INTEGRATING INCLUSIVE LEADERSHIP PRACTICES INTO ENGINEERING EDUCATION

Renée Pellissier, Claudia Flynn, Stephanie A. Fernandez, and Marwan Kanaan
Faculty of Engineering, McGill University
renee.pellissier@mcgill.ca, claudia.flynn@mcgill.ca, stephanie.fernandez@mcgill.ca, marwan.kanaan@mcgill.ca

Abstract – *Growing diversity in engineering projects and teams calls for leaders who can put inclusion at the forefront. To enter the workforce ready to be effective, inclusive leaders, engineering students must be equipped with the necessary interpersonal skills and well versed in applied principles of equity, diversity, and inclusion. The E-IDEA Teamwork Initiative has developed a pedagogy integrating inclusive leadership practices into technical engineering courses through a series of skills-based workshops. The intended outcomes are to embed inclusive leadership training into the undergraduate engineering curriculum, to build capacity among course instructors, and for students to complete their degrees with a well-rounded skillset. Positive feedback from students and instructors alike has consistently reinforced the need for this shift in engineering education. With the tools to be inclusive leaders, students will enter the workforce ready and able to recognize bias, challenge the status quo, and promote sustainable innovation.*

Keywords: Inclusive Leadership, Teamwork, Equity, Diversity, Inclusion

1. INTRODUCTION

As globalization gives rise to complex issues [1] that require wide-ranging expertise to address, there is an increased need for diverse teams with distinct skills and viewpoints that can develop innovative and nuanced solutions. As such, training engineers to become effective team members and leaders has become increasingly critical in post-secondary education [2]. While many engineering courses require students to work in teams, there is little formal instruction around teamwork or leadership [2] and the competitive atmosphere of the engineering classroom strongly contrasts with the collaborative nature of teamwork. To harness the full potential of diverse teams, students must be able to cultivate an environment that utilizes each person's unique strengths and knowledge [3,4]. This requires the development of inclusive leadership skills such as communication, collaboration, and self-awareness, as well as a functional knowledge of equity, diversity, and inclusion (EDI) in teams.

Leadership in engineering takes many forms. It can be official, such as management roles, or unofficial, in cases where individuals show leadership through skill and expertise. In either scenario, effective leadership in teams involves creating a vision, getting buy-in from team members, and initiating useful change [5]. Leaders, whether formal or informal, are also responsible for fostering an inclusive culture in their teams [6]. Inclusive leadership involves a set of behaviours through which a leader creates a sense of belonging among group members while simultaneously promoting group collaboration and individuality [7]. These behaviours include supporting team members, ensuring justice and equity on the team, and utilizing unique talents and perspectives [7]. Inclusive leadership is linked to creativity and innovation in teams [8,9] and leverages diverse thinking [10], making it an ideal style in engineering fields. These leadership practices weave authenticity and a sense of self into processes [6], humanizing the increasingly technological world. As it stands, there is no personality in a spreadsheet, or sense of humor in calculations; the humanity is found in the exchanges between these tasks, and inclusive leadership behaviours highlight this by inviting dialogue, engaging in shared decision making, and encouraging contributions [3,6].

Inclusive leaders are those who create space for personal connection and are able to understand and recognize bias [10]. By engaging in open reflection of their own personal bias and displaying empathy and humility, a leader can establish their own positionality and reassure team members that they will be heard and valued [10]. When this process is encouraged among others, it fosters the ethic of reciprocity [11] and promotes dialogue in the team. Such open communication provides leaders with the opportunity to learn about team members and better understand their skills and potential. They can then draw on the "funds of knowledge" [12] each member contributes, treating the diversity of the team as a valuable resource.
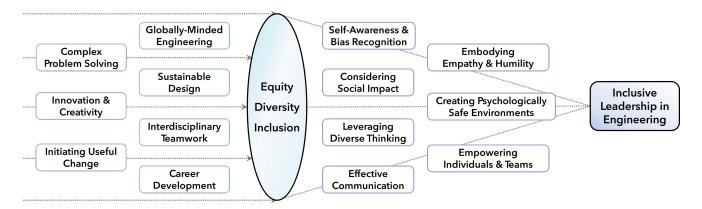
Peer reviewed

Figure 1: Inclusive leadership in engineering through an EDI lens.

