

Decolonizing and Indigenizing Engineering: The Design & Implementation of a New Course

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We are writing this on Treaty 1 territory on the lands of the Anishinaabeg, Cree, Oji-Cree, Dakota, and Dene Peoples, and on the Homeland of the Métis Nation. The clean water that runs through our taps comes from the waters of Shoal Lake 40 First Nation in Treaty 3 territory; the electricity that powers our computers, lights, car, is generated by the waters in Treaty 5 territory. We are dedicated to learning and teaching the truth about Indigenous Peoples, their cultures, their histories and their present, and working to reconcile these truths through education to find a better way forward.

Reading this small, miraculous book, I get the feeling of being at open sea, far from land, on one of those rare nights when the surface of the water becomes so still and the reflections of the stars so crisp that the horizon line vanishes and there is no longer a sense of sky or water, of up or down or East or West, of what is reflection and what is reality — only the feeling of being immersed in a cosmic everythingness, with pure spacetime stretching in all directions, star-salted and possible. — Maria Popova [16]

Abstract – This practice paper introduces a new course designed by one Indigenous and one non-Indigenous engineering educator at the University of Manitoba to decolonize and Indigenize engineering. Working with an Indigenous teaching assistant, and supported by a doctoral student auditing the course, we facilitated a small group of Indigenous and non-Indigenous engineering students to think critically about making place and space for Indigenous Peoples and worldviews in engineering. Here, we share the course design, our reflections on the course, and our plans going forward. Our initiative is one answer the Calls to Action by the Truth and Reconciliation Commission (TRC) of Canada to learn the truth about Canada as colonizer and use education as a tool for reconciliation. In doing so, we aim to provide engineering students with knowledges and perspectives for working successfully with First Nations, Métis and Inuit Peoples and communities in engineering practice in Manitoba, and in Canada.

Keywords: decolonization, Indigenization, engineering education, reconciliation, undergraduate course, critical reflection

1. INTRODUCTION

Decolonization – the undoing of colonialism – and *Indigenization* – the centering of Indigenous Peoples and their ways of being, knowing, doing, relating, and making – are being discussed in social, political, economic, and

cultural contexts in Euro-colonized nations around the world (e.g., [4][7][11]). Governments and citizens are grappling with the harms done/being done to Indigenous Peoples and Indigenous communities and are looking and working for decolonizing ways forward. Globally, this has led to the United Nations Declaration on the Rights of Indigenous People (UNDRIP)[24], which Canada endorsed in 2016 [3], and which received Royal Assent on June 21, 2021[6].

In Canada, efforts are being galvanized through Bill C-15 [15], and the Truth and Reconciliation Commission (TRC) of Canada's *Calls to Action* [21]. These declarations and calls have spurred reconciliation efforts in all levels of education, from K – 12 to postsecondary. At the University of Manitoba for example, the Strategic Plan highlights the necessity of decolonization and Indigenization of the university [25]. Engineers and engineering educators also have a professional responsibility to seek the truth, commit to and lead reconciliation efforts [20], and the TRC Calls to Action have galvanized their efforts [19]. An important goal of decolonizing is not only the recognition and undoing of colonialism but also critical reflection on western ideologies and knowledge systems. Indigenizing the engineering profession and engineering education will result in the explicit inclusion and integration of Indigenous knowledges, cultures, approaches, and perspectives in the engineering field.

This practice paper discusses a new course designed to introduce engineering students to a variety of topics relevant to decolonizing and Indigenizing the engineering

profession. *ENG 4100 Contemporary Topics in Engineering Practice: Decolonizing and Indigenizing Engineering*, first offered in Winter 2022 at the University of Manitoba, engages students to critically reflect on current perspectives and practices in decolonizing and Indigenizing engineering. The aim of the course is to provide students with knowledge for working successfully with First Nations, Métis and Inuit communities on engineering projects, with emphasis on engineering in Manitoba. In this paper we will share our process for developing the course and describe its details, share reflections from the course developers/instructors, the teaching assistant and a doctoral student auditing the course, and make recommendations for future offerings.

1.1 Positionality of Authors

Here we situate ourselves, so the reader knows who we are, where we come from, and why we are here. We do this as we have been taught by our relations, and our Indigenous teachers and colleagues, and as modeled by Indigenous leaders in education, such as Sheila Cote-Meek [2].

