Decolonizing engineering curriculum on stolen land: Settler amnesia within engineering education

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Abstract

In line with the LEES division theme, "Engineering Education for Truth and Reconciliation", this paper reflects on the question, what does it mean to 'Indigenize' or 'decolonize' engineering education on stolen land? Following calls to address colonialism in Canadian and American higher education, universities have increasingly undertaken Indigenization, reconciliation, and decolonization initiatives. However, without addressing the colonial legacies of the university, these initiatives can further maintain and legitimize white settler and university futurities. By extension, without confronting the colonial legacies of engineering in Canadian and American nation-building, initiatives to 'Indigenize' or 'decolonize' engineering education, consequently can reproduce the colonial extraction of Indigenous knowledge whilst naturalizing the permeance of the settler colonial state.

In this paper, we reflect on our experiences as white and racialized settler undergraduate and graduate engineering students, engineering education researchers, and faculty, within the Canadian and American university contexts. Our methodology draws on a duoethnographic approach, dialogically engaging with each of our individual stories to contextualize the themes of racial capitalism and settler colonialism as experienced through our engineering education experiences. We start our dialogue by contending with our experiences with institutional equity, diversity, and inclusion initiatives, and the tensions we felt doing that work within the colonial and racial capitalist foundations of engineering education and practice. We then discuss each of our experiences in our respective engineering programs, how they exemplified neoliberal and militaristic priorities in engineering education, and how they contribute to a dominant 'collective memory' in the engineering discipline. We offer reflections on our dialogue and writing processes, as well as questions that have arisen from this experience—both to ourselves and to the engineering education community engaging in decolonizing and anti-colonial work. Our reflections are part of our process for intentionally 'pausing' to make space to discuss the tensions, implications, and contradictions of 'Indigenizing' or 'decolonizing' engineering education.

Introduction

Following calls to address colonialism in Canadian and American higher education, universities have increasingly undertaken Indigenization, reconciliation, and decolonization initiatives [1], [2], [3], [4], [5], [6], [7]. In Canada, many such efforts have especially emerged following the creation of the Truth and Reconciliation Commission of Canada in 2015 and its report of 94 Calls to Action [8]. The Calls to Action urge policy and institutional changes, such as in education, health, and justice, that redress the injustices of residential schools in Canada and the ongoing colonial violence faced by Indigenous peoples. As engineering students, researchers, and faculty engaged in what is often institutionally referenced as 'EDI.I' (equity, diversity, inclusion, and Indigeneity) work in education, we find ourselves necessitating a 'pause' to question the long-term meaningfulness of our work whilst wrestling with our positionalities and complicity in furthering university institutional and colonial agendas.

Leigh Patel [9] has written about needing intentional deep pauses to challenge the colonial dogma of education research in the United States and to reimagine possibilities for anticolonial approaches through 'answerability', as opposed to the dominant values of ownership in research. Challenging the colonial practices of knowledge as property in education research, "answerability means that we have responsibilities as speakers, listeners, and those responsibilities include stewardship of ideas and learning, not ownership" [9, p. 372]. Patel's questions of "if educational research could, in fact, become something other than colonizing, if an entity borne of, and beholden to, colonization could somehow wrest itself free of this genealogy" [9, p. 358], resonate with us. This feels especially pertinent in engineering education research, in which the engineering discipline operates within imposed rigid (non-socio)technical boundaries. As a result, discussions of sociopolitical and social justice topics are neglected or met with resistance, as described in the scholarship by Cech [10] and Riley [11].

Further, what does it mean to 'Indigenize' or 'decolonize' engineering education on stolen lands? Scholars Daigle [7]; Gaudry and Lorenz [1]; Snelgrove, Dhamoon, and Corntassel [12]; and Stein [13] have written deeply about the ongoing colonial legacies of the settler Canadian university. Without addressing the implications of the university institution in the colonial nation-building project, such initiatives to 'Indigenize' and 'decolonize' can further maintain and legitimize white settler and university futurities. By extension, without confronting the colonial legacies of engineering, initiatives to 'Indigenize' or 'decolonize' engineering education, consequently can reproduce the colonial extraction of Indigenous knowledge whilst naturalizing the permeance of the settler colonial state. How can our roles in engineering education engage with Tuck & Yang's arguments that "until stolen land is relinquished, critical consciousness does not translate into action that disrupts settler colonialism" [3, p. 19]? As settler engineering education researchers based in the setter colonial nation now called Canada, we write this paper as a process of 'pausing' [9] to discuss the tensions we have experienced in 'Indigenizing' or 'decolonizing' efforts in engineering education in our Canadian and American university institutional experiences.