Features of inclusive leadership such as openness, accessibility, and availability are key to generating the psychologically safe environment that enables innovative thinking [8]. Psychological safety is defined as "the belief that the work environment is safe for interpersonal risk taking" [13]. In psychologically safe environments, team members are able to effectively give and receive feedback, own up to mistakes, challenge one another, and engage in open discussion about ideas [13], all of which are imperative in engineering teams. Diverse perspectives can only benefit teams if members feel safe to voice dissent and point out blind spots [4]. When students have the leadership skills to bring psychological safety to their teams, the result is higher engagement and increased creativity [13].

The ability to lead colleagues with diverse values, beliefs, and strengths will serve students over the course of their academic and professional careers [1]. As individuals, it will aid in career development, as often times "an engineer is hired for her or his technical skills, fired for poor people skills, and promoted for leadership and management skills" [2]. Figure 1 illustrates how applying an EDI lens helps to identify practical leadership behaviours that effectively support engineering goals such as career development, complex problem-solving, and innovation. Augmenting engineering students' technical education with professional and interpersonal skills will increase their ability to take on leadership roles in the future [14]. With the expectation that engineers will work in diverse teams, a functional knowledge of EDI will be imperative for students' future careers. The E-IDEA (Engineering, Inclusivity Diversity and Equity Advancement) Teamwork Initiative has developed a pedagogy to incorporate practical leadership skills into undergraduate courses within the Faculty of Engineering at McGill University. The Teamwork Initiative pedagogy, which is rooted in applied concepts of EDI, brings inclusive leadership practices into engineering classrooms, integrating invaluable interpersonal skills into technical courses to teach students to lead diverse teams in engineering contexts.

2. APPROACH

The Teamwork Initiative is an innovative program designed to address the interpersonal aspects of engineering. The program partners with engineering courses to bring teamwork and inclusive leadership practices into the classroom through a series of interactive, skills-based workshops. These workshops are conducted in class and are linked directly to course material. The only criterion for course partnership is a teamwork component, such as a project or a lab. This ensures students can immediately apply these interpersonal skills in their current teams. This framework illuminates the necessity of teamwork and inclusive leadership in engineering contexts and provides students the opportunity to try new behaviours in a supportive environment.

The partnership begins in a dialogue with the course instructor to gain an understanding of both the students and their tasks. This includes the goals, duration, and expectations of the student teams, as well as issues instructors have experienced with teams in the past. Based on the needs of the class, Teamwork Initiative facilitators will take 2–3 classes over the course of the semester to conduct 60–80 minute workshops. These workshops are designed to progress with students throughout their program, targeting early-, mid-, and late-stream courses. This integrated workshop design allows students to see interpersonal skills and EDI as pillars of engineering rather than supplementary material [15]. When leadership, teamwork skills, and matters of inclusion are separated from the teaching of technical engineering, the message is that these are 'nice to have' but are ultimately not necessary for engineering. In reality, these are core engineering skills [16]. Conveying this message to students by bringing discussions of leadership and EDI into their classrooms is, in itself, a step towards inclusion [17]. Given that the Teamwork Initiative framework approaches leadership as

a set of skills [7] rather than a standalone concept, every workshop focuses on a different leadership competency, providing students the opportunity to delve into each one in depth. The following are a selection of workshops and their related activities that address inclusive leadership skills in the Teamwork Initiative pedagogy.

2.1. Exploring Personal Values

A basic understanding of one's values and corresponding behaviours is a necessary element of leadership [1]. Students enter engineering programs with varying levels of self-awareness and collaboration experience. To address this gap, one of the Teamwork Initiative's early-stream workshops is an exploration of personal values. This introductory workshop draws links between a student's values, team behaviours, and leadership styles.

The development of self-awareness is an active process. As such, this workshop includes an activity for students to begin reflecting on their own values. Students are provided with a list of values such as power, friends and family, and respect, and asked to select those that are most important to them. Following this activity, students examine different values and discuss the types of behaviours teammates may display as a result of those values. The goal is for students to understand how team members can have conflicting priorities or may react differently to the same situation. Students are encouraged to discuss their own values with team members to avoid making assumptions about one another and approach their teammates with curiosity and respect.

