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Report on truth and reconciliation in engineering education

1. Overview

Currently, there is a gross underrepresentation of Indigenous people in the engineering profession, which is estimated at 0.73 per cent by Engineers Canada's report: Indigenous engineers in Canada (Engineers Canada, 2020). We are called to examine and acknowledge the past and present ways of knowing and being of the engineering profession and, by extension, engineering faculties, that have resulted in Indigenous exclusion. With this knowledge we can co-design a path forward in respectful collaboration and partnership with Indigenous peoples— reconciliation. This is also guided by the understanding that the current culture of exclusion is multi-faceted and complex; identity and experience is intersectional and institutional systems are complex. This culture of exclusion can be viewed as the result of the dominant settler-colonial discourse that defines the practice and ideologies of engineering education. Historically, Indigenous ways of knowing and being have been invisible within academia, especially within science, technology, engineering, and math (STEM) faculties. However, the respect for, and integration of, these ways of knowing and being are central in providing an environment in which Indigenous people can be included, safe, and empowered.

In this preliminary report, former and current Indigenous students, staff, and faculty in engineering faculties across Canada took part in interviews and completed surveys in which they shared their lived experiences of being an Indigenous person in engineering education, perspectives, and visions for inclusive and just engineering faculties. Synthesizing the voices of the participants, we seek to understand the truth, roots, and the intersecting forms of the culture of exclusion in engineering academia, but also, the path forward to reconciliation and transforming the engineering academic institution into one in which Indigenous epistemologies, ontologies, and cultures are meaningfully woven into the fabric of the engineering academic system.

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2. Methodology

2.1 Interviewees and survey distribution

Participants who self-identified as being Indigenous, and who are a current or former student, staff, or faculty in a Canadian engineering faculty were recruited through an email distributed through the Engineers Canada Decolonizing and Indigenizing Engineering Education Network. Participants completed an anonymous online survey that collected demographic and background information. Those who were interested in being interviewed or completing a survey to inform the report submitted a separate online form, in which they included their contact information, and were subsequently contacted

Interviews were an hour in length, and in a dialogue format with the team of investigators. The interview was held over the Zoom platform. The participant's anonymized responses during the interview were transcribed into an encrypted online document, and securely stored on a password protected OneDrive account. Surveys were hosted and distributed over the Qualtrics platform. The surveys included 18 questions, and the collected data were anonymous. Questions asked in the interview and the survey were aligned to aid in the analysis and synthesis of the report. In total, five interviews and two surveys were completed.

After the responses from the interviews and surveys were collected, responses for each of the questions were compared. Similarities and dissimilarities between the responses were identified, and synthesized into themes to present in the report.

2.2 Limitations

The primary limitation in this report that could be addressed in future research was the scope. Due to time constraints, the number of individuals who were interviewed and completed surveys was small, thus limiting the perspectives and voices that could be amplified and synthesized. However, due to the preliminary nature of this report, there will be opportunity to expand the scope and include more voices on reconciliation in engineering education in future work.

2.3 Positionality of the authors

Pamela Wolf and Nika Martinussen are white-settler women who gratefully live, work, and learn on the ancestral, traditional, and unceded lands of the Musqueam people.

3. Literature review

Several scholars have begun to examine ways in which a culture of inclusion and reconciliation can be created within academia for Indigenous people. A study by Gaudry and Lorenz, in which they collected surveys from 25 Indigenous scholars and allies on the state of reconciliation within academia, identified three distinct policy visions for the transformation into a culture of inclusion within Canadian engineering education: Indigenous inclusion, reconciliation Indigenization, and decolonization Indigenization (Gaudry and Lorenz, 2018). These three visions constitute a spectrum action, with varying degrees of system transformation. The most implemented policy within engineering education is Indigenous inclusion, which is the policy that aims to increase the representation of Indigenous peoples within the institution (Gaudry and Lorenz, 2018). Respondents to the survey overwhelmingly communicated that there exists a need to better serve Indigenous students, faculty, and staff; however, Indigenous inclusion policies uphold the academic institution as it currently exists, and place the burden upon Indigenous peoples to conform to it (Gaudry and Lorenz, 2018). Academic institutions are beginning to recognize the need to actively practice reconciliation; however, instead of adopting a suite of sweeping policies, they are adopting new rhetoric to talk about the institution's relationship to Indigenous peoples (Gaudry and Lorenz, 2018). For there to be a true culture of inclusion for Indigenous peoples in academia, respondents to the survey overwhelmingly called for the institution to be completely deconstructed and rebuilt with a renewed purpose and practice, one that would support Indigenous knowledge, resurgence, and culture (Gaudry and Lorenz, 2018).

