our one mentor and they have a lot of power over us. They completely determine, um, like what we work on, how much work we do, and they are the kind of key to us getting paid. Like our, our pay is routed through the work that we directly do on the grants that they, um, win. … And so we are very dependent on having this relationship with our PI. … I think that being so tied to someone who you would be withholding your work [from] and be very directly like potentially alienating through the process of striking, can have a lot higher consequences just by the nature of our kind of contract with the school and how our education is arranged."

The power dynamics Aster describes can serve as a depoliticizing barrier by leaving students hesitant or unwilling to challenge the power their advisors have over them. A number of participants discussed this as a way to contextualize low strike participation from international engineering students. In turn, this form of entrenched power can be tied to a lack of support for minoritized students in the college as described by AK:

"... [this university] is not doing a good job supporting underrepresented students in general, that may just be the [engineering college], again I can't speak to [other colleges] and how that works. How, I mean there's like the certain, the certain

entrenched power structures and like the tenure system, how you have a bunch of old white professors that … [are] causing major issues."

They also discussed how conservatism among the engineering professors detracted from the power of the strike. This is not unexpected, because engineering has been shown to have one of the highest percentages of conservatives among all academic disciplines [12]. Matilda described faculty conservatism in a refusal to acknowledge the political nature of their work:

> "I think that department leadership and many engineers think that they can somehow avoid making it political. That it's not political until they make it political and that's where I think they're wrong. It's already political whether or not they want to accept and address the fact that it's political, but they think that it's somehow won't be political if they don't talk about it or participate in it. Like that somehow their acknowledgement of it being political is what makes it political, which is not true. Yeah. So from the perspective of like department leadership, um, they clearly see graduate students making it political, even though it was already political - they see it as the graduates made it political and that - that's a problem because education isn't supposed to be political by the popular rhetoric."

Participants also lamented that their formal engineering education was frequently shaped by corporate or industry influence (subtheme 1e). Carrigan and Bardini described how, "corporations and university agendas align as funding is largely concentrated within STEM, profit-making fields as a way to generate greater output and larger future profit for both parties" [27, p. 13]. Multiple participants discussed facets of this influence. Richard described how corporations shape engineering education to fit their needs, including at the expense of engineers applying their labor toward community benefit:

> "… who has been crafting the narrative of what engineering is? At least for a while, largely it has been … massive corporations. Right? And there's been a lot of reasons why it is that they would want to kind of tailor the way that engineers think or are educated in order to make us more productive workers for them in whatever type of labor that they would like us to do, … really kind of instead of what type of labor we want to do, (chuckles) um, or what type of labor would actually be helpful to our community."

Similarly, Matilda described the role of the military industrial complex in engineer depoliticization, including the individualistic framing that allows for others to profit off of engineering labor:

> "I think it is in the interest of people who get wealthy from the military industrial complex to make sure that engineers don't question their role in that system and think about their work as being apolitical. … it's easy [for] us [as engineers] to say, 'oh, well, I make more money than other workers around me as an engineer and I should be grateful of that, and I'm advancing the fields of science and

technology, and maybe I'm even protecting myself and my family, and my country, maybe, maybe I buy that rhetoric.' But it's easier to just think that it's apolitical, it's way easier to not even have to think about the bigger picture. But when you do that - when you, when you don't think about the bigger picture and you just start applying that labor, what happens? You get a paycheck and your paycheck might be a little bit better than other workers so you feel pretty good about yourself, but somebody else at the top just got super rich off of your labor. And when you do that labor again tomorrow, they get even richer and even richer. So it's in their interest to make sure you think your work is de-political."

Maria similarly described a separation of engineers from the moral and ethical consequences of their work and how that separation benefits corporate interests:

"… [to] face [engineers] with the thought that, you know, what they're doing actually has consequences when you consider them, they're gonna say 'that's not my job. I'm just the engineer, that's management, that's business, that's something else.' Because really, they're there to do this very specific thing. And the fact is, um, if you were to try to get them involved in all these other things, it's going to take away time from the main reason they're there. Which can harm their compensation, that can harm their involvement, it can harm their hiring later on. And so I really don't think that engineers are going to want to do something that isn't in their job description. And that benefits the company."

