



Indigenous Knowledges and Perspectives in Engineering Education: Team Reflections on a Series of Faculty Workshops

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ABSTRACT

CONTEXT

Indigenous Peoples, and their languages, cultures, Knowledges, beliefs, and values have been historically silenced through systematic colonial suppression in Canada for centuries. Since 2008, the country has been engaged in a national effort to learn these truths and practice reconciliation, called for by the Truth and Reconciliation (TRC) of Canada. Education, used as a tool to eradicate Indigenous Peoples in Canada, is one mechanism by which Canadians can right these historical wrongs. As such, four engineering faculty members in a large research university in Western Canada in a year-long internally funded project designed a series of engineering-specific faculty workshops/events to bring Indigenous Knowledges and perspectives into engineering education.

GOALS AND PURPOSE

The project goals were for faculty members to experience a shift in perspective by seeing engineering education through Indigenous worldviews, and to support faculty in integrating Indigenous Knowledges, perspectives, and design principles into engineering curricula. The purpose of this paper is to explore the impact of this work from team members' perspectives.

METHODS

Team members' Reflections After Events are inductively analysed for overarching themes.

OUTCOMES

Three themes emerged from team members' individual critical reflections: *challenges*, *culture*, and *change*. There were differences in team members' responses to the themes and in the tones of their reflections. It is anticipated that this paper will stimulate both intertextual and interpersonal conversations with Indigenous Peoples and allies working to make space in engineering education for Indigenous Peoples and their ways of being, knowing, and doing.

CONCLUSIONS

Overall, 1. This work requires many people; 2. mistakes are made; 3. students are vital in forwarding this work; 4. faculty are in different places; and 5. a paradigmatic shift is required. Through team members' critical reflections we have stimulated deeper understandings on the impact of this work and how paradigmatic change was observed and can be encouraged.

KEYWORDS

Engineering education, faculty workshops, decolonize, Reflection After Events

Introduction

Indigenous Peoples, and their languages, cultures, Knowledges, beliefs, and values have been silenced through systematic suppression via colonialism in Canada for centuries. Since 2015, the country has been engaged in national efforts to learn these truths and engage in reconciliation, as called for by the Truth and Reconciliation (TRC) of Canada. Education, used as a tool to eradicate Indigenous Peoples in Canada, is now named as one of the mechanisms by which Canadians can right these wrongs, as outlined in the TRC's 94 Calls to Action (Truth and Reconciliation Commission of Canada, 2015). As such, four engineering faculty members in a large research university in Western Canada were awarded a year-long internal Indigenous Initiative Fund (IIF) grant to build good relationships between Indigenous and non-Indigenous engineering stakeholders and enrich engineering education by seeing engineering through Indigenous worldviews. The project involved (1) funding a part-time Elder-in-Residence position to support our Indigenous and non-Indigenous engineering community and guide our project in safe, culturally sensitive and shared ways; (2) offering a series of engineering-specific workshops/events to explore Indigenous cultures, pedagogies, Knowledges, beliefs and values in teaching and learning and integrate these worldviews into engineering education in relevant, genuine, and good ways; and (3) recruiting an Indigenous student leader to advise the project. Our project team designed 12 engineering-specific faculty workshops/events in partnership with several groups, including a team from the institutional teaching and learning centre led by an Anishinaabe-Metis-Dakota Indigenous Initiatives Educator and artist, an Indigenous undergraduate engineering student, and colleagues from the Department of Native Studies. It was supported by the Indigenous Student Centre on campus.

The project was action-oriented toward characterizing the barriers to integrating alternate worldviews into engineering curricula and enacting ways to alleviate those barriers. The goals of the project were for faculty participants to experience a paradigmatic shift by seeing engineering and education through Indigenous worldviews, and to support faculty in integrating Indigenous Knowledges, perspectives, and design principles into engineering curricula. These outcomes were purposed to affect an increase of Indigenous partnership, achievement, representation, and belonging in the Faculty, and support the enhancement of engineering education with Indigenous worldviews in significant, safe, and culturally sensitive ways. The work is aimed to resonate with our engineering students through its translation into engineering curricula and ultimately engineering practice.

