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Development of an Equity, Diversity, and Inclusion Curriculum Initiative for Undergraduate STEM Students

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Article abstract

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Development of an Equity, Diversity, and Inclusion Curriculum Initiative for Undergraduate STEM Students

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Abstract

Equity, diversity, and inclusion (EDI) gaps persist in science, technology, engineering, and math (STEM) fields, as demonstrated by the discrimination, stereotyping, and inequities that historically and persistently marginalized groups face. Recognition of this gap led a transdisciplinary team to develop foundational-level e-learning modules, titled *Foundations for Inclusive and Respectful Engagement* (FIRE) on EDI capacities to be delivered in STEM undergraduate classes at the University of British Columbia's Okanagan campus. FIRE consists of online, asynchronous, self-study modules delivered through the learning management system, Canvas. Feedback from pilot testing the FIRE modules has demonstrated that STEM students find the modules to be relevant and beneficial. Throughout the development of FIRE, we learned the importance of aligning the course with our institution's values, working in a transdisciplinary team, and revising iteratively. This documentation of the development and preliminary feasibility of the FIRE modules aims to assist other institutions or organizations who are in the process of developing their own EDI teaching and learning materials.

Introduction

Numerous gaps in EDI are present in the science, technology, engineering, and math (STEM) fields (Cech, 2022). For example, women scientists are systemically under-recognized by both academic institutions (e.g., scientific journals, universities) and individuals (e.g., citations, hiring, salary) (Filardo et al., 2016; Knobloch-Westerwick et al., 2013; Knobloch-Westerwick & Glynn, 2013; Rossiter, 1993). This inequity is present before women scientists enter the workplace, with the proportion of women students in STEM fields declining every year over the course of a four--year undergraduate degree (Clark Blickenstaff, 2005; Statistics Canada, 2021). Women with intersecting identities, such as being racialized, face exacerbated discrimination within STEM (Blosser, 2020; Lee et al., 2020; Park et al., 2020). In professional contexts, women in STEM are less likely to be hired, are paid less than men, and face recurring stereotyping within the workplace (McKinnon & O'Connell, 2020; Padavic et al., 2020). Members of other historically and persistently marginalized (HPM) groups such as Indigenous peoples, people with disabilities, and racialized individuals face similar barriers within STEM (Kerr et al., 2018; Khan et al., 2021; McGee, 2020; Mitchell & Sawyer III, 2014). There is a need within STEM education to address these inequities, so that students of all identities and experiences can feel included and valued in their fields.

Undergraduate students, institutions, and employers have expressed needs for EDI capacity trainings within institutions, and STEM employers have demonstrated a desire for EDI-competent staff (Hinton-Smith et al., 2022; Karimi & Pina, 2021; Lee et al., 2022). Despite this, foundational level curriculum initiatives related to EDI are uncommon (Arora & Wolbring, 2022; Hinton-Smith et al., 2022). While online curricular resources related to EDI do exist, these often require the instructor and students to seek out these learning opportunities on their own time. The University of British Columbia (UBC) is a public institution located in Western Canada, with over 70,000 students spread across two campuses. UBC has stated that it has a commitment to the development of equity, diversity, and inclusion (EDI) initiatives throughout its campuses. As of 2023, there were close to 60,000 students at the UBC Vancouver campus, and nearly 12,000 students at the UBC Okanagan campus (UBC, 2024). The UBC *Inclusion Action Plan* (IAP) was developed out of its strategic plan for 2018-2028 (University of British Columbia [UBC], 2020). Within the IAP, five goals are set out: (1) recruitment, retention, and success, (2) systems change, (3) capacity building, (4) learning, research, and engagement, and (5) accountability. These goals aim to guide the direction of all initiatives at UBC, so that EDI is centered within all policy and development moving forwards (UBC, 2020). In 2023, UBC released the Strategic Equity and Anti-Racism (StEAR) Framework to "guide the implementation of equity and anti-racism priorities and cyclical evaluation of progress over the next three to five years" (UBC Equity and Inclusion Office, 2023, p. 4). The StEAR Framework builds off priorities outlined in the IAP and other documents to ensure that EDI-related strategies are implemented and evaluated to ensure that they are meeting the institution's priorities. Additional plans and reports such as the Indigenous Strategic Plan (UBC Office of Indigenous Strategic Initiatives, 2020), Task Force on Anti-Racism and Inclusive Excellence Final Report (Chau et al., 2022), and the Trans, Two-Spirit and Gender Diversity Task Force Report (Stewart et al., 2023), further demonstrate UBC's commitment to increasing EDI within the institution. Similar strategic plans and policies have been developed by government bodies, organizations, and other institutions, all with the goal to reduce gaps and deficiencies in EDI (BC Public Service Agency, n.d.; Fraser Health Authority, 2023; McGill University, 2020). However, developing and ensuring that resources are easily accessible can be challenging.