Thus, the participants were able to pinpoint ways that corporate interests maintained perceptions of depoliticization, meritocracy, and majorism that they identified in the engineering education environment.

Labor as a vehicle for change in engineering (theme 2)

Participants in the strike explicitly communicated organized Labor to be a mechanism through which changes in the field of engineering could occur. Valle, Bowen, and Riley [13] articulated an engineering and labor theory of change in which labor can be a vehicle for liberatory change in engineering and engineering education, particularly when labor unions engage a diversity, equity, and inclusion-centered organizing model.

Participants described the union as an entity they could use as an outlet for their politics and as a means to politicize their engineering education (subtheme 2a). The prevalence of the ideology of depoliticization in engineering serves to promote the notion that social and political concerns lie outside of the realm of engineering. Jon David described joining the union as a site for political work, describing himself as having a "strange perspective" for being an engineer seeking to engage in political work:

"I think I have a little bit of a strange perspective because I came into [this university] immediately wanting to do like political work and I joined the union pretty quickly. Um, basically, as soon as I realized that you didn't have to be a GSI [graduate student instructor] to [join]."

Importantly, the strike participants saw the union as a means to make improvements to their material conditions (subtheme 2b). They described the union as an institution that has improved working and material conditions for graduate student workers, particularly relating to wages, healthcare benefits, and anti-discrimination policies. Matilda, for example, described the value of the union to working class students: "Without the union, the thing that makes working class students like me even able to pursue graduate studies … would be gone."

Richard described the impacts the union has on students' standard of living and an example of a union campaign for improved transgender health care led by transgender members:

> "… your standard of living has kind of been set by how much it is that the union has been able to push the university … One of the big wins that has … come out of the past three years has been … our trans healthcare coverage ... back in like 2017 … the university, pretty much said like 'go away, like this isn't something that should be in the contract,' … Now like I think our university has one of the best like trans health coverage plans in the nation (chuckles) … and that effort was led by trans folks. Right? So it was like people who are seeing this very like real, intimate problem that personally relates to them … are given a vehicle by which they can help solve that problem, not only for themselves, but also for other like other generations that are coming behind them."

In doing so, Richard frames improvements to material conditions as a result of power struggles between the union and the university, depicting the union as a means to engage in problem solving.

Participants discussed how the union was an institution capable of altering organizational conditions at the university and also how the union itself was a site for organizational characteristics to be altered (subtheme 2c). The organizing framework for advancing understanding about supporting underrepresented students in engineering developed by Lee et al. [29] demonstrated organizational characteristics as one of the key components of the context of students and their institutions. They described how organizational characteristics presented challenges for marginalized students and ways that organizational characteristics influenced how student support practitioners and the students they support operate within the institution.

Fundamentally, Aster described a form of power the union allows graduate student workers to access in relationship to university administrators: "I think that having the union is really powerful in that university setting because it forces [university administrators] to listen to us when not having that access would make it really easy for them to ignore us."

Additionally, Jon David described how the strike was representative of the union itself shifting toward being more political in its orientation toward social justice:

> "Yeah, I'm, um at least doing this sort of thing [in striking] is it's more of … it's more GEO is moving more towards what I sort of expected and hoped it would be when I, when I initially joined. Which is a broad organization that for sort of

> social justice, as well as bargaining for people that is like sort of used as a political instrument, um, more than just like very strictly a Labor Organization."

In light of Lee et al.'s framework, the strike's enactment of methods for instituting organizational change is a concrete example of the type of action that holds potential for greater underrepresented and marginalized student support within academia [29].

Engineers can be community organizers (theme 3)

Valle, Bowen, and Riley [13] discussed the potential for engineers to be community organizers, leveraging concepts from whole worker organizing as a way to nurture a social community. Mondisa and McComb defined a social community as "an environment where like-minded individuals engage in dynamic, multi-directional interactions that facilitate social support" [30, p. 152].