We structure this paper as a dialogue between the first two authors, Jess Tran and Jessica Wolf, to reflect on our engineering education experiences, as recent Canadian and American undergraduate and current Canadian graduate students. This written dialogue is an artifact of the many dialogues we have engaged in wrestling with these tensions, including several conversations we had as an author team. We reflect upon our education experiences as intertwined with settler colonial agendas, particularly through the pervasiveness of engineering techno-saviour culture, neoliberal priorities, and connections to the military-industrial complex. We highlight our experiences to illustrate the production of an engineering 'settler historical amnesia' [14] that is enacted by the simultaneous omission of engineering education's role in perpetuating in colonial land dispossession and the reproduction of a narrative of engineering technocracy that is explicitly bound to colonial state and neoliberal market priorities.

Settler colonialism & racial capitalism

We situate our understanding of settler colonialism through Robin D.G. Kelley's conceptualization of settler colonialism [15], expanding upon the works of Patrick Wolfe's 'logic of elimination' [16] and Cedric Robinson's 'racial capitalism' [17]. Kelley describes settler

colonialism as the elimination and exclusion of Indigenous peoples to acquire land and labor. Kelley emphasizes that genocide, ethnocide, dispossession, and proletarianization are processes of the exploitation of land and labor that are necessary for building the settler state. Settler colonialism, and subsequently, decolonization, varies between and within geographical and sociopolitical contexts, and as such, ought to be considered both an ongoing structure and process as opposed to a historical event.

In Cedric Robinson's 1983 *Black Marxism*, Robinson describes capitalism as operating within, rather than outside of, racial stratifications. In other words, capitalism *is* racial capitalism. Dating back to feudal Europe, Robinson demonstrates how the histories of social stratifications of racialism have been deeply integral to and inseparable from processes of state-building and the social organizations of slave versus mercenary and bourgeoisie versus proletariat. Robinson writes that it was necessary for the creation of the European nation-state through capitalism "not to homogenize but to differentiate—to exaggerate regional, subcultural, and dialectical differences into 'racial' ones" [17, p. 26]. Aligning with Robinson, Kelley describes the enforcement of racial capitalist logics within settler colonialism. As capitalism originated, developed, and operates within a racist system, racism is necessary for the reproduction of colonial violence needed for extracting land, resources, and labor.

Theorizing decolonization

As we think of settler colonialism as a process, we also view decolonization as an ongoing process. In "Decolonization is not a metaphor", Tuck and Yang [3] write that decolonizing the settler state necessitates land back and the restoration of Indigenous sovereignty. As engineering education practitioners and researchers, we are wary of how "the pursuit of critical consciousness, the pursuit of social justice through a critical enlightenment, can also be settler moves to innocence—diversions, distractions, which relieve the settler of feelings of guilt or responsibility, and conceal the need to give up land or power or privilege" [3, p. 21]. In an essay titled "Can academia be decolonized beyond the metaphor?", Pérez suggests that "it is not possible to decolonize academia beyond a metaphor unless academia, as a set of colonialist institutions, ceases to exist" [18, p. 31]. One possible approach to orienting our pedagogical goals is Gaudry and Lorenz's characterization of 'decolonial indigenization'. They offer this decolonial direction as envisioning "the wholesale overhaul of the academy to fundamentally reorient knowledge production based on balancing power relations between Indigenous peoples and Canadians, transforming the academy into something dynamic and new" [1, p. 219].

In this paper, we do not offer a resolution of how decolonization can be achieved, particularly not through academic reforms in engineering education. However, we believe that as researchers benefiting from the academy, we have a responsibility to move towards an anti-colonial education that supports decolonizing the Canadian and American settler colonial nation states through Indigenous land back and sovereignty.

Engineering in settler colonialism & racial capitalism

Engineering education and practices have long historical and contemporary roots in maintaining Western colonial and racial capitalist domination. Colonial techno-science knowledge production

has been and continues to be imperative to advancing European imperial trading and settler colonial nation-building [19]. For example, Mitra et al. [19] highlight the prominent example of the steam engine, widely celebrated as an engineering feat that prompted the industrial revolution, being funded by British enslavers in the Caribbean to drive plantation economies. With the expansion of European settlements, the pervasiveness of colonial techno-science also resulted in the increased dependency of colonized nations on the technologies of the colonizers, such as agricultural, military, transportation, and medical infrastructures, to name a few [19]. Our discussion in this paper builds on our experiences seeing engineering education as reproduced by and reproducing racial capitalist and settler colonial power structures through focusing on neoliberal technocratic and military priorities. We also hope to uplift and enter into conversation with existing dialogues in engineering education, such as the recent 2023 ASEE conference paper by Valle, Slaton, and Riley titled "A Third University is Possible? A Collaborative Inquiry within Engineering Education" [20], Rodrigues Affonso Alves' self-reflection on their position in the Canadian settler colonial project as an immigrant [21], and others [22],[23].