As described by Seniuk Cicek et al. in their paper on Indigenous initiatives in engineering education, currently the work being undertaken at many higher-education institutions (HEIs) is aimed at the "inclusion" and "reconciliation" policy visions of Indigenizing education described by Gaudy and Lorenz, repairing Indigenous and settler relations to alignment with the Truth and Reconciliation Commission of Canada's 94 Calls to Action, and integrating Indigenous knowledge and teaching methods into post-secondary curricula (Seniuk Cicek, et al., 2020). Of the 276 accredited engineering programs at 44 HEIs, 24 HEIs have documented Indigenous initiatives, and these initiatives are largely at the granular, grassroots level within the institution (Seniuk Cicek, et al., 2020). Seniuk Cicek et al. argue that achieving the overall goal—the decolonization of engineering education—requires the current bottom-up initiatives, but accompanied by increased and intentional top-down initiatives supported by administrative leadership required to enact the structural change needed for true realization of reconciliation within engineering education (Seniuk Cicek, et al., 2020).

Rauna Kuokkanen's (2008) book, Reshaping the University: Responsibility, Indigenous Epistemes, and the Logic of the Gift explores the intellectual and structural transformation of academia by the interweaving of Indigenous worldviews into the fabric of the institution. Kuokkanen argues that Indigenous students and faculty "leave their ontological and epistemological assumptions and perceptions at the gates of the university, [to] assume the trappings of a new form of reality" (p. 2), thereby conforming to academia's ways of knowing and being in exchange of their traditional ontologies and epistemologies. However, Kuokkanen further calls HEIs to practice "unconditional welcome," to whom she calls the "other," or those who are not in the dominant demographic (p. 138). The "unconditional welcome" are not surface-level bureaucratic policies aimed towards assisting the "other" into assimilating into the institution and thus upholding existing academic frameworks, but rather a transformation of the institution's worldview, in which a culture centred on the understanding of the ecosystem of reciprocal relationships between the land and society, and the inherent value placed upon the offerings and ways of being of each (p. 139).

Likewise, Angela Cavender Wilson and Devon A. Mihesuah's book (2004), Indigenizing the Academy: Transforming Scholarship and Empowering Communities, explores several Indigenous scholars' ideas on the integration of Indigenous ontological and epistemological traditions into the frameworks of academic institutions. Taiaiake Alfred (2004) describes the academic institution as "a battleground," a place in which Indigenous scholars must tirelessly advocate for institutional reform to be more receptive and welcoming to Indigenous worldviews (p. 92). The principal proponent to the resistance of Indigenous epistemologies being welcomed into academic spaces, Alfred argues, is the historical and ongoing colonialism at the heart of its structure (p. 89), a culture of domination and submission that must be reverted, and a truth that must first be acknowledged before real progress is made. A relationship governed by power, as opposed to reciprocity, currently marks the institution, and creates an uninhabitable environment that propagates the systems of colonization and oppression.

In an essay within the same book, Devon Mihesuah explores the underrepresentation of Indigenous students within the academic institution, analyzed through the lens of place and identity. The pursuit of post-secondary education often requires Indigenous people to uproot their lives, move away from community, and try to survive within the Eurocentric culture of the academic institution, a reality reminiscent of the boarding/residential school system present within Canada and the United States (p. 192). The cyclical and

undoing systems of colonialism, as detailed by Alfred, become abundantly clear. To receive an education requires being removed from the land, a source from which many Indigenous students find meaning and identity, into an environment in which their ontologies and epistemologies are not meaningfully visible. Further, to survive within the institution, Indigenous students often feel the need to conform to the dominant culture and discourse of academia, incurring a further loss of connection to the land, and at which point, they leave the academic institution (p. 194).