The project team comprised of the *Project Lead*, a new tenure-track assistant professor, a white woman settler, born and raised on Treaty 1 Territory and the Homeland of the Métis Nation, with a disciplinary background in visual arts, creative writing, communication, and education; a *Post-Doctoral Fellow*, a Friday-born girl from the Akan Clan in Ghana, with a PhD in Biosystems Engineering; a *Director*, a Métis Professional Engineer and Director of the Indigenous engineering access program (ENGAP) in the faculty; and an *Administrator*, a Professional Engineer with Mennonite heritage and disciplinary backgrounds in engineering and engineering education, who at the time of this project, was an Associate Dean (Design).

The workshops and events were designed using the Anishinaabe teachings of the Sacred Hoop – as taught to us by the Indigenous Initiatives Educator and artist, Leah Fontaine – as an organizational framework to both demonstrate the incorporation of Indigenous ways of being, knowing, relating, and doing into curricula, and connect participants to the power of these perspectives (see Figure 1). The Sacred Hoop is a circular framework in which the four human aspects – Mental (knowledge; cognitive), Emotion (feelings; affective domain), Physical (hands-on, skill-based; psychomotor), and Spirit (history, relationship-building) – are represented to celebrate their connectivity and unity (Fontaine 2010). The Sacred Hoop offers an Indigenous framework from which one can design curricula that align with the knowledge, skills, attitudes, values, and behaviours that engineering educators are required to develop in their students (for more on how the Sacred Hoop in engineering education, see

Seniuk Cicek et al. 2019). We argue that engineering educators often omit integrating the Emotion and Spirit elements in traditional engineering courses. The Sacred Hoop teachings offer an Indigenous way to design curricula that will holistically activate faculty and students and enhance their learning through the diversification of perspectives. Using Indigenous perspectives to design engineering curricula was chosen to demonstrate to Indigenous and non-Indigenous faculty and students the Price Faculty of Engineering's commitment to honouring a shared history, holding shared values, and developing a shared approach for working towards Truth and Reconciliation in Manitoba and in Canada.

The purpose of this paper is to share project leaders' individual critical reflections on the workshops /events offered thus far, stimulating deeper reflections for the team, and conversations with Indigenous Peoples and allies working to enhance engineering education with the voices of diverse, historically, and presently silenced Indigenous Peoples. Through the processes of critically reflecting and sharing, we aim to learn more on how to move forward in meaningful and impactful ways.

Workshops

There were 12 workshops and events designed using the Anishinaabe teachings of the Sacred Hoop as guided by Leah Fontaine, planned over the four seasons of a year (see Figure 1).

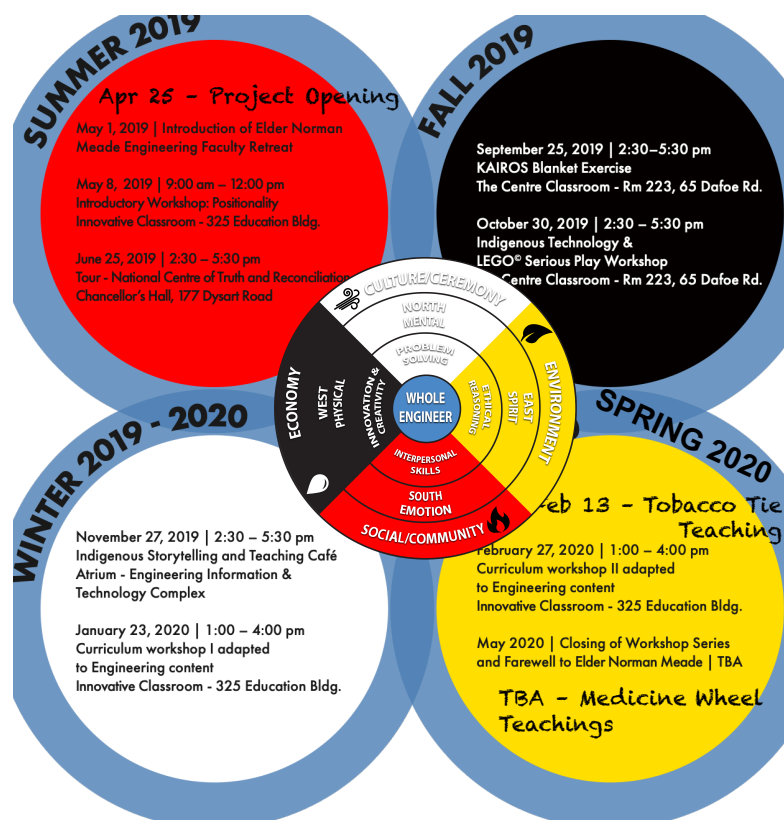


Figure 1: Post card designed using the Anishinaabe teachings of the Sacred Hoop, to communicate to faculty the Indigenous Initiatives Fund workshops & events