What do we mean by 'settler amnesia'?

Through our discussion we borrow the concept of 'settler historical amnesia' [14] to conceptualize our perceptions of this dissonance within engineering education, in which discussions of racial capitalist and colonial systems of oppression are 'missing' despite ambitions to 'solve' social and environmental problems. Cook [14] builds upon the concepts of collective amnesia and white ignorance from Charles Mills [24] to offer 'white settler ignorance' and 'settler historical amnesia' in her discussions of the settler state-sanctioned recognition and settler denial of Canada's Truth and Reconciliation Commission. She writes, "settler colonialism as a structure mandates the ignorance of its own operations" [14, p. 21]. Cook, elaborating on Bruyneel's work [25], urges that colonial collective 'amnesia' is not accidental nor even an intentional forgetting. Rather, "the political problem with white majority settler nations such as the United States is not what they forget but how they remember" [25, p. 239].

While we discuss our experiences of an *engineering settler amnesia* largely as the omission of engineering's colonial and racial capitalist complicities, we are also wary of suggesting that informed education about the past is the 'cure' to this amnesia. Bruyneel writes about this as the 'liberal misdiagnosis' of collective amnesia:

> The diagnosis of amnesia and the cure of remembering are liberal rationalist ways to conceive the problem of, and solution to, racial and colonial domination. The liberal rationalist approach says that if only we all knew better, had all the facts, then these historic injustices would be resolved, or at least we would be on our way to addressing them [25, pp. 237–238].

In particular, thinking of Glen Coulthard's influential work on the politics of recognition in *Red Skin, White Masks* [26], it is not only that Indigenous presence and Canada and America's colonial legacies are omitted from engineering education, but also that the selective inclusion of Indigenous content and narratives may continue to serve the settler colonial university agendas.

Rather, we hope to first conceptualize and complicate this idea of *engineering settler amnesia* in this paper as a 'pausing', while considering more radical possibilities of allyship, solidarity, and movement-building within engineering education. We want to emphasize that the pursuit of a

just and decolonial future must uplift Indigenous resurgence, as written about by, for example, Glen Coulthard [26] and Leanne Betasamosake Simpson [27].

Locating ourselves

Our understanding of settler colonialism is deeply informed by our academic and lived experiences as racialized and white settlers who grew up and live uninvited on stolen and treaty Indigenous lands in so-called Canada and the United States.

Jess Như Tran (JT)
I draw from my experiences as a recent graduate from a biomedical engineering undergraduate program at a large research-based Canadian university. I am now a master's student conducting engineering education research at the same university. My exposure and engagement with theory, particularly in understanding settler colonialism, came through non-engineering university courses, namely through a minor in human geography, as well as involvement in student organizing and social justice campaigns. My education experiences and lens are shaped by my positionalities, being a queer first-generation Vietnamese Canadian university student.

I was born and raised in 'Canada' on the traditional and treaty territories of the Mississaugas of the Credit First Nations and now live on the stolen lands of the xʷməθkʷəy̓əm (Musqueam), Sḵwx̱wú7mesh (Squamish), and səlilwətaɬ (Tsleil- Waututh) nations. My parents immigrated to Canada from Vietnam in the 1990s, with my father settling as a political refugee. As my parents migrated here in hopes of a better life, I am navigating my complicity in the settler colonial nation-building project through the occupation of stolen land and the perpetuation of Canada's humanitarian exceptionalism narrative [28]. I am pulled to engage in anti-colonial work in this discipline to also make sense of my diasporic grief, trying to understand my family histories and the deep wounds inflicted by French colonial and American imperial oppression in Vietnam. Through my citizenship and formal education, I have amassed privileges that allow me to navigate the spaces of higher education. Although I seek to challenge the university colonial and neoliberal dogma through my research, I also contend with my participation in benefiting the 'progressive' university, and by extension, the Canadian state.

Jessica Wolf (JW)
In this paper, I reflect mainly on my experiences in a general engineering undergraduate program at a small liberal arts STEM-focused college in the United States. After graduating, I worked for a year as a full-time mechanical engineer at a large defense contractor in the US, after which I began my graduate studies at a large research-based Canadian university. I am currently a PhD student studying engineering education, having transitioned away from mechanical engineering research during my master's degree, and I have been constantly 'learning as I go' when it comes to theory and education research. This learning has come from a small variety of graduate courses in various social science disciplines, from reading and talking extensively with Jess Tran and other peers, and from my involvement over the past few years with labor organizing at our university.