Further, Sasakamoose and Pete speak of Indigenizing educational institutions, a process, they write, that attempts to re-centre Indigenous epistemologies and ontologies within the framework of these institutions (Sasakamoose and Pete, 2015). They followed a story-telling approach to gather their data, based upon traditional Indigenous oral tradition, using oral conversation, email transcripts, and narrative to synthesize the knowledge for the paper. The presented method of information gathering is inherently rooted in relationship (Sasakamoose and Pete, 2015). Sasakamoose and Pete centre the idea of the “epistemic ignorance”—the historic and ongoing exclusion and discrimination of non-Eurocentric epistemic and intellectual traditions—of HEIs and its institutionalization through policy, as a key barrier to its Indigenization (Kuokkanen, 2007, as cited in Sasakamoose and Pete, 2015). To demonstrate this, Sasakamoose chronicles her journey to follow the Anishinabe teaching of bimadiziwin, “doing things in a good way,” through her research and pedagogy, but is met with institutionalized barriers that directly come into conflict with the Indigenous epistemologies and ontologies guiding her work.

Mi’kmaw Elder Albert Marshall is a leader and teacher of Etuaptmumk, Two-Eyed Seeing. Etuaptmumk is,

“learning to see from one eye with the strengths of Indigenous knowledges and ways of knowing, and from the other eye with the strengths of Western knowledges and ways of knowing ... and learning to use both these eyes together, for the benefit of all.” (Bartlett et. al., p. 295)

Elder Marshall teaches us to bring our multiple ways of knowing together, and to view this synthesis of knowledge as a gift, one in which we can use our different understandings to make the world a better place for all beings. Elder Marshall’s teachings of Etuaptmumk are often accompanied by teachings of Netukulimk, the Mi’kmaw understanding of the interconnectivity and interdependence of humans and the natural world, bringing about an awareness of maintaining balance in the relationships between each world. Both Etuaptmumk and Netukulimk come together to help us to embrace the understanding of the world through different lenses, and use these different understandings to benefit and maintain balance in the reciprocal ecosystem of relations all beings share.

Elder Marshall further teaches us the importance of Etuaptmumk, saying that,

"when you force people to abandon their ways of knowing, their ways of seeing the world, you literally destroy their spirit and once that spirit is destroyed it is very, very difficult to embrace anything – academically or through sports or through arts or through anything – because that person is never complete.” (Bartlett et. al., p. 296)

We come to understand, then, the inherent relationship between one’s sense of self and belonging, and one’s way of being and knowing. They are intertwined, and the ability of one to live and be their authentic self is dependent upon their ability to synthesize their ways of knowing and being into their work and life.

4. Synthesis and amplification of Indigenous voices and perspectives

Four major themes that were synthesized from the voices of the participants were ‘Resiliency and resurgence’, ’Including cultures, not ethnicity’, ‘Interweaving Indigenous and empirical worldviews’, and ‘It always comes back to the land.’

This report seeks to amplify the voices and lived experiences of current and former Indigenous students, staff, and faculty within engineering academia. At the centre of this work is the understanding that Indigenous people know their needs best, and as allies, non-Indigenous people have the responsibility to listen and support the work and advocacy of Indigenous communities in whatever capacity is needed.

4.1 Resiliency and resurgence

Participants did bring forward several barriers to post-secondary engineering education for Indigenous students. These included:

1. Geographical separation of community and the institution
2. Financial requirements
3. Lack of Indigenous representation in the engineering profession

However, while these challenges to Indigenous representation in engineering do exist, participants also

voiced the strength and resiliency of Indigenous people. Academic institutions have an opportunity to be places for Indigenous reclamation of space and resources to practice their cultures and ways of being.

4.2 Including cultures, not just ethnicity

Many participants expressed the need they felt to assimilate into the dominant Eurocentric engineering academic culture as a survival mechanism. One participant recalled being ridiculed about their language and manner of speaking while they were in the engineering education system:

“My first language was my connection to the land, and I worked so hard to lose my language. It was the start of losing myself…I worked so hard in university to fit in and lose my language, and now I am working so hard to rebuild and become the person I am supposed to be.”

A colonial culture that causes individuals to not feel safe being their authentic selves persists in engineering education. As Elder Marshall has taught us, the abandonment of one’s way of knowing and being in the world indeed destroys spirits.