The concept of whole worker organizing was repeatedly alluded to by participants (subtheme 3a). McAlevey discussed whole worker organizing as a recognition and leveraging of embedded social relationships that a person has in their workplace and community toward transformational change [15]. Billie described how his involvement in the union began through his relationship with Richard, his friend, the sense of community he feels with other graduate workers through the union, and how striking provided a means to counter injustices:

> "It started primarily with my involvement through my [friend, Richard]. So he was the one that first initially got me involved, but what motivates me to continue [in GEO] is, um, I guess my sense of community with my fellow graduate students … graduate workers. I think it's important that, you know, we're here at the [this university] and we identify ourselves as individuals who are, um, workers and, um, [pertaining] to working here in this environment, we have a responsibility to speak out, um, and at least, you know, let ourselves be heard when it comes to injustices, where there … where there is a discrepancy with how things should be done from our perspective. And so the strike was a, I guess, a structural tool to navigate that and to voice our opinion."

Similarly, Maria described the personal interactions that drove engineers to strike and continue to stay involved:

> "So, like, if anyone in engineering was a part of the strike, I feel like it's because of the people they interacted with, that kept them there. Um not to say that people weren't generally interested on their own, but I think it would have been harder for them to give that much more time or energy or effort if there wasn't someone who they could believe in to stay and back them up."

These relationships between engineers at the human level thus constitute a vital component of the organizing process that impacts their ability to enact change.

Leveraging agency of la paperson's scyborg [16], participants discussed actions that they

engaged in and key conversations they had with others that resulted in increased participation in the strike (subtheme 3b). Billie described how communication with his research group and with other engineers developed solidarity that increased strike participation: "members of [my] research group and I all collectively decided to withhold our labor." He explained that they collectively discussed the issue and then brought it to their advisor, who was supportive. They felt a need to communicate with their advisor privately, directly, and honestly to maintain a positive future working relationship. Billie went on to explain:

> "I think the graduate students that I know who participated, it came from a sense of community. So if they saw their fellow peers, engineering peers, going on strike and going out there and voicing their opinion, they are more likely to join in. So, the sense of, you know, everyone's all in it together, solidarity, concepts like that, it's been one motivating factor."

Billie leveraged the institutional machinery of his research group, subverting its intended use to instead create a way to collectively withhold labor, acting in solidarity as a means to motivate others.

Participants discussed ways in which unions could be a means to fight for benefit to the wider community as a whole, instead of just the bargaining unit of the union, through the framework of Bargaining for the Common Good (BCG) (subtheme 3c). Bargaining for the Common Good seeks to organize with community partners to achieve this, particularly by centering racial justice in union demands, seeking to address root causes of injustice, and combatting "the role that employers play in creating and exacerbating structural racism in our communities" [31]. Bargaining for the Common Good is a framework of union bargaining that centers race in analysis and strategy while expanding traditional notions of participants, processes, and purposes of bargaining [32].

In an attempt to embrace of this framework, Matilda described how her participation in protests against police brutality drove her to propose including the policing-related demands on the strike platform:

> "I was very upset that, at the … general membership meeting, that the discussion over why we were going on strike was all COVID concerns when I had been marching with people in Ann Arbor and Ypsilanti … [who were] planning demonstrations against police violence … I had traveled to Detroit to participate in the … Detroit Will Breathe demonstrations. Those were extremely moving experiences for me and *given* - given the fact that national discourse was *so* centered, at the time of George Floyd's murder, around policing and discrimination-related state institutions, it seemed like an *absolute waste* of an enormous opportunity to improve conditions for the most marginalized people that we are now seeing were even worse than we thought they were. … So I called in that general membership meeting for the addition of policing-related demands in support of people of color at the university to be added … to the strike platform. That got enormous support immediately from the general in the rank and file membership, even while [some members] continue[d] to hedge. It - when,

uh, the vote ended up taking place, it overwhelmingly passed. Because there was [so much] support for policing demands from the people of our union."

Matilda indicated that the strike presented an opportunity to leverage the power of the union towards racial justice as a communal benefit. Also looking at the strike through a lens of power, Richard discussed power dynamics at play between the union and the university while also framing the importance of the demands for the benefit of the entire community:

"… I think the driving factor for me [to participate in the strike was] … trying to have the university … administrators in particular, cede some of their power. But yeah, I think like the actual common good elements of the demands were particularly important, especially for like … with the policing, like, certainly, but I guess also like in the way that the COVID demands were articulated around like … this is really kind of for the safety of the entire community."