I was born in the United States on the traditional land of the Lenape, in so-called New Jersey. My parents each immigrated to the US, from Germany and China, to pursue the 'American dream.'

As my parents attained graduate degrees in the US and found successful careers in computer science, I grew up with a lot of socio-economic privilege, as well as in my education and citizenship. I did not really start thinking critically about my positionalities and their intersections with colonialism until very recently; I certainly feel some amount of 'white guilt' when approaching this topic while also trying to contend with my unique family history and my place in the American racial system as a mixed (white) woman. My hope in this paper is to reflect on my locations within the university and engineering systems, and further my own and our collective understandings of the tensions and complexities in challenging colonial norms therein.

Jillian Seniuk Cicek (JSC)
I come to the paper in my roles as a faculty supervisor, and a learner. I am a settler of European descent on both my mother's side (her people come from Ireland and were settlers in Australia) and my father's side (his parents immigrated from the Ukraine between the first and second world wars). I was born and raised on Treaty 1 territory and homeland of the Red River Métis, in the place now known as Winnipeg, Manitoba. I am a mother, a wife, a daughter, a sister, an auntie, friend and mentor. I am a writer, a teacher, and an artist. I am also an associate professor in the Department of Engineering Education at the University of Manitoba. It was through my work in EER that I first met Jess Tran, then Jessica Wolf. JT and I began our research relationship in summer of 2023; this has evolved into me being invited to work on this paper.

My work at the university has been centred on learning the truth about Canada's colonial and genocidal history and present; learning how to make space for Indigenous peoples, and Indigenous ways of being, knowing, doing and relating in engineering education; and learning how to decolonize curricula, and help students and faculty learn decolonized curricula in decolonized ways. My work with JT and JW on this paper has been to listen, to learn, to reflect, to amplify, to encourage, to support, and to guide. This work is a series of dialogues with ourselves, with each other, with scholars, and with this text. We circle back on these dialogues, again, and again, layering our thoughts, our feelings, our meanings, one on top of another, wrestling with our experiences, our ideas, and our responsibilities in our positions in engineering education, in academia, in our colonial institutions, in our complicities, with the aim to make explicit what we are doing when we try to decolonize curricula. I hope to help JT and JW find the space to make sense of their engineering education, and alert faculty to what students may be experiencing in engineering education, and what they may need. I recognize that doing this work, engaging with these students, and learning from them, with them, in this space, is a privilege, and that I am doing this work from multiple positions of privilege in my life. To reconcile this, I try to be open, honest, vulnerable, and humble, and work with good intention, from my heart.

Methodology

This essay draws on a duoethnographic approach [29], engaging with JT and JW's stories. Weaving our stories together, we contextualize the themes of racial capitalism and settler colonialism as experienced through our engineering education experiences. This work is inspired by the paper "Unsettling settler colonialism: The discourse and politics of settlers, and solidarity with Indigenous nations" by Snelgrove et al. [12]. The structure of a dialogue, weaving our

stories and reflections, as graduate students with recent experiences as engineering undergraduate students, is reflective of our process for working through and within 'pausing'. As Burleigh and Burm describe in their duoethnography on duoethnography, this process centres self-examination and dialogue, through which "we begin to give meaning to our collective experiences" [29, p. 4]. This dialogue offered us the space to contend with the coloniality of the engineering discipline and our positionalities within academia as engineering education researchers.

The written form of our dialogue in this paper is a representation of many discussions and writing sessions over the past months, primarily between JT and JW, and often occurring informally while just spending time together. We want to recognize our friendship, which developed alongside our research collaborations, as a site of knowledge production; the vulnerability and openness with our feelings and thoughts during this dialogue can be attributed to the level of trust we have with each other. Many of these threads of thought also developed as we co-facilitated weekly discussions as teaching assistants for a fourth-year engineering ethics course this year, which constantly presented new challenges in approaching critical topics with the students. We also found ourselves regularly resonating with the writings of JSC, and as JT began working and learning with her, the collaboration on this paper seemed fitting. As a more experienced and more senior researcher in engineering education, JSC has occupied a supporting/advising role in our academic lives.

We collectively determined to represent our student voices in the dialogue, as this felt the most authentic to the aim of this paper, though all our voices are present in the paper at various points, and all of us worked through the paper in its iterative construction. Inspired by bell hooks, we engage in a process of critically reflecting on our experiences as a feminist methodological framework in which "personal testimony, personal experience, is such fertile ground for the production of liberatory feminist theory because it usually forms the base of our theory making" [30, p. 70]. Being engineering students ourselves, we hope to also encourage more undergraduate and graduate students to share their stories through authorship of engineering education literature.