Randy: I am perceived, and society treats me as a white cis-gendered middle-aged male. I am heterosexual and I use he/him pronouns. I understand by virtue of my whiteness and maleness that I have been blessed with significant privileges that many others do not have. In reality, I come from a mixed background that includes German, French and Métis ancestry. Almost none of my cousins share the same privileges I have by virtue of their skin colour (race), location where they were raised, and school they were educated in. I am a geological engineer. I practiced engineering for 10 years as a consultant geotechnical engineer, technical services advisor, and a project manager before returning to Manitoba to become the Director of ENGAP. I am a husband, father, son, uncle and nephew.

Reed: I am a Métis/Mennonite man born and raised in Winnipeg, Manitoba. I am a white-passing individual, and do not take for granted the privilege this holds and the ways this shapes my experiences as an Indigenous person. I am currently a master's student in the Price Faculty of Engineering at the University of Manitoba, with a focus on engineering education. My primary interests lie in how Indigenous students experience engineering education, and how involvement in an access program shapes those experiences. Indigenizing engineering is also of interest to me, hence my involvement in this course. It has been a privilege to be a part of the inaugural offering of this course alongside Randy, Jill, and Kyle, and all the students who enrolled.

Kyle: I am a Métis and Ukrainian man (he/him), born and raised in the Métis homeland, on Treaty One Territory. My dad and his parents were born on Treaty Two Territory near Lake Manitoba First Nation where

many of my relatives currently live. I am presently a doctoral student, studying physics at the University of Manitoba. Being raised in a large city has given me many privileges. This includes the preparation required for me to succeed in courses at the university. I am grateful for Randy, Jill, and Reed for inspiring me to learn, study and improve myself. Viewing their pedagogy in their course has enabled me to become a better student, educator, and person.

Jill: I am a white settler woman and use the pronouns she/her. I grew up as an uninvited visitor on Treaty One territory and in the homeland of the Métis Nation. I am a mom, a wife, a sister, a daughter, and friend, and mentor. I work as an Assistant Professor in the Centre for Engineering Professional Practice and Engineering Education at the University Manitoba. My research focuses on people, space, and place in the engineering education context. My motivation is to make space and place in engineering education and research for emotion and spirit, and for the unheard and unloud voices, and to broaden worldviews of who and what are the stakeholders in this field. I am privileged to work with Randy, and to have developed and taught this course with him, to work with Reed to teach this course and support him on his graduate school journey, to learn from Kyle, who is auditing this course, and to hear and learn from the knowledges and perspectives of our guests and students in the space of this course. I am grateful to our faculty and our university for supporting this course.

2. COURSE DETAILS

Randy and Jill are involved in several initiatives to make space for Indigenous Peoples and their ways of being, knowing, doing, relating and making in engineering education. They received two internal Indigenous Initiatives Fund (IIF) grants to advance this work. The first grant, awarded in 2019, consisted of a series of faculty/staff workshops, hiring an Elder-in-Residence, and working with an ENGAP student leader in the project (e.g., [17][18]). The second grant advanced these initiatives but added the design of a course to prepare engineering students to work with Indigenous Peoples and communities in engineering practice. The fund enabled us to hire an instructor, a teaching assistant and offer honorariums for Indigenous guest speakers.

Serendipitously and unbeknownst to one another, both Randy and Jill had a research leave in Fall 2021. They determined that as part of that leave they would develop the course. It took six months. They began with a list of topics that they brainstormed together, and then both gathered and reviewed readings, resources and videos, designed assignments and evaluations, and contacted and invited guest speakers. They were supported in their knowledge gathering in several ways. First, Randy, a Métis Man and Professional Engineer with over 10 years'

experience in industry and almost 25 years as the Director of ENGAP has accrued knowledges, friends, and experiences that give him unique perspectives and knowledges in this area. In addition, they both participated in a 10-week Summer Institute for Literacy in Indigenous Content course that is offered by the Department of Indigenous Studies at the University of Manitoba. They are both involved with the national Decolonizing and Indigenizing Engineering Education Network (DIEEN), and in several research projects and activities that have connected them with Indigenous colleagues and allies who are working in these ways. This provided them with knowledges, resources, and connections with Indigenous colleagues that they are very grateful for and have been integral in building this course.

There were some challenges with dates; a few speakers had to be rescheduled as the term start-date changed. However, for the most part, the process, though a lot of work, was surprisingly smooth. This likely can be credited to the foundations that had been built prior to this initiative, and to the synergy Randy and Jill had working together.

The remainder of this section provides the course details, including goals, assessments, guests and topics. (For learning outcomes, see Appendix A.)