Workshops/events included:

Spring/Summer: *Project Opening: Smudging Ceremony and Feast (April 2019); Welcome to the Elder-in-Residence at the Faculty Retreat (May 2019); Positionality Workshop* where Faculty participants learned of the importance of relationships fostered in knowing What is my Story? (i.e., Who am I? Where am I from? Why am I Here? Where am I Going?) from the centre of the Sacred Hoop (May 2019); Tour of the National Centre for Truth and

Reconciliation (housed in our institution) in honour of the victims and survivors of Residential Schools in Canada, and their families and communities (June 2019).

Fall: “*Gwayakotam: They Hear the Right Thing, Find Out the Truth*” Workshop, where participants experienced a KAIROS blanket exercise that simulated the histories and stories of colonialism (September 2019); *Indigenous Technologies and LEGO © Serious Play Workshop* where faculty and students learned of the technical designs and innovations of Indigenous Peoples and used LEGO© builds to discuss bridges and barriers to bringing Indigenous ways of being, knowing, and doing into engineering education (October 2019).

Winter: *Teaching Café* with Indigenous and ally academics teaching faculty, staff and students about the history of Indigenous Peoples in Manitoba, the negative impacts of engineering hydro projects on Indigenous Peoples and their communities in Northern Manitoba, and Indigenous perspectives in Science as understood via Indigenous Languages (November 2019); “*Mashkiki Beshibii’igan: Medicine Line*” Workshop (*Curriculum I*) that introduced how curricula and pedagogy can be intersected with both western and Indigenous perspectives to promote successful teaching and learning in new and innovative ways via the Sacred Hoop framework (January 2020).

Spring: *Tobacco Tie Teaching* offered by Elder-in-Residence Norman Meade (February 2020); “*Mashkiki Beshibii’igan: Medicine Line*” Workshop (*Curriculum II*) (February 2020); *Medicine Wheel Teachings* by Elder-in-Residence Norman Meade; *Closing of Workshop Series* and feast.

The project has not yet closed as two Spring 2020 workshops/events (*Medicine Wheel Teachings* and *Closing of Workshop Series*) were delayed due to the COVID-19 pandemic.

Methodology

Team members’ experiences with the project were explored using critical reflection and inductive analysis. We engaged in Reflection After Events, as described by Boud (2001):

Much important reflection can occur once the immediate pressure of acting in real time has passed. Some learning inevitably takes time and requires the ability to view particular events in a wider context. ...it is important to emphasize that it is not simply a process of thinking, but a process that also involves feelings, emotions, and decision making. We can regard it as having three elements: return to experience, attending to feelings, and reevaluation of experience...

Return to experience offers the opportunity to revisit the event with a wider perspective and experience its full impact (Boud, 2001). Importantly, *attending to feelings* supports experiencing both negative and positive emotions, so the former can be “discharged or sublimated; otherwise, they may continually distort all other perceptions and block understanding” and the latter “can be celebrated, because they enhance the desire to pursue learning” (Boud 2001). Re-evaluating the experience enables “freer evaluation of experience than is often possible at the time” and involves scaffolding knowledge, making connections, and taking ownership of the ‘new’ knowledge (Boud 2001).

Team members’ critical reflections were inductively analyzed. Inductive analysis is recommended if little is known about the phenomenon, and the aim is to move “from the specific to the general, so that particular instances are observed and then combined into a larger whole or general statement” (Elo and Kynga’s, 2008).