At UBC, there are in-person, and online resources related to EDI available to faculty, staff, and students both for free and at a cost. However, these resources may not be accessible to everyone, due to potential time constraints, difficulty finding the resources, and cost. While these examples are specific to UBC, other institutions may have access to EDI resources structured in a similar way. To engage those who may not have had the opportunity to participate in EDI-related learning, and to make university campuses more equitable, respectful, and safe for everyone, there is a need for foundational, accessible, and program-integrated EDI training for undergraduate students.

Curricular Intervention

To help address the need for foundational level EDI learning and engagement opportunities, four faculty members at UBC's Okanagan campus came together to develop the *Foundations for Inclusive and Respectful Engagement* (FIRE) e-learning modules. These modules were designed as a curricular intervention to be implemented within undergraduate courses in different disciplines and programs. The goal of the FIRE modules is to help learners build foundational capacities in engaging with members of the UBC and broader communities in an inclusive, respectful, and equitable manner. Within the FIRE project, foundational capacities in EDI were defined as introductory-level concepts. This focus was chosen because of the context in which the FIRE modules were designed to be delivered. Specifically, they were designed to be primarily presented in first or second-year undergraduate courses. While the modules can be delivered within any course at UBC, they are targeted to entry-level courses, so that students build these capacities at the start of their post-secondary education. Further, this foundational level was designed to meet the needs of the diverse student body. Students at UBC come from a variety of backgrounds, therefore the knowledge and capacities of EDI-related concepts varies widely within the study population.

The faculty members who led the development of FIRE have expertise in the fields of health and exercise sciences, engineering leadership, and nursing, in addition to experience as EDI leads within their respective departments. They collaborated with students to create the FIRE modules. A transdisciplinary team was strategically formed so that FIRE would be applicable to students within multiple STEM-degree programs. The core team now consists of three faculty members and one graduate student. We feel that it is critical to state our positionalities as authors and leaders of the FIRE modules to situate ourselves and acknowledge how our various lived experiences contributed to the modules. The authors involved in this project not only come from different professional backgrounds, but also have different lived experiences and positionalities. JAPS is of White settler-colonial origins, and resides within the ancestral, traditional, and unceded territory of the Syilx Nation. She is working on a master's degree in health and exercise sciences at UBC Okanagan, where her research focuses on health equity and type-2 diabetes prevention. She recognizes that her privilege shapes her research and worldview, and aims to centre and amplify voices that are typically left behind in academia and health. MEJ is a second-generation Canadian who identifies as a cis-gender heterosexual woman of mixed ethnicity. Her worldview has been shaped by racism, colonial education, and poverty, as well as the unearned privilege of holding a researcher position at UBC Okanagan on the unceded and unsurrendered Syilx Territory. RC is a cis-gender, abled-bodied woman of Caribbean descent, who has lived in Canada her whole life. As an assistant professor, she brings the experience of her cultural heritage and professional development to her work. As a person who has benefited from education, she acknowledges her privilege and access to resources. RC strives to be aware of her own biases, and recognizes how

they shape her teaching and research. She commits to continuous learning for achieving greater equity. JHE is the child of Japanese and Dutch immigrants to the ancestral, traditional, and unceded territory of the Syilx people. He is a son, nephew, cousin, brother, husband, father, and uncle, who is also a faculty member at UBC Okanagan, where he studies, teaches, and leads work in communication, leadership, Indigenous reconciliation, and inclusive excellence.