2.1 Course Goals

The intent of this course is to:

- Introduce students to *United Nations Declaration on the Rights of Indigenous Peoples* and the Truth and Reconciliation Commission of Canada *Calls to Action*.
- Engage students to critically reflect on current perspectives and practices in decolonizing and Indigenizing the engineering profession.
- Teach students about the history of Indigenous Peoples in Manitoba, Treaties, Land Acknowledgments and traditional Indigenous technologies.
- Expose students to Indigenous perspectives on sustainability, extractive industries, Indigenous sovereignty, and water.
- Engage students to critically reflect on western ideologies and knowledge systems in engineering and Indigenous worldviews in engineering.
- Challenge students to make space for Indigenous worldviews in engineering.

- Provide students with knowledge for working successfully with First Nations, Métis and Inuit communities on engineering projects, with emphasis on engineering in Manitoba. This includes consultation with Elders, Traditional Knowledge Keepers and the affected communities.

2.3 Course Structure & Assessments

The course was co-taught by one Indigenous and one non-Indigenous instructor, and one Indigenous teaching assistant. Classes were on Tuesdays and Thursdays for 1.25 hours each, and students were responsible for a weekly asynchronous tutorial, which average 1.5 hours per week. Indigenous pedagogies (e.g., sharing circles, oral critical reflections, choice in how the learner presents their knowledge, choice in how the learner is assessed, discussed as a group in the first class) and ways of knowing (e.g., most speakers in the course, and one instructor and the teaching assistant were Indigenous) were coalesced with western approaches (e.g., assessments and grades required by the faculty/university, one instructor and a few speakers were settlers and allies) in course delivery, with all course decisions consciously guided by our commitment to this space and place being for Indigenous Peoples and worldviews. Students participated in several sharing circles and weekly reflections, to emphasize how kinship and relationships guide how knowledge is shared [12].

For the inaugural offering in Winter 2022, classes were online (using Zoom) due to the university's remote operations in response to the pandemic.

Students completed class homework, readings of articles and news reports, and weekly tutorial viewings of films/documentaries, as well as weekly critically reflections on the lectures, guest presentations, class dialogues, readings and viewings, and their connection and relevance to engineering. Students could choose to upload a written response or an audio/visual recording of their critical reflection (or other medium, as students could choose to make room for multi-modal forms of expression and knowledge) in the course's online learning management system. Written reflections were approximately one page, and recordings were approximately 5 minutes.

Students were also required to complete the approximately four-hour online course, *4 Seasons for Reconciliation*, which was available online through the University's library system. Two tutorials were allocated for this. As well, students completed a workbook, *Working in Good Ways Practitioner Workbook* [1], as part of another tutorial, which is a foundational resource that has emerged from a three-year action research project supported by the University of Manitoba IIF grant to develop practical strategies for working with Indigenous communities. Finally, students presented summative

critical reflections of their learnings in the course during the last week of classes, for which they could also choose the medium (see Table 1 for course assessments).

Table 1: Course Assessments.

Assignments	Evaluation Percentage
4 Seasons for Reconciliation Course	Certificate of Completion – Required for ENG 4100 course completion
Class Participation: assessed by level of active, engaged participation in class, which looks like: thoughtful responses and dialogue as well as active listening and sharing of time with others during class; timely completion of homework.	25%
Weekly Critical Reflections: critical reflection on lectures, guest presentations, readings and viewings are due every Monday by 4 pm (upload to UM Learn)	60% (12 x 5% each)
Summative Critical Reflections presentation: students will present a summative critical reflection (poster, presentation, other?) on their learnings on April 19th & 21st.	15%
TOTAL	100%

Students were assessed for the depth of their crucial reflections, and their ability to connect their learnings to the course content (presentations, readings, and tutorials). We identified four graduate attributes that were relevant to students’ competency development in the course: ethics & equity, the impact of engineering on society and the environment, economics & project management, and lifelong learning (see rubric in Appendix B).

2.4 Elders, Knowledge Keepers, and Indigenous and non-Indigenous Experts

The course drew on the knowledges and experiences of Indigenous instructors, specialists, Knowledge Keepers, and Elders, as well as Indigenous allies. Guests were offered tobacco to ask them to share their knowledges, if culturally appropriate, and given an honorarium to acknowledge their time and thank them for their knowledge. This is in keeping with the practice of reciprocity [10]. As explained by Dr. Niigaanwewidam Sinclair, professor in the Department of Indigenous Studies at the University of Manitoba, “the giving and receiving of gifts has been central to building relationships of collaboration and reciprocity” [22].