In February 2020, the project lead invited all team members to critically reflect on the project in a Reflection After Events “by writing a reflection from your own perspectives of the project.” She explained, “I envision perhaps a paragraph or two where you share your own observations, thoughts, reflections, and evaluations of the workshops you’ve co-designed or facilitated and/or have observed/participated in, and suggestions for moving forward. Perhaps a ‘lessons learned’ retrospective.” The project lead then inductively analyzed these

critical reflections for overarching themes. Themes and the resulting discussion were critically reviewed by all team members.

Project Team Perspectives: Findings

Three themes emerged from team members' individual critical reflections: *challenges*, *culture*, and *change*.

Challenges. There were diverse, and at times “clashing” perspectives among the team members and the different contributors team members engaged with from across the institution to develop the workshops. These challenges were resolved by “listening to understand”, revisiting workshop objectives, and making relevant changes to engage all contributors and audiences. As one team member explains, “It was easy to assume that all Indigenous Peoples had the same negative experiences. I know we read that we can't generalize Indigenous Peoples but that is something that comes so fast as we meet people. That is one of the many things I learned. Listen to understand first.”

There were also challenges in finding a “healthy middle” ground to engage engineering faculty and staff interests. We wished to lean towards concrete action while authentically respecting and honouring the processes one needs to engage in with Indigenization, including spending significant amounts of time active listening, reflecting, learning the historical contexts, and engaging with more elusive ideas (such as positionality and the KAIROS© Blanket exercise). There was also the challenge of lack of attendance in the workshops despite the belief that all faculty held a “principled agreement” in the importance of Indigenization for its own sake as well as to “make Engineering more relevant and of better service to society.” As one team member reflected: “...the attendance at workshops has caused us to wonder why the principled agreement has not translated to active participation...” Indeed, the participation challenge was mitigated after several workshops by inviting two allied faculties – Agricultural and Food Sciences and Architecture – to attend the workshops, and in two cases, by including students as participants (e.g., in the LEGO workshop and in the Teaching Café). At times this solution was very successful, increasing attendance in the LEGO workshop to capacity (~35 people) and resulting in over 70 people attending at least one of the three presentations during the Teaching Café. However, this was problematic when some of the allied faculty members attending for example, the Curriculum I workshop, were at different places in their journeys to Indigenize the curricula than their engineering colleagues. As a result, they were frustrated by the perceived beginner level of the workshop. There was also frustration with their colleagues' engineering thinking, which is typically more concrete/positivistic than our architecture colleagues.

Culture. The workshop series highlighted the “engineering profession's culture for action.” This culture made offering some of these workshops tricky. Workshops that dealt with concrete ideas like historical engineering projects' impacts on Indigenous communities or curriculum initiatives that were purported to support Indigenization seemed to garner more interest. Engineers typically expect concrete solutions to ‘problems’. So, for example, some engineer participants came to these workshops expecting to walk away with concrete programming that they could implement in their curricula. When this wasn't the outcome, they were disappointed. This recalls Expectancy violations theory (EVT), which “is an interpersonal communication theory that... distinguishes between positive and negative violations. ...[M]ost advice for communicators is to avoid violations of expectations” (Burgoon, 2016). Leaving participants' expectations unfilled can lead to participant dissatisfaction and unrealized project outcomes. At times, some participants found the workshop objectives/titles unclear, both prior to and after attending the workshops. In unclear objectives and expectations, there is evidence of communication barriers. The engineering profession's culture for action, problem solving, and penchant for solutions is something that we must explicitly consider as we move forward with this project. Finally, there is a culture of “ambivalence” and “privilege”, reflected on as: “those who have no quarrel with the objective but who sit in privilege, and thus in ambivalence. These are well-intentioned, engaged faculty

members who do not identify any personal imperative to attend or engage deeply with the issue.” Privilege was also felt by our team members – the privilege to feel proud by this work and measure it by colonial counts, and as one team member reflected, the “‘all-round rights and privileges’ where my choices have never been restricted, where my acquiring knowledge based on different perspectives was an asset and welcomed by my peoples, where I am always connected with my peoples no matter where I am in the world.” In this work, privilege and ambivalence requires explicit recognition and disruption.