This same values exercise is then used as a tool to reflect on leadership. In self-managed teams, students have many opportunities to take on leadership roles. An understanding of their own tendencies can provide confidence in their abilities and guide their behaviour. Self-awareness can illuminate a student's natural leadership inclination (task-focus, coaching, visionary, etc.) [18]. However, the purpose of this reflection is not to lock students into one leadership style; rather, it is meant to build an awareness of the styles towards which one gravitates. This is an opportunity for students to try new behaviours or cultivate a new skillset, developing leadership skills based on interest and intention instead of comfortable habits.

2.2. Collaboration and Communication

The Collaboration and Communication workshop, geared toward early-stream courses, introduces students to the concept of psychological safety as a core component of successful teamwork and facilitates process conversations at the outset of a team project. This workshop focuses on creating a positive team climate, which is an essential feature of psychological safety [19]. A positive team climate is created when members' contributions are valued, when they care about each other's well-being, and when

they have input into work processes [19]. During this workshop, students are asked to create a Team Norms and Expectations Contract, which outlines the specific behaviours and processes they will use to build a positive climate for their team. For example, students must set boundaries around communication, such as scheduling constraints and expected response times. They must also outline expectations around conflict management, accountability, and organization. The contract includes a section on values, to be certain all team members are aligned and working toward a common goal, as well as a plan to develop positive working relationships.

The act of co-creating this document provides students with a common language to discuss teamwork and can illuminate possible points of tension due to conflicting objectives. Furthermore, it can serve as a helpful tool in group conflict when used as a reference point to identify the source of issues or potential intervention points for instructors. Students are invited to refer to this document throughout their teamwork as a type of check-in, to determine the processes that are working well and those that could benefit from revision. Students are provided with a contract template that can be used in future projects, as every team is a unique ecosystem and the needs, expectations, and dynamics will change each time.

2.3. Managing Conflict in Groups

Targeting students in mid- to late-stream courses, the Teamwork Initiative workshops progress beyond an awareness of communication methods into more practical and application-based skill development. The Managing Conflict in Groups workshop teaches students about the inevitability of conflict and how to transform disagreement into new ideas. Students are introduced to conflict management theory, such as the Thomas-Kilmann Model [20], and asked to reflect on their own patterns of behaviour regarding conflict. The workshop also offers strategies to engage in constructive conversation [21] and meaningful apologies [22].

This workshop uses a problem-based learning (PBL) approach, as PBL is "an enabler to the development and growth of leadership competencies such as the ability to work within diverse teams, set goals and make decisions, communicate effectively and many others" [23]. Students who are already working together on a project team are presented with case studies involving interpersonal issues. They are asked to discuss the scenario, diagnose the problem, and make recommendations for future action. This opens up a new kind of dialogue among team members, revealing different ideas, methods, and problem-solving strategies that highlight the impact of inclusivity on teamwork.

Additionally, students are asked to analyze the strengths and challenges of different conflict management styles to practice recognizing the most effective strategies to apply to different situations. The goal is for students to develop a

level of comfort with conflict and find ways of keeping it constructive. Students are encouraged to approach disagreement with curiosity, seeking to understand rather than to win [21].

2.4. Giving and Receiving Feedback

One of the most valuable leadership behaviours is the ability to effectively give and receive feedback. This is a very specific form of communication that requires thought and practice. The Giving and Receiving Feedback workshop, aimed at mid- to late-stream students, delves into the framing and intention of feedback. It illuminates the differences between the helpful nature of feedback and the negative impact of criticism. Students are provided with techniques to give feedback effectively, such as using observable data and showing the impacts of the persons' behaviour [24]. Additionally, feedback is examined through the lens of power, to understand how both overt and covert power dynamics must be taken into consideration.

To practice this vital skill, students are provided with common teamwork scenarios, such as unbalanced team member contribution or the micromanagement of a project. Once they have reviewed the scenario, two team members volunteer to role play a feedback discussion. One student acts as the feedback giver and another as the receiver. The rest of the team observes. Once the role play is complete, the observers provide feedback to the role-players. This is followed by a discussion with the entire class, giving each team the opportunity to talk about their feedback strategy as they question and comment on other teams' solutions. This workshop engages both action and reflection to help students fully grasp the material and consider their own behaviour in a team.