How this paper took root: Contending with institutional 'EDI.I'

JT: The idea for this paper started with the question: "Why do we learn to incorporate Indigenous building design principles without questioning why our buildings are constructed on stolen lands?" This question came up for me two years ago while taking a geography seminar course, engaging with decolonial and critical Indigenous theories for the fourth time. In this course, we began unpacking the colonial assumptions and practices of academia. At this point, I had started engaging with 'EDI.I' initiatives and research within engineering education. Upon reading *Unsettling the University* by Sharon Stein [13], the threads of my woven hopes in institutional 'EDI.I' began to disentangle. As I learned (and am still learning) about the colonial histories of the university institution, broadly in the Western context and at my university, while also getting more involved in student organizing, I started to question the limited borders of perceived social change possible within engineering education. This process of learning/unlearning/relearning has consisted of and will continue to consist of many pauses. How can we make space for more

radical liberatory educational possibilities before unpacking the discipline's own epistemological and cultural bounds of *doing* engineering within a colonial and racial capitalist paradigm?

JW: I also dove into the 'EDI.I' space about three years ago, when I switched my master's research from a mechanical engineering focus to engineering education, while remaining in our university's mechanical engineering department. My master's thesis was based on the idea of 'EDI.I' as a group of concepts that could be taught *to* students (as opposed to, e.g., creating more inclusive classroom practices). Part of my thesis focused on curriculum mapping of how well and to what extent EDI.I was taught in engineering courses at our university [31]. I categorized equity, diversity, inclusion, and 'Indigeneity' into a digestible matrix-like framework. Since then, I have learned more about the complexities of 'EDI.I' issues, the way 'decolonization' is treated in institutional initiatives, and the dissonance between EDI.I 'goals' espoused by our university and its actions on actual issues of equity, such as the university's response to grad students unionizing, or to the community's divestment demands. Looking back, I realize that my approach to EDI.I was an oversimplification and an example of applying colonial practices to 'decolonization', or using the master's tools to dismantle the master's house, which, as Audre Lorde has written [32], will never happen.

What I did find from my master's research was a tendency for well-meaning engineering instructors to justify their 'EDI.I content' with assumptions of profit and performance as priorities. For example, more than one course cited studies showing how diverse teams lead to more innovation and profit for companies, as their main reason for teaching engineering students about EDI.I. Most of the courses also implemented 'EDI.I content' as an add-on to the traditional course content, such as a single guest lecture by an Indigenous speaker or a single module focused on equity, diversity, and inclusion, rather than committing to a "wholesale overhaul" [1] of the course content.

JT: Having been in some such classes, the selective inclusion of Indigenous knowledge into the engineering classroom reminds me of Cash Ahenakew's framework of *grafting* [33]. Ahenakew critically contends with the institutional agendas for Indigenizing initiatives within a non-Indigenous context:

> Grafting, in itself, is neither good nor bad. Indeed, hybridity can be a generative process. However, in the context of grafting Indigenous knowledges into non-Indigenous ways of knowing, we are operating with severely uneven environments shaped by historical circumstances where the grafting/hybridizing does not happen as a mutual exercise, but as assimilation [33, p. 324].

Ahenakew highlights challenges to grafting Indigenous knowledges when grafting serves settler colonial state interests through recognition politics, and when grafting homogenizes Indigenous ways of knowing as an othered or peripheral knowledge system [34], without critiquing the naturalization of Western epistemology. Ahenakew's works [2], [33] ask us to consider the tensions of epistemological incommensurabilities when grafting Indigenous knowledges *into* the Western university classes, without disrupting existing colonial university ways of learning. Bringing this back into engineering education, how can we contend with and challenge the naturalization of settler colonial engineering knowledge and practices?

Reflections on neoliberalism and militarism

JT: In my engineering education in Canada, engineering projects upholding the settler colonial racial capitalist state appear most plainly evident in natural resource extraction and infrastructure, otherwise known as 'racial extractivism' [35]. This is where the engineering settler amnesia and dissonance feels most glaring, especially amidst the popularizing interests of engineering technological 'solutions' for climate change and sustainability. As geographer Laura Pulido [36] writes, environmental injustice, particularly environmental racism, fundamentally sustains contemporary racial capitalism through land, resources, and human appropriation, commodification, and segregation. Examples of engineering projects maintaining environmental racism include invasive infrastructures such as oil and gas pipelines [37], corporate entitlements to pollution such as the petrochemical industry in Chemical Valley, Ontario [38], and urbanization projects of city-building to engineer racist settler colonial landscapes [39]. However, these were never discussed during my formal engineering education, not even in my engineering ethics or engineering social impact courses.