The benefit of offering the course remotely meant that we could invite guests from out-of-province. Therefore, we had a combination of Elders, Knowledge Keepers, and Indigenous and non-Indigenous experts from the

university and industry in Manitoba, as well as from Saskatchewan and Alberta. Additionally, we were able to access a wide variety of powerful video panels and presentations for students’ tutorials as many online events over the past two years have been recorded and made publicly available, or available to use with permission (see *Tutorials*, under *Course Topics*).

2.5 Course Topics

Topics included protocols and working effectively with Elders and Traditional Knowledge Keepers, history of Indigenous Peoples in Manitoba, Treaties, Land Acknowledgements, decolonizing engineering, traditional Indigenous technologies, community engagement, sustainability, extractive industries, sovereignty, and water. Elders, Knowledge Keepers, and Indigenous and non-Indigenous Experts were contacted and invited to deliver specific class topics that we were already familiar with and that were unique to each speaker. We list topics here. We include the names of the Elders and course instructor, but do not include the names of our guest speakers here.

- *Opening the course in a good way & Tobacco Teaching* – Elder Norman Meade, Métis, Manigotagan and Elder-In-Residence at the University of Manitoba.
- *Understanding Worldview Differences* – Indigenous guest, Faculty of Engineering, University of Alberta.
- *Our Path to Reconciliation* [23] – Equity, Diversity and Inclusion (EDI) facilitator, and Indigenous Student Advisor from St. Peter’s Peguis community with family roots in Peguis First Nation. University of Manitoba.
- *Treaties and Residential Schools* – Indigenous Supervisor of Education, Outreach, and Public Programming at the National Centre for Truth and Reconciliation (NCTR), University of Manitoba.
- *Indigenous Technology* – Randy Herrmann, Course instructor.
- *Engineers Role in Decolonization* – Randy Herrmann, Course instructor.
- *Land Acknowledgements* – Randy Herrmann, Course instructor.
- *Indigeneering: Engineering Through Indigenous Knowledge and Mino Pimachisowin* – Cree-Metis guest from Cumberland House, in Northern Saskatchewan, B.Sc., MBA, President Elect – Association of Professional Engineers and Geoscientists of Saskatchewan.
- *UNDRIP, UN Sustainable Goals & Engineer Grand Challenges* – Randy Herrmann, Course instructor.
- *Community Collaboration, Working in Good Ways* – Two-Spirit Red River Métis Sundancer from the Lorette and Îles-des-Chênes communities in the heart

- of the Métis homeland, M.A. in land-based education, Community Service-Learning Coordinator (Indigenous) University of Manitoba.
- *Engineering & Community Collaboration: Doing Engineering Work in Indigenous Communities*, Indigenous guest, Treaty 5 Territory, B.Sc., P. Geo. Senior Manager, Community Relations, Exploration Team Canada, Yamana Gold Inc.
 - *Water Teaching* – Elder Mae Campbell, Anishinaabe, Clan Mothers Village, Manitoba
 - *Wahkohtowin: The Interconnectedness of Design and Engineering* – Cree, guest speaker, B.Sc., P. Eng., M.Sc. Renewable Energy, Manitoba
 - *Food Sovereignty* – Anishinaabe (Ojibway) and fluent Anishinaabe language speaker from Lake St. Martin First Nation. Assistant Professor / Indigenous Scholar, in the Department of Chemistry, Faculty of Science, University of Manitoba, and Dr. Shirley Thompson, Associate Professor, Natural Resources Institute, University of Manitoba.
 - *Indigenous Housing* – guest speaker from Opaskwayak Cree Nation, Associate Professor and Academic Director of the Aboriginal Education Research Centre, University of Saskatchewan.
 - *Manitoba Hydro & Northern Impact* – guest speaker from Bissett, Manitoba, attended the government-run residential school Frontier Collegiate in Cranberry Portage, Manitoba. Professor, Department of Indigenous Studies, University of Manitoba
 - *Manitoba Hydro Current Context* – Vice President, External, Government & Indigenous Relations & Communications at Manitoba Hydro.
 - *Indigenous Peoples and Settler Peoples: Immiscible Worldviews* – Métis guest speaker, Deputy Registrar and Chief Regulatory Officer, The Association of Professional Engineers and Geoscientists of Alberta (APEGA).
 - *Shoal Lake 40 First Nation and the Winnipeg Aqueduct* – ally guest speaker, B.Sc., EIT, Chief Drygeese Territory, the traditional home of the Yellowknives Dene and traditional lands of the North Slave Métis.
 - *Incorporating Indigenous Design into Buildings* – Elder Carl Stone, Anishinaabe, Brokenhead Ojibway First Nation. Elder-in-Residence, University of Manitoba
 - *Decolonizing Design* – Métis architect with the Manitoba and Ontario Association of Architects, Assistant Professor, University of Manitoba.
- [Braiding Ways of Knowing](#) – Reconciling Ways of Knowing Forum with Robin Wall Kimmerer (1.5 hours) (public)
 - *Creating Ethical Space Towards Decolonizing Engineering and STEM Education* – Panel Discussion with Deanna Burgart & Kerry Black with Matthew Oliver, Kaella-Marie Earle, and Carol Crowe (with permission)
 - [Why Reconciling Ways of Knowing?](#) – Reconciling Ways of Knowing Forum with Miles Richardson, O.C.; Dr. David Suzuki; Dr. Nancy Turner; and the late Elder Dr. Dave Courchene, Jr., (2 hours) (public)
 - *4 Seasons for Reconciliation* (licensed through University of Manitoba (two tutorials)
 - [Working in Good Ways Practitioner Workbook](#) – Anny Chen, Gera Villagrán, and Nicki Ferland, Community Engaged Learning, University of Manitoba (public) [1]
 - [The Role of Engineers in Decolonization and Reconciliation](#) – John Desjarlais and Pam Wolf – Truth and the Role of Engineers in Decolonization, UBC Applied Science (public)
 - [Indigenous Ways of Knowing](#) – Elder Albert Marshall & Curtis Rattray – Truth and the Role of Engineers in Decolonization, UBC Applied Science (public)
 - [Indigenization in the Time of Pipelines](#) – Chelsea Vowel, Weweni Indigenous Scholars Speaker Series (public)
 - [Land Acknowledgements for Engineers and Geoscientists](#) (EGBC) – Chief Leah George-Wilson, Linda Murphy, Nalaine Morin, and Matthew Dunn (with membership, free to join)
 - [Douglas Cardinal: Architect of the Future: Film Screening and Conversation](#) with Randy Herrmann (with permission)
 - [Indigenous Practitioner Perspectives on City Building](#) – Canadian Urban Institute (public)