2.5. Power, Privilege, and Bias in Team Dynamics

Individuals who invoke humility and an awareness of their own personal values and biases are recognized as strong, inclusive leaders [10]. While implicit bias cannot be eliminated, the impacts can be mitigated through a better understanding of how bias influences decision making. Self-awareness plays an important role in this skill. The ability to reflect on personal actions and behaviours through a critical lens and the willingness to face uncomfortable truths is crucial. To directly address the matter of bias recognition, the Teamwork Initiative has designed a suite of workshops entitled Power, Privilege, and Bias in Team Dynamics, with the intention of engaging students in active reflection around bias in early-, mid-, and late-stream courses.

In the foundational workshop, aimed at early-stream engineering students, the focus is on power and privilege at the individual level, and is intended to frame EDI as a part of everyday life rather than abstract theory. It examines the individual concepts of equity, diversity, and inclusion before delving into recognizing each one in action. Students engage in a reflection of their own privilege using an assessment tool previously co-designed by the Teamwork Initiative and a group of undergraduate engineering students. This tool examines different dimensions of diversity such as race and ethnicity, gender, social class, disability, and more, illuminating the impacts of intersectionality on societal privilege.

The second workshop in this series, designed with mid-stream students in mind, builds upon those foundational learnings to explore the concept of implicit bias. Students are led through a visualisation exercise to convey the ubiquity of implicit bias, followed by a discussion on the different types of bias and how each one impacts teamwork. This workshop also uses a case study approach, however, in this scenario, students reflect on the case studies from different perspectives. Examining bias from multiple viewpoints is an important practice to build empathy and helps students consider options and outcomes outside their own experience.

In the third workshop, which targets late-stream students, implicit bias is considered at the societal level by analyzing how personal biases can become systemic barriers, and exploring the engineer's role in this process. Students examine how bias can be built into the system using examples from engineering projects around the world and discuss the ramifications, particularly for marginalized groups. The active reflection in this workshop comes into play as students consider their own field of engineering, the influence bias has in their decisions, and begin to imagine how to design with equity in mind.

3. INTENDED OUTCOMES

The overall intent of these workshops is for students to improve their interpersonal abilities and complete their degrees with a well-rounded skillset. The inclusive leadership skills taught by the Teamwork Initiative will allow students to create psychologically safe environments, improving the experience and productivity of their project teams in school and in their careers. Approaching leadership as a set of skills rather than a monolith or a character trait gives each student the opportunity to develop their own style of leadership. Every student has the potential to be a leader but does not need to be the leader in every circumstance; these workshops aim to teach leadership as a fluid process that adapts to the situation. With the self-awareness, communication, conflict management, and applied EDI skills gained in these workshops, students will bring inclusive practices to teams throughout their engineering careers.

A second outcome for this strategy is for inclusive leadership training to be embedded into the undergraduate engineering curriculum. As it stands, students' access to

inclusive leadership education is dependent on course instructors or extracurricular activities. Integrating these learnings into the curriculum provides all students with equal access. This translates to our third intended outcome: build capacity among course instructors to integrate leadership and EDI education into their teaching. The workshops are a strong foundation, and the continuous reinforcement of these concepts within the classroom will ensure the link between leadership, EDI, and engineering is clear. Immersion into an environment of inclusivity will promote an equitable and inclusive mindset that will be brought into students' future work, and course instructors are well-positioned to contribute to this practice.

4. DISCUSSION

Over the past three years, The E-IDEA Teamwork Initiative has piloted this in-class workshop framework in all eight departments and schools of the Faculty of Engineering. During that time, we have constantly adapted and iterated both the content and delivery of our workshops based on observation, experience, and feedback. We are in an ongoing dialogue with partner professors to assess the impact of the workshops on student teams' experience. We are also exploring new avenues to better integrate workshops with course material, as well as additional support we can offer regarding teamwork, leadership, and EDI in the classroom.