There is a need, then, to reimagine the fabric of engineering education, and view inclusion not through an ethnicity lens, but through a culture lens. Until the focus of Indigenous inclusion is centred on the celebration, validation, and resurgence of Indigenous cultures, epistemologies, and ontologies within the engineering academy, Indigenous students, staff, and faculty will continue to feel unwelcome within academic spaces.

Many participants, however, approached cultural inclusion through an intersectional lens. One participant noted:

“The decolonization of engineering faculties is intersectional by nature. Everyone belongs. However, different groups are being forced out by the engineering culture.”

What, then, is being lost due to this “forcing out” or exclusion of non-white, non-European cultures? Participants often came back to the nature of the engineering profession. It is one of service, one which directly and intentionally works to make society better, safer, and healthier. As one participant explained, “Engineering is about community, it is at its heart, a service profession.” Engineering directly interfaces and impacts community. If groups of people are systemically excluded from the profession, there is a richness of perspective that is lost in the technological, infrastructural, and societal challenges that engineers are often tasked with solving. The engineering profession has everything to gain in increasing the cultural representation of Indigenous and other historically excluded groups—there is another dimension of understanding the world and complex design problems through the epistemological and ontological systems of Indigenous people.

Engineering institutions need to embrace the cultural complexity of the people they serve, and rebuild away from the institutionalized cultural homogeneity and sanitized environment. Only then will Indigenous and other historically excluded communities be safe and welcome within the fabric of HEIs and be able to synthesize their identities and ways of being into their work and education.

4.3 Interweaving Indigenous and empirical worldviews

Participants overwhelmingly spoke of the need to include traditional Indigenous worldviews into engineering curricula, as well as the deconstruction of what engineering education traditionally holds to be a “keeper of knowledge.” Participants cited Elder Marshall’s teaching of Etuaptmumk, Two-Eyed Seeing. In the words of one participant:

“Western science and traditional Indigenous ways of knowing overlap and support each other. We as engineers need humility for the impact we have on others and the impacts on the planet. We sometimes externalize and commodify certain things in the natural world. If engineers can change our mindsets to encompass Indigenous ways of knowing, it will only improve our practice. The friction point lies in convincing faculty that the wholistic incorporation of Indigenous ways of knowing into the curriculum is an enrichment, and a natural result of reconciliation and decolonization, as opposed to a burden.”

In the words of another participant:

“There is huge opportunity to incorporate Indigenous worldviews into the engineering curriculum. As Elder Albert Marshall speaks of the principles of two-eyed seeing - there is room for both ways of knowing. We can use both together, incorporating Indigenous understandings of interconnectivity and the connection to the land into our work.”

Participants spoke of the need for Indigenous worldviews to be wholistically woven into engineering curricula, as opposed to isolated, granular initiatives sprinkled within the undergraduate programming. Indigenous presence needs to be felt throughout a student’s journey in engineering, so that they may actively practice

and learn the skill of synthesizing knowledge through Two-Eyed Seeing.

Academic institutions have much to learn from Indigenous communities. As one participant said:

“Generally, Indigenous communities appreciate the wholistic nature of things and have an inherent understanding of the complexity of systems. Changing one thing in a system will affect everything else because of the vast web of interconnections that exist. There is also the idea that engineering doesn’t stand alone, science doesn’t stand alone. All of these things are wrapped together with artistry, creativity, spirituality and beauty.”

However, another participant warned:

“We must be careful about pan-Indigenizing. Not all Indigenous cultures are the same, which is why it is important to present a variety of Indigenous worldviews from a variety of nations, and not simply just tokenizing Indigenous voices and perspectives.”

This way of understanding the world is rooted in Indigenous communities and the land. There is a need, then, to reframe what the engineering education views as a “keeper of knowledge.” Does an individual need a PhD to be considered an expert in a subject, or qualified to pass on their knowledge to the next generation of engineers? A participant explained, “Elders have always been doing the work of engineers. They serve community, they shape society, and that is what an engineer does.” There is great opportunity to weave together traditional and empirical technical knowledge and build partnerships between communities and HEIs. By approaching relationships between Indigenous communities and HEIs with an understanding that each party comes to the table as a learner, and not an authority, creating an ecosystem in which reciprocal relationships of learning and bringing together worldviews can be realized. As Elder Marshall has said, “It should be simple, it’s just re-balancing.” By learning from each other in partnership, we can move to re-balance the relationships and power hierarchies that have resulted in power imbalances between Indigenous communities and engineering education and profession, moving our shared journeys forward in the spirit of reconciliation.