Change. There was evidence of change via implementation, engagement, learning, and transformations. As one team member reflected: “During the workshops the attendees were engaged and appeared to be learning. Afterward it came to my attention that some of the professors who attended the workshops implemented the things they had learned in the workshop directly into their classrooms.” This same team member assuaged their challenge with participation when they recognized the “snowball effect” the workshops were having:

I was originally disappointed with the turnout for many of the sessions until I realized that there was a bit of a snowballing effect. After I did presentation on Indigenous Technology to what I thought was a small crowd I had at least six professors approach me and ask if I could do my presentation to their students. I gladly accepted and have been able to reach hundreds of students through this initiative.

The work of the Elder was also acknowledged as transformative:

Also, the Elder, [who is] part of the IIF [project], is housed within ENGAP [Indigenous engineering access program] and there has been a real transformation of the ENGAP space because of this. Some of this transformation was physical as a space had to be provided for the Elder which gave us the opportunity to request additional space for ENGAP students that we had lost due to providing an office for the Elder. This allowed us to secure two additional small rooms that the students are able to use as study rooms or group work rooms. More importantly having Elder Meade in our space once a week has resulted in an emotional and cultural change. I see numerous students and Engineering Faculty taking the opportunity to speak with Elder Meade.

There were changes in perspectives for participants – e.g., “they recognized that it takes a mindset shift” – and for team leaders: “One unexpected learning and finding out of these workshops/events is that this work takes mindset shifts... This happened to me.” Another team member reflected on the shifting perspectives they experienced when they embodied the role of workshop participant, and became aware of how Residential schools were not schools in the familiar affable sense, but rather instruments for the genocide of Indigenous Peoples in Canada:

As a participant, the workshop series gave me the opportunity to better understand the culture of the place through learning about the history of Indigenous Peoples and the meaning of “We Are Treaty People.” ...our visit to the National Centre for Truth and Reconciliation (NCTR) provided me with the opportunity to learn and have a better understanding of the “residential school” system and the Truth and Reconciliation Commission of Canada’s (TRC) 94 “Calls to Action.” At the NCTR, I got the opportunity to explore with others the meaning of the “residential school” system. To my surprise, the word “school” and “education” used in the “residential school” system were nowhere near what I had perceived them be.

Finally, it is important to note that the other two themes, *challenge* and *culture* require, *change*: “One observation is that like many initiatives, the workshops tend to attract those already on board and already to some extent educated on the issues. This is coherent with change management, where one seeks to engage champions and allies (10%) and disregard noisy detractors (10%). In this case, it has brought the “ambivalent 80%” into focus...”

Discussion

Despite the commonality of the three themes *challenges*, *culture*, and *change* across team members, there were differences in team members' responses to the themes and in the tones of their reflections. Perhaps these differences were due to their positions on the team, and their power or powerlessness to effect or experience change.

The Post-Doctoral Fellow and Director of ENGAP recognized the challenges but felt motivated/encouraged by the changes they respectively witnessed in personal and community transformation. The Post-Doctoral Fellow celebrated their opportunity to be both a team member and participant in the workshops, appreciating the "opportunity to learn" and acknowledging that the workshops "set my foundation right to move forward in my current position..." The Director had the opportunity to witness how the Elder-in-Residence... afforded "real transformation of the ENGAP space" – transformation described as physical, – gaining space for Indigenous students – emotional, and cultural, resulting from the opportunities to interact with Elder Meade. These transformative changes can be classified as "Decolonial Indigenization" on the spectrum of Indigenization as ascribed by Gaudry and Lorenz (2018). Decolonial Indigenization is the most impactful type of Indigenization that can be achieved according to Gaudry and Lorenz (2018), which could explain the inspiration in the Director's critical reflection.

Differently, the Project Lead and the Administrator expressed that the challenges remained, with the Project Lead more pessimistic and the Administrator more contemplative in their respective responses. The Project Lead witnessed a change in a mindset shift during the second last workshop, and although understanding this paradigmatic shift as remarkable and necessary in the process of Indigenization, and recognizing it in herself, she still wondered if this was enough impact to justify the resources spent:

One unexpected learning/finding in these workshops is that this work takes mindset shift, perhaps rather than concrete action, or rather first. This happened to me; it's a way of thinking about and learning about Indigenous perspectives and opening up to our own understanding of these as missing from our curriculum. I saw this firsthand with one participant who came to most workshops in the series. At the second last workshop, the Curriculum I workshop, they recognized that it takes a mindset shift. I saw that person bring their own stories (i.e., positionality) to their classroom; I saw them change their approach to teaching, personalizing it more. Personalizing engineering! Is this success? Is one person's changing mindset a victory in all the hours and hours and hours put into these workshops?