The goal of building foundational EDI capacities for STEM students also informed the content included within FIRE. Four introductory, EDI capacity modules were included within the first iteration of FIRE: working with conflict, psychological safety, allyship, and sex and gender equity. These topics were chosen to address the gaps that STEM students currently exhibit in relation to EDI, not only while they are in their undergraduate degrees, but also as they move into the professional world (Bryson et al., 2020; Chen et al., 2019; Corneille et al., 2019; Miner et al., 2019). The modules include evidence-based readings, videos, reflection activities, and quizzes related to the module topics.

The planning of each module began with a literature review to determine the key learning objectives. Bloom's Taxonomy (Adams, 2015; Bloom, 1956) was used during their development. The aim was for each to be structured in a way that instructors could evaluate whether or not the students met the learning objectives according to the first three levels of Bloom's Taxonomy (knowledge, comprehension, application). Two to four learning outcomes were developed per module to keep the length of each module between two to three hours.

Based on the learning outcomes, a second literature review was then conducted to gather content to include within the modules, which was a variety of different instructional formats, with the goal of having at least one video and evaluation tool (e.g., quiz or reflection activity) per learning outcome. This was done so that students can engage with the content in more than one format, and to accommodate different learning styles (Pashler et al., 2008). Students were required to achieve 100% on the quizzes in order to progress, which would prevent "skipping" through the content. Each module then ended with a reflection activity, where students could think about how they would use and implement what they learned throughout their degree, and eventually, into the workplace. For example, in the sex and gender equity module, one learning objective is to "identify the stereotypes women and 2SLGBTQIA+ people face in the workplace and cultural contexts." Based on this learning outcome, the module has two videos, written content, a quiz, and a personal reflection on gender stereotypes.

The FIRE modules were designed to be flexible, so that instructors could adapt content to be specific to their individual courses, if desired. This includes giving each instructor the autonomy to choose how learning outcomes for the modules are met. For example, some instructors have incorporated the modules "as is" in their courses and evaluated student achievement based on the provided evaluation tools within the modules. On the other hand, some instructors have implemented only one, or part, of one module. When starting the pilot of the modules, it became apparent that the confidence and experience that instructors have with EDI capacities may influence their ability and interest in delivering the FIRE modules. To aid instructor delivery, an implementation guide was developed. The guide offers instructors further explanation of how each learning outcome could be evaluated, depending on which level of Bloom's Taxonomy the instructor was targeting. An example of the implementation guide is offered in Table 1.

The authors feel that it is important to note the omission of Indigenous Truth and Reconciliation content from the FIRE modules. While this work is fundamental to inclusive excellence, it is, however, distinct. The omission was purposeful, as at UBC, there are many other resources and learning opportunities available that have been created with Elders, Knowledge Keepers, and others with lived experiences and expertise in decolonization, reconciliation, and

Indigenization. These Truth and Reconciliation resources have been created thoughtfully, and are excellent instructional aids that all members of the UBC community can access.

Table 1. FIRE implementation guide example

FIRE Module: Working with Conflict *Learning outcome 2: Describe the role effective dialogue plays in conflict resolution*	
Bloom's Taxonomy Level	Implementation guide explanation
Knowledge	Students should be able to state an example of what contributes to effective dialogue. *Example assessment: Provide students with a multiple-choice question with one example of an effective dialogue (e.g., listening to what others say fully before responding) amongst incorrect responses. Or, have students write out all components of effective dialogue*
Comprehension	Students should be able to explain different components of effective dialogue and how these contribute to conflict resolution. *Example assessment: Have students state all the components of effective dialogue and explain how it contributes to conflict resolution. Students can provide an example to demonstrate further understanding*
Apply	Students should be able to come up with a response to a conflict scenario using all components of effective dialogue. *Example assessment: Students are asked to come up with a mock conflict scenario and present options of both effective and ineffective dialogue and demonstrate how effective dialogue leads to a positive resolution, compared to ineffective dialogue.*