We have grown our workshop offerings based on feedback from both students and instructors. This has allowed us to create a workshop series that is relevant to students' current realities and prepares them for challenges they will face in their careers. Through ongoing feedback discussions, we have identified additional needs and future directions for the Teamwork Initiative. Leadership training has consistently been one of the most prominent requests from students, which is why it has evolved into a key focus area. For this level of training to be sustainable, however, course instructors must have the skills and knowledge to incorporate inclusive leadership into their own teaching. As our program continues to grow, our focus will shift to training instructors through modelling, coaching, and building a community of practice to share ideas and best practices. Our goal is to provide instructors with opportunities to develop their competencies and create lasting change in their pedagogy.

5. CONCLUSION

The ability to lead with integrity, honesty, and humility is critical not just in the field of engineering, but in all aspects of life. The E-IDEA Teamwork Initiative aims to build inclusive leadership practices into engineering education through a series of workshops to develop key interpersonal skills with an EDI lens. By integrating inclusive leadership practices into core engineering courses throughout their degree, students have the opportunity to test out leadership behaviours and learn from their experiences. Engineers who leave their program proficient in communication and collaboration, and with a deep understanding of equity, diversity, and inclusion, will set themselves apart in the workforce. We encourage students to approach any projects, team members, and challenges with curiosity and compassion, allowing space for growth, creativity, and innovation.

Acknowledgements

References

[1] P. Winkelman, "When Does Leadership Become Engineering Leadership", *PCEEA,* Dec. 2018, doi: https://doi.org/10.24908/pceea.v0i0.13108

[2] D. B. Knight and B. J. Novoselich, "Curricular and co-curricular influences on undergraduate engineering student leadership", *Journal of Engineering Education*, vol. 106, no. 1, pp. 44-70, Jan. 2017, doi: https://doi.org/10.1002/jee.20153

[3] M. Pollock, J. Holly, and P. Leggett-Robinson, "Inclusive leadership development for engineers" in *New Directions for Student Leadership: No. 173. Student leadership development in engineering,* M. R. Kendall & C. Rottmann, Ed., Wiley, Apr. 2022, sec. 4, pp. 119–128, doi: https://doi.org/10.1002/yd.20483

[4] P. V. Gallegos, "The Work of Inclusive Leadership," in *Diversity at Work: The Practice of Inclusion,* B.M. Ferdman and B.R. Deane, Eds., 2013, ch. 6, pp. 177-202, doi: https://doi.org/10.1002/9781118764282.ch6

[5] P. McCaulay, *Essentials of Engineering Leadership and Innovation*, Boca Raton, FL: CRC Press Taylor & Francis Group, 2017.

[6] B.M. Ferdman, "The Fulcrum of Inclusion," in *Inclusive Leadership: Transforming Diverse Lives, Workplaces, and Societies*, J. Prime, R. E. Riggio Ed. New York, NY, USA: Routledge, 2021, ch. 1, sec. 1, pp. 3-24. doi: https://doi.org/10.4324/9780429449673

[7] A. E. Randel, B. M. Galvin, L. M. Shore, K. H. Ehrhart, B. G. Chung, M. A. Dean, and U. Kedharnath, "Inclusive leadership: Realizing positive outcomes through belongingness and

Peer reviewed

being valued for uniqueness," *Human Resource Management Review*, vol. 28, no. 2, pp. 190–203, Jun. 2018, doi: https://doi.org/10.1016/j.hrmr.2017.07.002

[8]   A. Carmeli, R. Reiter-Palmon, and E. Ziv, "Inclusive Leadership and Employee Involvement in Creative Tasks in the Workplace: The Mediating Role of Psychological Safety", *Creativity Research Journal*, vol. 22 no. 3, pp.250-260, Aug. 2010, doi: https://doi.org/10.1080/10400419.2010.504654

[9]   B. Javed, A. Karim Khan, and S. Quratulain "Inclusive Leadership and Innovative Work Behavior: Examination of LMX Perspective in Small Capitalized Textile Firms," *The Journal of Psychology,* vol. 152, no. 8, pp. 594-612, Sept. 2018, doi: https://doi.org/10.1080/00223980.2018.1489767

[10]   J. Bourke, A. Titus, and A. Espedido, "The key to inclusive leadership," *Harvard Business Review,* 6, March 2020, doi: https://www.researchgate.net/publication/355807489_The_Key_to_Inclusive_Leadership

[11]   C. Fiola, *Rekindling the Sacred Fire: Métis Ancestry and Anishinaabe Spirituality.* Winnipeg, Canada: University of Manitoba Press, 2015.