Additionally, my engineering education really emphasized the techno-saviourist narrative [40] of engineering as a way of 'making a difference' or solving prominent social issues. Like many of my classmates, this is what appealed to me about pursuing engineering in the first place. Although, this also prompted so much pressure for us engineering students to feel that as individuals, we are somehow both responsible for and capable of solving huge social and environmental issues for communities we often are not even a part of.

JW: Perhaps these dominant narratives of engineering work and engineering priorities, what *counts* as engineering [41], can be considered part of the engineering 'collective memory' and thus settler ignorance or amnesia reproduction. Bruyneel's concept of settler amnesia is not just about a collective forgetting but about the construction of a dominant collective memory [25].

JT: I think this is what the narrative of engineers as benevolent problem-solvers does to absolve our complicities in colonial violence. The representations of engineers as globetrotting benevolent techno-saviours in our education fits neatly within Western development discourses, which is a perpetuation of neocolonial rule [42]. Modern science and engineering are instrumentalized as unassuming tools for reproducing European notions of 'progress' and 'innovation'. My course design projects early in my undergrad were often design problems based in countries and communities that were framed as 'less-developed'. I also remember reflecting on these tensions of engineering saviourism during my short time in Engineers Without Borders. Reflecting back on this now, I wished we could have had critical discussions about the power dynamics of engineering consultation where engineers are positioned as 'experts' with 'power over' as opposed to 'power with' or 'empowering' communities [43].

JW: The emphasis on engineering students' responsibilities to engineer solutions to issues that are often deeply sociopolitical and sociocultural is something we have talked about often. Especially when there are also underlying expectations for such solutions to be marketable, investable, and profitable—there is a clear tension between the ideal of engineers helping people and society by solving problems, and engineers creating technology for profit. You've told me about the disproportionate focus in your program on entrepreneurship; how did that resonate with you given your hopes of making a difference through engineering?

JT: Throughout my biomedical engineering undergrad, it felt like the message was that it was not enough to learn how to be an engineer; rather, we had to learn how to be an entrepreneur. Particularly, in biomedical engineering, we learned that solutions to healthcare issues must operate within Western free-market logics. In project design courses, learning objectives routinely included identifying possible stakeholders to weigh risks and benefits to our designs, completing market analyses, establishing intellectual property, and ensuring profitability through cost analyses. I found that the language of free-market entrepreneurship is eerily reflective of the colonial and capitalist logics of discovery and expansion: 'untapped markets', 'uncharted territories', 'new frontiers', and 'pioneer opportunities'. Despite its guise of an apolitical curriculum, my engineering program maintained the white settler colonial system through this racial capitalist praxis of engineers as pioneers of market terrains that freely span across geographies.

JW: In my undergrad degree, there was not so much explicit emphasis on entrepreneurship, but much of the underlying neoliberal logic and motivations were the same. I think the environment for engineering students in my program exemplified the deep-seated nature of militarism in engineering culture, as well as the material reliance of engineers on the military industrial complex for employment that Riley details in *Engineering and Social Justice* [11]. For engineering majors, most companies at our career fairs and sponsors of capstone projects were defense contractors. I personally got placed in capstone projects that were for defense contractors, interned at a large defense contractor in my last summer, and worked there as a mechanical engineer for a year before going to grad school. It really felt like all my options for employment were defense-related in some way, and all the experiences I gained in my program as a mechanical-focused engineering major was geared towards the defense industry. I actually tried for a while in my final year to get a job in the biomedical industry, thinking that that would be a safe bet for having a positive impact on society (JT: ha ha), but I was unsuccessful, probably in part due to all my project experiences being with aerospace/defense companies.

Working in aerospace (which is almost always tied to defense in the United States) out of my undergraduate degree, I've had a lot of thoughts and conversations with peers about where to draw moral boundaries in my work as an engineer. I realize now that these conversations focused on individual student choices of who to work for and what types of projects to work on, rather than interrogating what industries the college decided to partner with and the historical and ongoing relationships between engineering and the military, and mutual relationship between the two for maintaining US settler colonialism. I do still feel a lot of shame about my time in that job; I felt at the time that it was my only option aside from being unemployed. Looking back, I think I could have been unemployed and been fine, and maybe I shouldn't have taken that job. However, I also think this individualized thought process that myself and many of my peers have had—while valid and important—is not enough to foster meaningful change. Even if I refused a capstone project for a defense company, another student would fill that spot because the college still has that partnership. Similarly (though not exactly the same) if I didn't work at the defense company, my program and countless others would still be funneling engineering students into these jobs.