The Administrator felt our engineering community "seems to agree in principle that Indigenization is important for its own sake and that it can make engineering more relevant and of better service to society", whereas the Project Lead did not perceive this agreement, and questioned how to garner it:

How do we encourage the learning about Indigenous Peoples, Indigenous history, Indigenous engineering/engineers, colonial history, residential schools, the truth about Canada as a genocidal nation presently and in history, to continue? How do we make it, communicate it, as really relevant and important to engineers and engineering education? How do we get engineering faculty to understand the importance AND the connection to engineering? Can we change faculty? Or are we better off to work with students, who will demand change and already see the world differently than the older generations who teach them?

The Project Lead was left questioning the work and her role, whether her position as an assistant professor and her identity as a non-engineer made her an effective project lead:

Is our work a waste? What are the ripple effects? What are the unintended consequences? Are they harmful? Are they good? How do we know we are making a difference? Inroads? Truthfully, I felt tired after all this work... Who should take the lead

on this? Where is my role? I'm not even an engineer! Does my/the message get lost because it doesn't come from an engineer? Am I demonstrating 'followership'? Is this my role?

(For a discussion on *followership*, see Hurwitz and Hurwitz (2009), who argue, "the good follower, having seen what direction the leader wants to go in, figures out how to get there quickly, effectively, and without anyone getting hurt in the process".)

The Administrator felt the workshops supported institutional structures: the TRCC's Calls to Action; the university's Strategic Plan; and the faculty's vision and mission, and was encouraged that she did not encounter "any administrative or academic barriers to holding the workshops", whereas the Project Lead felt a fundamental clash with the academy:

This type of work and evaluation are marred by the structures of the western academy. As an assistant professor, pre-tenured, I must measure and evaluate this work. I must find its impact – which is super helpful and exciting – but motivated by demonstrating my own worth – commodities to apply for personal gain: for tenure. Not for the sake of the work itself. I wasn't motivated to do the work for this reason; and yet I must report on it to support myself in this system.

The Administrator recognized that "it remains a challenge to find a healthy middle that engages faculty and staff members' interest while authentically honouring the issues with which one needs to engage in Indigenization." The Project Lead believes "...engineering students and Indigenous engineers must help us figure out how to move forward with this work. And the administration must embrace it so that this is someone's mandate and we keep moving forward in alignment with the vision for the faculty supported by the power of those in charge." Despite these expressed frustrations in doing this work, there was also recognition by the Project Lead of the fortune in being able to engage in this work. As she reflected: "I am grateful for all the very good and giving people whom I've met and worked with through this work. And humbly acknowledge that I've only put in 3 years – and many – most especially Indigenous Peoples – have put in lifetimes of work. I don't have the right to feel frustrated. Only to figure out the next way forward."

Concluding Remarks

In keeping with the teachings of the Sacred Hoop, we reflect via this framework that this work:

- Takes a lot of people (Ground, Sky)

And in this work:

- Mistakes are made (East)
- Students are vital in forwarding this work (South)
- Faculty are in different places (West)
- A paradigmatic shift is required (North)

And in doing this work:

- We're grateful (Centre)

Through team members' critical Reflections After Events, we have stimulated deeper understandings of the impact of this work and our roles in doing this work; discharged negative emotions and celebrated positive ones; recognized the challenges and cultures at play; and observed paradigmatic change, all of which will inform how we can move forward with this project in ever more meaningful and impactful ways. Further, as stated by one reviewer of this paper: *While this article is not directly about the change being proposed by the program as described and conducted, change of a very major kind is what would be the outcome should the program succeed, as hoped, in the long term. The nature of the change*

being proposed, and the kinds of resistance experienced - e.g., absence of intended audiences - suggest that attention needs to be paid to the nature of the change proposed and the resistances it will inevitably meet along the way. We are grateful for this insight. Theories of change, particularly Appreciative Inquiry, where hopeful images and positive questions will be explored as the research and this work continues (Coghlan et al., 2003).

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