Students were given a video to watch every week for their tutorial. They included:

3. REFLECTIONS

3.1 Randy's Reflection

When Jill first came to me with the idea to put forward a proposal to develop a course on decolonizing engineering, I was intrigued and agreed to help if her proposal was accepted. Despite my agreement to help I was hesitant because no course like this had ever been taught in a Canadian engineering school before. I worried how the course would be accepted by the students and engineering faculty, or if any students would even take the course. Could we make the course relevant? I wondered if we could find enough material to fill a one term course with a tutorial section. Jill's proposal was accepted by the funding agent because the idea of such a course was one that has been a long time in coming. As

we developed the course over the Fall of 2021, I was adamant that while I was willing to help construct this course, I was unwilling to teach it. I felt that I did not have the requisite experience or knowledge to teach such an important course. I believe it was Jill's intention to have me teach the course from the onset of the proposal and it was up to her to convince me to do that.

As the fall progressed, we developed an extensive reading list, suggesting readings to each other and removing others from the list as too complex or not pertinent. We developed a list of proposed speakers and on-line tutorials, panel sessions, etc. My worry about filling time in the course changed to a worry about having too much material! We continually came up with new sections to add and then had to decide which sections to remove in order to add new sections. It was difficult choosing which sections of material, or potential speakers to include – we wanted to include everything but didn't have the time.

Development of the course progressed. After much persuasion, Jill convinced me that we would co-teach this course. Even though I was hesitant I agreed, and I am glad that I did. Although the class size was small at 15, it was suitably diverse. There were at least four Indigenous students in the course, and two graduate students; we had several academic staff sitting in on various lectures, one non-academic staff, and one student who had not yet entered Canada and was taking the course on-line from his home in Bangladesh. The students were exceptional and more receptive to the course than I thought they would be. Reading their weekly Critical Reflections gives me confidence that this generation of engineering students will be more receptive to differing worldviews, ideologies, sexual preferences, gender preferences, and issues of race and privilege than my generation was. I am confident that they are starting to understand the role that engineers played in colonization.