JT: On the other hand, these small moments can build up and contribute to shaping the collective memory and collective change, as in all social and political movements. As engineering students,

we were not taught to develop this sort of agency or belief in collective change. The belief of individualist moral responsibility and change-making within our engineering education reflects the neoliberal dogma that dominates engineering education culture. For example, the institution, in pursuit of appearing neutral yet benevolent, encourages students to make their own decisions about the impacts students wish to have on society, taking no accountability for its participation in the military industrial complex. How can we challenge these oppressive structures while still recognizing the agency we do have as individuals to engage in collective action and change in engineering?

How can we conceptualize actionable yet radical change in engineering education that both challenges the institutional power structures that reproduce engineering settler amnesia whilst also advocating for students to feel empowered to challenge the racial capitalist and settler colonial ways of knowing and doing engineering?

Amnesia enacted

JW: One salient aspect of my undergrad experience was the lack of time I had for anything outside of my engineering schoolwork, and particularly lack of time to engage in critical discussions or reflection about engineering as a discipline and its histories and ongoing complicities. Our engineering curriculum was described as a 'firehose of information'. I heard of students feeling like they didn't have time to socialize or shower, mental health issues abounded, and on top of that, ideas of heroism and martyrdom were badges worn proudly by students. Many of my friends, myself included, glorified the sense of 'shared suffering' that forged the bonds of our community. And my program had a pretty large non-engineering course requirement, relatively—but that was just so de-prioritized by the engineering students. It was common to choose 'easy-A' courses for our humanities/social sciences requirements because we were struggling to get by in the technical courses. And I didn't make this connection at the time, but being in that state for four years really stifled my ability to think critically about engineering and society. I have often felt regret for not taking advantage of those opportunities, but in reality, the way the engineering curriculum was structured simply didn't allow for it.

JT: I strongly resonate with the experiences of feeling so deeply overwhelmed in engineering coursework and extracurriculars during my undergraduate that I felt stressed into depoliticization. In addition to a full course load, I was on an engineering design team that occupied most of my weekends. Being part of an all-consuming design team was seen as another badge of being part of the engineering in-group and felt necessary for job applications. I also felt a sense of pride over my excessive busyness. My packed schedules and hasty timelines felt like an audition for what I had thought my dream job would be, in some sort of medical technology start-up venture.

I wonder how our conceptualization of engineering collective memory ought to consider how the construction of academic student time perpetuates the reproduction of an engineering settler amnesia. Bruyneel opens his essay 'The Trouble with Amnesia' with, "in politics, time is a structuring force that shapes collective and individual identities, subjectivities, and imaginaries" [25, p. 236]. He elaborates on the construction of collective settler colonial memory through an analysis of the US holiday calendar as "public documents of state building, of nationhood, and of

resistances to both" [25, p. 237]. Perhaps the ideologies of depoliticization and meritocracy within the culture of engineering, as written by Cech [10],[40], are reproduced and enforced by this academic calendar time. How does the constricting of students' time during their degrees enforce the dominant reproduction of engineering colonial memory-making?

JW: I think this is an important way that we see this idea of amnesia enacted. Students' lack of time and agency—as imposed by the university and engineering education systems—in having conversations and critical thinking about these aspects of engineering contributes to the omission of these histories and construction of a collective memory in the culture of engineering.

Ongoing reflections

In this last section, we offer our reflections as an author team on our dialogue and writing processes, as well as on the questions that have arisen from this experience both to ourselves and to the engineering education community engaging in decolonizing and anti-colonial work. This paper started with the pause-prompting question of: If/as we view the engineering discipline being deeply implicated in the construction and maintenance of the racial capitalist and settler colonial nation building project, how can engineering education for decolonizing and anti-colonial work take place? We engaged in writing this paper as an attempt of 'pausing' from our 'business as usual'. We wanted to make space to intentionally engage in theorizing settler colonialism, racial capitalism, and anti-colonial possibilities within engineering education—where these discussions do not currently fit within the scopes of our thesis research.

However, practicing 'pausing' through writing, especially with an intention of submitting this work to the ASEE conference, in and of itself, at times became contradictory to the very intentions of pausing. Progressing through our writing process, we found ourselves left with more questions than answers and increasingly felt pressure to offer resolution. As our dialogues continued, without a clear end, our pauses progressively felt longer, prompted questions felt harder to answer, and what we could offer to ourselves and to our readers as 'future directions' felt more unsatisfactory.