Building a sense of community, helping engineers move into shared struggle, and engaging in work for community benefit are all components of community organizing participants exhibited.

Strikes as opportunities for liberatory pedagogy (theme 4)

Valle, Bowen, and Riley [13] argued that strikes can be understood as opportunities for liberatory pedagogy in engineering education. Strikes can provide an opportunity for students to engage in transformational resistance, which Solórzano and Delgado Bernal describe as "student behavior that illustrates both a critique of oppression and a desire for social justice" [33, p. 319]. In doing so, strikes also allow engineers to engage in divergent thinking, also called idea generation [34]. Divergent thinking has been shown to not be well represented in engineering education, where convergent thinking, or digging deeper into ideas, is generally more heavily emphasized.

Participants discussed the strike as an outlet for political action (subtheme 4a). They indicated a broadly felt anger around inadequacies in the university's COVID re-opening plan and a need for local action in the wake of Black-led uprisings and rebellions for racial justice following a series of killings of Black people by police. Jon David described these political motivations for engineers to participate in the strike: "… lots of engineers … have grievances with their departments, … have issues with how the school's [operating], and as well as just have political commitments that they were um, sort of interested in seeing with[in] … the strike."

Like Jon David, Billie described the strike as a politicizing action, framing it as a moral responsibility around recognizing that what the university administrators were doing was wrong and choosing to act against it:

"I think [a motivating factor for engineers to participate in the strike] is kind of like a sense of moral responsibility, so I felt like a lot of folks knew that this was the right thing … to do. Like they knew that the university is wrong, and they knew that they weren't doing enough, and it was their responsibility to speak up about it. And that to be silent was … to be silent was to be, like doing the wrong thing."

Finally, participants reflected on forms of learning that they experienced by participating in the strike (subtheme 4b), highlighting forms of pedagogy, education, and experiences that were not otherwise prevalent in their engineering education.

Billie described how his participation helped him recognize systems that reinforce hegemonic power structures:

> "I think that this is my first time in part of an organized action against the university and I think I recognize just how much power the university does have, um, over its employees and no matter what [the university may] say to the press or, you know, [through] emails to folks … Their actions really speak louder than their words and it really does show that … if you do have the power to enforce like or just activate legal measures it … like really puts a, like handcuffs the folks who are trying to, um, speak out. So there are, I do think it's … the laws really do make it difficult for people in general to, um, let themselves be heard in an organized fashion, I'd say."

In countering these existing structures of power, Matilda discussed the sense of fulfillment another engineer expressed regarding their strike participation, contrasted with the lack of fulfillment from their technical engineering work:

> "We can actually change the world. And people talked about that in … these conversations that we had …'I've been a graduate student for five years and this is the first time I've ever felt like I've actually done something fulfilling with my time,' people would make comments like that. And those comments are both inspiring and also a little bit sad, that like the de-politicization of engineers is making them feel like that … they're making them feel like that or making them do work that isn't fulfilling."

Participants showed that the action of striking helped them to align with their morals,better understand power structures, and gain a sense of fulfilment.