Developing a proper rubric for this course so the grading was as reflective of decolonization as the course material proved to be quite difficult. We knew that a standard final exam where students regurgitated facts and figures would be a poor indicator of their learning journey. It was decided to have a substantial amount of the final grade awarded to the weekly Critical Reflections (60% of the final grade). These reflections allowed the instructors to understand where the students were in their learning journey and where more focus or explanation was needed. On the first day of class, we told students that the format of the Critical Reflections was up to them and that they could present their learning journey in Interpretive Dance if they were willing to explain it. Most of the Critical Reflections we received were written, a number of students videotaped their reflections (with the students verbally reflecting), and several were done using PowerPoint presentations with images and audio dubbed in. One of these Critical Reflections (utilizing PowerPoint

with audio) was incredibly moving. Unfortunately, despite repeated invitations, we did not receive an Interpretive Dance Critical Reflection.

A portion of their final grade was determined by their final project: a summative Critical Reflection (15%) where students were asked to assess their learning over the course. Students were given the option to prepare a report, a poster presentation, or any other way to relay the knowledge they gained throughout the course. The only criteria were that they include both visual and verbal elements. And yes, we told them we would accept Interpretive Dance.

3.2 Reed's Reflection

Going into the new ENG 4100 course as a teaching assistant, I was unsure of what to expect with regards to my role in the course, the course itself, and how students would respond to the course. Overall, it was an enlightening experience for me as both an educator and a learner in this class.

Based on what I saw from the weekly reflections and in-class interactions, students were enthusiastic and open-minded about the course content. I was impressed with the students' reflections on the course material throughout the term; self-awareness and humility were apparent among all the students, and many displayed a strong understanding of the course material and how the concepts are applicable in engineering contexts. While the course introduced many concepts that may have been unfamiliar or abstract to some students, they were presented in various contexts, which provided the students opportunities to engage with those core concepts in ways that resonated with them.

The smaller class size worked to the advantage of this course, in my opinion. Having only 15 students and staff contributed to a comfortable, relaxed environment where the students seemed to have the space they needed to speak their minds and ask questions. One of my primary questions about this course going forward is how this type of environment can be maintained as the class size grows.

I have learned a lot through this course, and I do feel that this type of learning experience holds immense potential for engineering students. As an engineering student, I would have loved to have taken a course like this and would have appreciated the opportunity to gain this kind of knowledge in addition to typical engineering content. At the end of the day, I think this course is providing lessons that are broadly applicable even outside of Indigenization and decolonization efforts, especially in areas of social consciousness and community engagement.

3.3 Kyle's Reflection

This course can help both Indigenous and non-Indigenous people gain a deeper understanding of various Indigenous worldviews and the history of colonialism in Canada. We had the privilege of receiving teachings from multiple well-respected Elders. These teachings will help us respect the environment and each other as we go forward in our careers. In addition to teaching history, the professors and invited speakers addressed and challenged problematic views held by some settlers in Canada. These lessons are essential for all people, especially for those who will one day have the honour and responsibility of being an engineer.

Personally, I have been inspired by the professors, the speakers and in particular, the students. This has been my first experience seeing a group of non-Indigenous people participate in sharing circles and actively learn Indigenous history. Although I have an optimistic worldview, I was still shocked at the depth of reflection and willingness to learn by the non-Indigenous people. This experience has given me the confidence to start a reading/discussion group in the department of physics where I study. Our group is led by me and another Indigenous student. Every two weeks we have Indigenous and non-Indigenous people meet to learn from one another.

Overall, professors at the university have varying views/beliefs, which may or may not change. It's important for them to know that regardless of these views, decolonization/Indigenization is a part of what the university is doing. It's as important as anything else, such as their research/teaching and otherwise. Highlighting the University of Manitoba's Strategic Plan is one way to emphasize this point.

There are a limited number of Elders and Indigenous professors at the university. That is why everyone should do their part in helping one another learn. This course is a massive step in bringing this type of education to the engineering faculty. I hope all students who can take this course will do so.

3.4 Jill's Reflection

I am always amazed by what I hear and learn when space and place is made for others. As a teacher, it is easy to get caught up in the space of teaching and dominate it, in that the act of teaching can translate as only one voice, one's knowledge – i.e., the transmission or 'banking' model of teaching. There's so much we want to tell our students! But there's so much that they know! It never fails to amaze me when that space is made, and students speak. I've learned so much in this class, from the Elders, Knowledge Keepers, and Indigenous and non-Indigenous Experts who've shared their truths and their knowledges, and from the students who have shared their voices through sharing circles and weekly and final project

critical reflections. Their learning journeys have been incredible, and humbling, with the students' final reflections bringing me to tears.