While this paper was a meaningful process for furthering our own theorizings, we struggle with our complicity in advancing inauthentic approaches to decolonizing engineering education. We do this by 'grafting' decolonization onto other efforts—like EDI.I—that are perceived as not 'belonging' in/to engineering. This is a disservice to decolonization, to Indigenous peoples, and to the acknowledgement of the truth of the United States and Canada's colonial and genocidal histories and present, which are our moral, legal, and ethical responsibilities. We perpetuate our mistakes by trying to 'solve' decolonization, rather than pausing and learning in partnership with Indigenous peoples on the lands where we live and work. We fall into dualisms: land back, or not, decolonization, or not, activism, or not, privileged, or not…. We miss the complexities. We are constrained by the English language we speak in this paper, in this space. English has a lack of ability for complexity, and a penchant for dualisms, as taught by Dene Thá First Nation engineering educator, and leader, Jessica Vandenberghe. In our thinking, our approaches, in our solutions, we are constrained by the lack of nuance in our language. Truth work, reconciliation, decolonization will never be 'solved' or 'resolved'... it is an ongoing journey, a commitment to walk with an open heart, mind, to walk with humility, with self-awareness, with reflexivity, with

action, in partnership with Indigenous and non-Indigenous peoples, and with humans, and more-than humans, and the lands, waters, animals, birds, insects… all living beings. Decolonizing is not grafting moments or acknowledgements on top of curricula, but helping students understand the history of engineering and its role in the colonial project—helping students accept that engineering isn't neutral, and that they have agency to choose how they wish to be engineers, and who they choose to work for.

We also feel isolation within our broader engineering community. In our institution, we do not often see acknowledgement among engineers of the tensions or complicities that we discuss here. Rarely do we see engineers involved in grassroots organizing, much less in ways directly connected to their profession as engineers or academics. While writing and engaging with theory is/can be liberatory, to the cautions of Tuck and Yang [3], have we inadvertently sought such efforts to 'decolonize' the mind, curricula, pedagogy, which distract from settler responsibilities to pursue radical change that overturns the racial capitalist and colonialist status quo?

At the same time, we recognize that we are having and sharing these dialogues about decolonization and settler colonialism without more input from Indigenous scholars or students in engineering education. Decolonization is not a monolithic project, and the dreams and actions for decolonial futures are diverse among Indigenous people, places, communities, and nations. A limitation of writing with both an American and Canadian perspective was our generalization of the impacts of settler colonialism throughout our reflections on our experiences. Have we reinforced the overstated view of universities and engineering as globalizing institutions? An important question often prompted in post-colonial urban studies is: What are the place-based relationships of the theories and frameworks we reference? Post-colonial scholars such as Roy [44] and Spivak [45] remind us that all theory is deeply situated. As such, where are we theorizing from? From where has our theory come from, where do we seek to transplant/graft and apply our theory? In our efforts to engage in theory applicable to both Canada and the United States and achieving 'comprehensiveness' in our arguments, we lost sight of the place-based contexts of settler colonialism and racial capitalism in engineering education at the sites of our specific universities.

Although we intended to contribute ideas to 'further the conversation', such as a conceptual framework of engineering settler amnesia or suggestions for pedagogical steps forward, the (in)conclusion of this paper (to borrow Valle et al.'s words [20]) serves as an extended pausing. The late Honorable Murray Sinclair, who has been a leader in Truth and Reconciliation in Canada decades before the TRCC, teaches us that it is going to take education and generations to learn the truth, to reconcile, to decolonize [46].

We see part of the outcome of this paper as a call to action for ourselves, to be more intentional in starting and amplifying these conversations in spaces where we might normally hesitate, with students, with faculty, in our personal lives. In offering our starting point but not a solution, we want to acknowledge the importance of rooting this dialogue in place—especially, the importance of dialoguing with the Indigenous voices in the places in which we situate our dialogue, and our commitment to this journey being life-long and generational. We offer an invitation to our readers to join their dialogues with ours, to engage with each others' questions and experiences, struggles and fears.

For those of us also contending with our positions in the university, particularly as marginalized academics in pursuit of institutional disruption, Peña, referencing Kelley's advice [47], writes in *Community as Rebellion: A Syllabus for Surviving Academia as a Woman of Color* [48]:

> to not ask the university to 'love us back,' to not demand the university – a neoliberal, colonizing, racializing institution – provide that which is against its own nature, but rather to take its resources and structures and repurpose them to create freedom spaces, freedom schools, and liberation movements within and through its violent exclusion [48, pp. 19–20].

We remind ourselves that the work of building solidarity with Indigenous peoples, disrupting settler colonial status quo, engaging in anti-colonial alternatives to education, and committing to decolonization, does not end at this practice of reflecting and theorizing. Rather, it has just begun.

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