Discussion and future directions

Emergent themes from this narrative analysis tentatively support components of the engineering and labor theory of change, including that engineers can use their positionality for community organizing and improvements to the common good and that strikes can be a form of liberatory pedagogy in engineering spaces. These data support the existing understanding of the effectiveness of community organizing [18, 35, 36]. This work also makes a contribution to the literature on depoliticization, meritocracy, and majorism, illustrating how these phenomena impact efforts to equitably change the material conditions in and around the neoliberal universities.
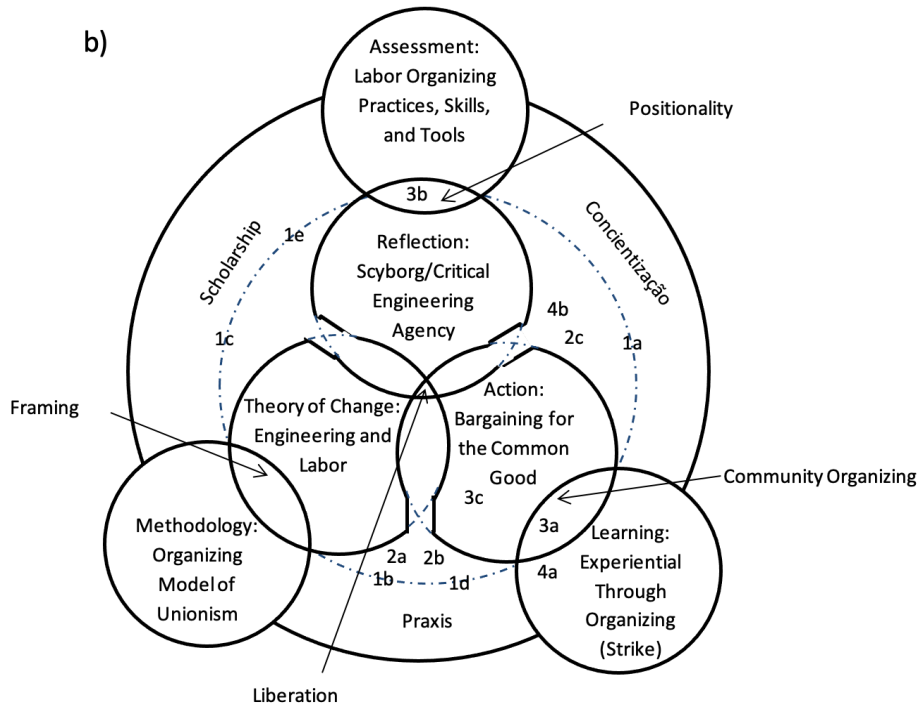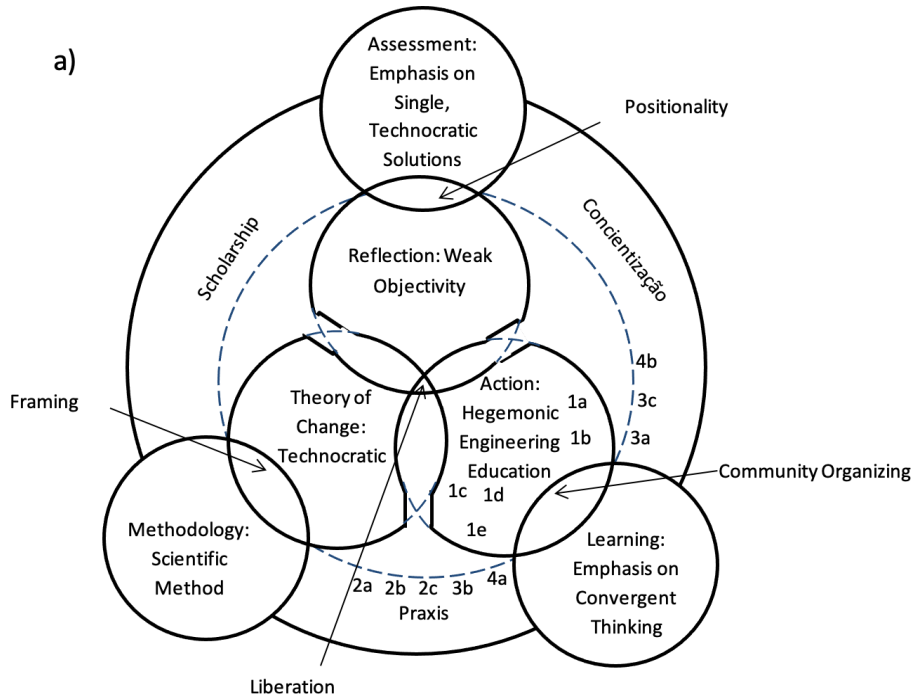
Figure 2: Mapping of subthemes onto the liberatory engineering education model proposed in [13] using a) the technocratic theory of change, where themes sitting outside of the dotted thin blue line are blocked by constructed barriers, and b) the engineering and labor theory of change, where themes sitting along the dotted thin blue line constitute constructed barriers.