4.4 It always comes back to the land

The importance of the connection to the land was a final common theme that participants spoke about when asked how engineering education can become a more just and inclusive place for Indigenous students, faculty, and staff. The experience within engineering programs was expressed to be extremely academically rigorous, but without tangible connection to the land. As said by one participant:

“If you are not given opportunity to appreciate the beauty and complexity of the land, when you become an engineer, how will you know how to protect it? There is spirit and life in the land that is sacred; without an appreciation of the complex interconnected webs of relations, you will approach your engineering work without a mindset of respect and stewardship.”

Another participant said:

“What does higher education mean? I think we get lost in the physical structure of the institution, as opposed to the spirit of education. It’s about thinking beyond bricks and mortar. Especially as engineers, we need to draw inspiration from the land when we are solving our engineering challenges, and reimagine what it means to be innovative.”

Participants could not imagine an academic institution that had woven reconciliation into its praxis and structure without being rooted in the land. In many ways, the relationship with the land is an extension with our relationships with one another. Teaching engineering students to be stewards of the land, and to view the world through a lens of Netukulimk, is transformative and is at the crux of decolonizing engineering education.

5. The path forward: recommendations for future actions

Decolonization and Indigenization are two sides of the same coin. In order to Indigenize without harm, university engineering faculty settlers like ourselves need to decolonize. Said another way, university engineering faculties need to change (i.e behaviours, norms, processes, and structures) to do no cultural harm to Indigenous students staff, and faculty.

We highlight that this reports’ anonymized data describes experiences and direction provided by Indigenous engineers at Canadian institutions. Based on the anonymized data that we heard in the interviews for this report, we recommend the following concrete actions that enable the Indigenous cultural safety needed in our Engineering faculties.

Here are practices that we heard would be useful to Indigenous academics that we interviewed.

1. System change requires changes at all scales. Change need to be made in ourselves as individuals, in our classes' curriculum and conversations, in research groups' culture and practices, in our faculties' and our national institutions' policies. Leadership must take an active, engaged, and meaningful role in building systems that enable other scales of change to succeed.
2. Hire and partner with Indigenous people as a strength, not an obligation. Observe and celebrate Indigenous knowledge and strength.
3. Ask your Indigenous team members about their cultural practices, including their relationship with the land. Reflect on whether your institution has barriers to or strengthens and supports those practices. With guidance from your Indigenous members, develop an action plan and resource a strategy to eliminate the barriers to Indigenous inclusion.

   Note that different Indigenous cultures will have different practices. Seek to understand the Indigenous members engaged with your faculty, as well as the Indigenous peoples of the land you are located on.

4. Notice, ask about, and appreciate the strength of the different lenses through which your Indigenous colleagues may act in and understand the world. Value Indigenous people keeping their cultural ways of being and knowing. Explore the creation of Indigenous lead cultural spaces and relationships with your institution's Indigenous Centre and studies department.
5. Proactively identify and eliminate economic barriers to Indigenous participation in your program through bursaries, scholarships and Indigenous access to engineering programs.

The challenge of continuing our shared journey of reconciliation is complex and multi-faceted. The conversation on how we can make engineering in academia more inclusive and just for Indigenous and other historically excluded groups is still developing. We invite a continued conversation about these opportunities for growth, improvement, and equity, and the challenges encountered along the way.

Until the focus of Indigenous inclusion is centered on the celebration, validation, and resurgence of Indigenous cultures, epistemologies, and ontologies within the engineering academy, Indigenous students, staff, and faculty will continue to feel unwelcome within academic spaces. This is the experience of Indigenous engineers in Canadian engineering faculties.

We recommend a leadership community of practice, guided by Engineers Canada's Indigenous Advisory Committee, to synthesize tangible steps and courses of action that accredited engineering programs across Canada can take to make academia more inclusive of Indigenous people.

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