For me, that's what needs more space in this class – weekly space for the students in circle, so that all students hear and learn from one another throughout the course, as we did. This is all the more important in a class where we are learning how to make equitable space for Indigenous peoples and their knowledges and worldviews. Kirkness and Barnhardt [10] explain how fundamental this is for Indigenous students particularly:

One of the most frustrating aspects of the university experience for First Nations students is the role dichotomy between the producers and the consumers of knowledge in university settings. The conventional institutionalized roles of a university faculty member as the creator and dispenser of knowledge and expertise and the student as the passive recipient of that knowledge and expertise have a tendency to interfere with the establishment of the kinds of personalized "human" relationships to which First Nations students are most likely to respond. [p. 10]

The authors write about how to make education a dialogue between teacher and student, where both are engaged in teaching and learning:

...the emphasis is on making teaching and learning two-way processes, in which the give-and-take between faculty and students opens up new levels of understanding for everyone. Such reciprocity is achieved when the faculty member makes an effort to understand and build upon the cultural background of the students, and the students are able to gain access to the inner-workings of the culture (and the institution) to which they are being introduced [10, p. 11].

Reciprocity is something that I'm learning on this journey of reconciliation. Although I've always centered my pedagogical practice on building relationship, thinking about reciprocity in the context of teaching and learning is new for me. I am grateful for this course, and the space and place it makes for the opportunity for reciprocity. I'm grateful that both Indigenous and non-Indigenous students have chosen to take this course. I believe this is one way to learn about the colonial truth of Canada and work together to reconcile the path forward in engineering education, where equitable space and place for all Indigenous peoples is our reality.

4. IMPROVEMENTS AND NEXT STEPS

One of the biggest learnings for us is the power of sharing circles. We need more space for them in the course. Originally, we envisioned that we would follow each presentation with a sharing circle, led by the guest presenter, to listen to one another's voices after the teachings. However, the teachings have been so rich, and time so limited, that we have run out of space for sharing circles after many of the classes.

In our next offering, we plan to schedule synchronous weekly tutorial (rather than the asynchronous tutorials we had in the inaugural offering) that will be dedicated to sharing circles. In this way, we can listen to each other's voices and reflections on the learnings from the presentations, readings and tutorials each week without rushing or running out of time. We have learned through previous research (e.g. [9]) how vital time for reflection is and are committed to making place for this process. This will mean that students in future offerings of this course will spend an additional ~90 minutes each week viewing the tutorials as homework on their own time. However, we will revisit the homework readings and tutorials, and adjust our selections based on what we observed resonated with students in this inaugural offering.

Presently, the instructors teaching the course are doing so in addition to their regular teaching responsibilities. We felt it was important to do this so we could reflect on the course and make needed adjustments for future offerings. One essential approach to facilitating this course for us was to have one Indigenous and one non-Indigenous instructor; students heard both Indigenous and allied voices in this way and could identify with both. We also benefited from having one instructor identify as a man and one as a woman, which supported some gender diversity, and one identify as an engineer, and one who did not. Randy brought in his Métis, male, engineering perspective; Jill was nurturing and welcomed and made visible emotions, which is somewhat atypical of engineering courses. We feel there was power in these complimentary but different approaches and perspectives in the course and recommend facilitators of similar courses considering and making visible their positionalities.

New to the Price Faculty of Engineering, all engineering students now need to take at least one Indigenous course from a list of options as part of their engineering program. We feel this course will meet this requirement for many engineering students. Therefore, we need a contingency plan to continue offering this course, and to grow with what we expect to be an increasing demand. Presently, Biosystems Engineering is in the process of hiring an Indigenous instructor as part of the university's strategic pathways to Indigenous achievement [26]. It is our hope that this new instructor will eventually take over teaching this course and

envision that Randy will mentor this transition. We will also think about how to structure the course so that we can potentially offer the classes to large numbers of students, while holding sharing circles (e.g., the weekly tutorials) with groups of 10-15 students. This will depend on the uptake of the course by engineering students.

We were given permission by most Elders, Knowledge Keepers, and Indigenous and non-Indigenous Experts to record their presentations. We are in the process of considering how to share these knowledges and perspectives to advance truth and reconciliation across the faculty. Ideas include holding a summer session, much like the Summer Institute offered by the Department of Indigenous Studies, with an intensive weekly 3-hour commitment, or forming a community of practice to share these recordings and hold circle discussions on a bi-weekly basis over the next academic year. However we approach this, we are committed to sharing these teachings with faculty and staff.