In Figure 2, we map the emergent subthemes onto versions of the liberatory engineering education model using the current, technocratic theory of change (Figure 2a), and the engineering and labor theory of change (Figure 2b), both of which are discussed in greater depth in [13]. In doing so, we can see that the subthemes relating to theme 1 around dominant ideologies operating within engineering education fit within the action (learning method) of the current, hegemonic form of engineering education, while they serve as a barrier to engaging in scholarship, praxis, and/or concientização toward liberation in an engineering and labor theory of change. The nature of themes 2-4 pushing up against the constructed barriers in the version of engineering education utilizing a technocratic theory of change is indicative of risk in participating in the strike. Alternatively, a version of engineering education utilizing an engineering and labor theory of change allows for some reduction of the constructed barrier size and salience, reconfiguring engineering education to allow subthemes from themes 2-4 to become more normalized within engineering.

Future directions for this work include:

- Further analysis of the remainder of the 15 interviews to construct a collective story, building on the themes emerging from this work-in-progress paper.
- Meet with participants to discuss the themes that emerged from analysis, gather their input on the theming,development of a collective story, and conclusions, and address how their role in this study can be more fully recognized and credited.
- Increasing understanding of how Labor can be a means of intervening in the ideologies of depoliticization, meritocracy, and majorism on the neoliberal STEM campus. How can the lenses of Labor and theories of change allow for exploration of the interrelations of these three ideologies?

Acknowledgements

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Appendix

Table A1: Guiding questions for researchers posed by Mejia et al. adapted from Freire's principles of critical pedagogy [17].

Freire's Principles of Critical	Theory	Action	Reflection

Pedagogy			
Scholarship	Q: Is this theory critical and am I considering the political, cultural and historical factors that play a role into the research? A: Yes, we sought to use critical and liberative theoretical frameworks which investigate historical sociopolitical factors.	Q: In what ways is my research and my relationship with the participants ensuing that a liberating action will occur? A: This research provided a reflective space for strike participants to unpack their experience. It also provides opportunities for further action rooted in solidarity as participant experiences are shared.	Q: What is my positionality? A: Described in positionality section of paper. This reflective step allowed the first and third authors to seek out and recruit the fourth author as a faculty collaborator and the second author as the interviewer for this study.
Praxis	Q: Are the theories that I am trying to explore achieving the intended goal? A: An engineering and labor theory of change positing that engineers can be community organizers and strikes are a form of liberatory pedagogy, which is reflected in our results to date.	Q: How do I ensure that my research results can be easily translated into practice? A: Tying the theory to existing methodologies and methods used in engineering education research as a means for others to build upon the theory through further research.	Q: How am I reflecting upon my role as a researcher in the context of the phenomenon/populati on I am trying to explore? A: As two of the authors are participants in the study, it provided us with an opportunity to reflect on ways that participatory action research could be more deeply utilized in future studies.
Concientização	Q: Does the theory used assume a deficit or anti-deficit approach? A: The theories used assume an asset-based approach, rooting in the	Q: What are my assumptions about the community and the phenomenon? A: Many of the assumptions about this	Q: In what ways was I mistaken about the population or the phenomenon I explored? A: To be determined

	whole worker organizing [15].	community and phenomenon were articulated in the development of the labor and engineering theory [13].	in future analysis of the data.
Liberation (e.g., for participants)	Q: How can I make sure the theory development in my work is liberative and co-created with participants? A: Within this exploratory study more broadly, the co-development of a theory of labor and engineering based on interview analysis can produce a more robust theory. In co-creating a more robust theory with participants, barring logistical constraints, including concerns over participant anonymity, the researchers could present the existing theory and themes emergent from participant interviews to participants as a means of pragmatic validation. Pragmatic validation is a validation method that checks for the alignment of concepts and knowledge claims with the investigated reality [22].	Q: In what ways am I allowing participants to take action alongside me in order to achieve liberation from the obstacles that prevent action from occurring? A: In naming forms of harm participants and those in their networks anticipated or experienced, we hope to develop further studies that lead to shifts in conditions that bring about those forms of harm.	Q: In what ways am I allowing for participants to reflect about the research findings and to co-construct these narratives together? A: In this study we are not, beyond the inclusion of two participants as authors, due to the need to protect participants' anonymity. We acknowledge this contradiction and the need to share credit for published work. Regardless, we are dedicated to creating more equitable conditions by providing participants enough time and safety to co-construct these narratives and not face negative career impacts for their participation in this study.