[12]   H. Carlone and A. Johnson, "Unpacking 'Culture' in Cultural Studies of Science Education: Cultural Difference versus Cultural Production." *Ethnography and Education*, vol. 7, no. 2, pp. 151–173., 2012, doi: https://doi.org/10.1080/17457823.2012.693691.

[13]   A.C. Edmondson, *The Fearless Organization: Creating Psychological Safety in the Workplace for Learning, Innovation, and Growth.* Hoboken, NJ, USA: John Wiley & Sons, 2019.

[14]   C. Rottmann, D. W. Reeve, R. Sacks, and M. Klassen, "An Intersubjective Analysis of Engineering Leadership Across Organizational Locations: Implications for Higher Education", *CJHE*, vol. 46, no. 4, pp. 146–173, Jan. 2017, doi: https://doi.org/10.47678/cjhe.v46i4.186198

[15]   J. Walther, S. E. Miller, and N. W. Sochacka, "A Model of Empathy in Engineering as a Core Skill, Practice Orientation, and Professional Way of Being," *J. Eng. Educ.*, vol. 106, no. 1, pp. 123-148, Jan. 2017, doi: https://doi.org/10.1002/jee.20159

[16]   R. Pellissier, F. Siluk, C. Flynn, and M. Kanaan, "Approaching Equity, Diversity, Inclusion, and Social Justice Education as Imperative to Engineering Curricula", *PCEEA*, Nov. 2022, doi: https://doi.org/10.24908/pceea.vi.15924

[17]   J. E. Bennett and D. Sekaquaptewa, "Setting an egalitarian social norm in the classroom: improving attitudes towards diversity among male engineering students," *Soc Psychol Educ* vol. 17, pp. 343–355 Mar. 2014, doi: https://doi.org/10.1007/s11218-014-9253-y

[18]   Barrett Values Centre. "The Barrett Model: Seven Levels of Consciousness." https://www.valuescentre.com/barrett-model/ (accessed Mar. 9, 2023).

[19]   A. De Smet, K. Rubenstein, G. Schrah, M. Vierow, and A. Edmondson, "Psychological safety and the critical role of leadership development," *McKinsey and Company*, Atlanta, GA, USA Feb. 11, 2021. [Online]. Available: https://www.mckinsey.com/capabilities/people-and-organizational-performance/our-insights/psychological-safety-and-the-critical-role-of-leadership-development

[20]   R. H. Kilmann and K. W. Thomas, "Developing a forced-choice measure of conflict-handling behavior: The" MODE" instrument", *Educational and psychological measurement*, vol. 37, no. 2, pp. 309-325, 1977, doi: https://journals.sagepub.com/doi/pdf/10.1177/001316447703700204

[21]   J. Dhar, TED Salon, *How to Have Constructive Conversations*. (Mar. 11, 2021). Accessed: Feb. 17, 2023. [Online Video]. Available: https://www.ted.com/talks/julia_dhar_how_to_have_constructive_conversations?language=en

[22]   T. Okimoto, M. Wenzel, and K. Hedrick, "Refusing to apologize can have psychological benefits (and we issue no mea culpa for this research finding)," *European Journal of Social Psychology*. Vol. 43, no. 1, pp. 22-31, Feb 2013, doi: https://doi.org/10.1002/ejsp.1901

[23]   K. Cain and S. Cocco, "Leadership Development through Project Based Learning", *PCEEA,* Jun. 2013, doi: https://doi.org/10.24908/pceea.v0i0.4869

[24]   L. Renninger, TED, *The Secret to Giving Great Feedback*. (Feb. 10, 2020). Accessed: Feb.10, 2023. [Online Video]. Available: https://www.ted.com/talks/leeann_renninger_the_secret_to_giving_great_feedback?language=en

Peer reviewed