There are concepts in this course which can be standardized as general engineering education throughout Canada. These include understanding documents such as: *United Nations Declaration on the Rights of Indigenous Peoples* [24], the *Truth and Reconciliation Calls to Action* [21] and *Reclaiming Power and Place: The Final Report of the National Inquiry into Missing and Murdered Indigenous Women and Girls* [13]. In addition to these general concepts, learning the local history surrounding the institution where such teachings and learnings will take place is essential. The local Treaties and the institutional land acknowledgements are good places to start when learning local history.

Although there are general concepts to understand, the essence of this course is Indigenous Knowledges which came from Indigenous Elders, Traditional Knowledge Keepers, and leaders in Indigenous engineering. Building relationships with Indigenous faculty and staff at your institution is a good starting point. Lastly, we emphasize that tobacco offerings when culturally appropriate (many institutions have resources on this; find this out before approaching an Indigenous Elder, Knowledge Keeper and potential guest speaker, and humbly ask when approaching), honorariums and gifts are critical gestures of respect and practices of reciprocity when requesting a presentation from Indigenous experts and must be given.

Engineering is a pragmatic discipline, embedded in problem solving [5]. The inclusion of Indigenous perspectives, philosophies, and knowledges will enhance engineering problem solving, and benefit engineering education and practice [14]. Together, Indigenous and western knowledges should reside alongside engineering knowledge; all have a place in engineering education [8].

As explained by Kirkness and Barnhard [10], "Increasing the university's domain of human knowledge to include and respect First Nations cultural values and traditions is a formidable task, but it is a task that we must

begin if we are to make the institution more ‘user friendly’ for First Nations students” [p. 8]. As engineering educators, we must ask ourselves, “What then can be done to begin to reduce the cultural distance and the role dichotomy between the producers and the consumers of knowledge in university settings” [p. 8].

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Appendix A: Intended Learning Outcomes

At the conclusion of the course, students should be able to:

1. Apply principles from the *United Nations Declaration on the Rights of Indigenous Peoples* and the Truth and Reconciliation Commission of Canada *Calls to Action* when making engineering decisions.
2. Create equitable space for both western and Indigenous worldviews (ways of knowing, being, relating, doing, and making) in their professional environment.
3. Use equitable, decolonial and Indigenous perspectives when analyzing the impact of engineering on society, the environment, economics, and project management.
4. Demonstrate knowledge for working successfully with First Nations, Métis, and Inuit communities on engineering projects, with emphasis on engineering in Manitoba.

Appendix B: ENG 4100 Critical Reflection Rubric

Critical Reflection Rubric

ENG 4100 Contemporary Topics in Engineering Practice: Decolonizing and Indigenizing Engineering – Winter 2022

IE.1 – Understands the social, environmental, economic, health, safety, legal and/or cultural aspects of engineering activities	<ul style="list-style-type: none"> • Considers diverse (cultural, ethical) perspectives when investigating engineering impact on society and the environment • Understands regional and local societal values applicable to engineering activities • Understands the importance of interactions between environmental, social, health and safety, cultural, legal, and economic factors in both the built and natural environment
EE.1 – Demonstrates and/or applies knowledge of ethical principles	<ul style="list-style-type: none"> • Understands the codes of ethics • Analyzes and applies a code of ethics in an engineering situation/activity • Recognizes, understands and applies proper ethical and legal use of intellectual property, copyrighted materials, and research
EP.1 – Understands concepts of engineering economics	<ul style="list-style-type: none"> • Understands the limitation of economic analysis in an engineering context • Understands the effect of the regional/national economy on engineering projects
EP.2 – Understands concepts of project management	<ul style="list-style-type: none"> • Understands the problem, the client’s needs, and how to propose a plan in partnership with the client • Understands the limitation of engineering management techniques
LL.1 – Applies appropriate knowledge to new situations	<ul style="list-style-type: none"> • Applies prior knowledge, skills and/or behaviors to new situations
LL.2 – Engages in activities to advance knowledge and understands the role of on-going professional development	<ul style="list-style-type: none"> • Explores a subject/topic in the pursuit of knowledge • Constructs meaningful and pertinent questions/thoughts to guide learning
LL.3 – Learns from successes and mistakes; recognizes limitations	<ul style="list-style-type: none"> • Accepts and uses constructive feedback • Reflects on experiences/situations, and applies results from reflections to subsequent experiences/situations • Learns from successes and mistakes, and recognizes limitations

Elements	Level 5 Excellent (90-100%)	Level 4 Strong (80-89%)	Level 3 Competent (70-79%)	Level 2 Developing (60-69%)	Level 1 Needs Work (0-59%)
	Student thoroughly, explicitly, and/or insightfully	Student effectively	Student capably	Student somewhat	Student does not