Evaluation and Pilot Testing

A long-term goal that the research team has for the delivery of FIRE modules is for them to be integrated within undergraduate courses across disciplines at both UBC's Okanagan and Vancouver campuses, so that students leaving UBC are competent and confident in essential EDI skills. Since the student body at UBC is diverse, prior knowledge and UBC-specific exposure to EDI teachings and building of EDI capacities varies widely across the student body. As developers of the FIRE modules, we recognize that we have a level of knowledge and expertise that is likely beyond that of the intended audience. To ensure that the FIRE modules are aligned with the wants and needs of our intended audience, we sought feedback from students in a pilot project. The piloting and feedback from students were used as a tool for quality improvement of the modules, therefore ethics approval was not required.

Thirteen students participated in the pilot testing of the modules, 11 from health and exercise sciences and two nursing students. Of these pilot participants, four were undergraduate students, and the remainder were graduate students, including both master's and doctoral. No further demographic data was collected from the participants to protect participant anonymity and confidentiality, due to the small sample size. The students were given six weeks to complete the

five modules (i.e., introduction, working with conflict, psychological safety, allyship, sex and gender equity). At the end of each module was a questionnaire to gain information on user-friendliness, accessibility, and engagement metrics (i.e., time spent to complete module). The measures in the questionnaire were modified from the Usefulness, Satisfaction, and Ease-of-Use (USE) Questionnaire (Lund, 2001). After all five modules were completed, a focus group was held to gain feedback on the format, engagement, content, and satisfaction with the FIRE modules in their entirety.

The preliminary feedback from this quality-improvement assessment has shown that the content included with FIRE was applicable and relevant to students within STEM. Feedback for improvement mainly regarded the interactivity of FIRE. Within the focus group, students shared a wide range of experiences relevant to building and maintaining EDI capacities. Some students shared how they were already familiar with the content in the FIRE modules, and felt that parts were somewhat redundant, given their prior knowledge. Others shared how while they were familiar with the basic concepts, the modules reinforced the knowledge, presented opportunities for personal reflection, and allowed them to gain EDI capacities without feeling overwhelmed or guilty for past behaviours. Despite the familiarity with concepts in the FIRE modules, most students still shared how they believed that these topics were relevant for STEM students. Suggestions to improve the course included more peer interactions, and inclusion of more activities, visuals, and videos to replace some of the written text. This is similar to what has been seen in the existing body of literature: students prefer online learning environments that are engaging and include some type of peer interaction (Banna et al., 2015; Chakraborty & Muyia Nafukho, 2014; Martin & Bolliger, 2018; Tsang et al., 2021). The feedback from this focus group will inform revision of the FIRE modules to better fit the needs of students in STEM.

Lessons Learned

Although we are still evaluating, adapting, and building new content for FIRE as we work towards delivery across campuses, we would like to share the lessons that have been learned thus far in this process. We are continuing to learn from the development of a project such as this but hope these insights may be helpful to others who are working on similar projects. These lessons include work in a transdisciplinary approach, align the initiative with your institution's values, and revise iteratively.

Work in a transdisciplinary approach

When developing a curricular initiative with intentions of implementing it across disciplines, we have found it is beneficial to work within a transdisciplinary team, so that the initiative is applicable and relevant to all intended audiences. While discipline-specific approaches to developing curriculum may be effective for higher-level, specific topics, we found working with a transdisciplinary team to be an asset when developing a basic, foundational level EDI course for STEM students. Within the team, there were faculty members whose expertise span pedagogy and student leadership, nursing, health and exercise sciences research, and a health and exercise sciences graduate student. The roles that each team member held allowed for the FIRE modules to uniquely address the need for EDI education in STEM. The two team members with expertise in teaching and pedagogy helped to ensure that the learning outcomes, evaluation tools, and content were all aligned with the project's goals. Through their 20-plus years of combined teaching experience at a post-secondary level, gaps were identified in students' EDI capacities, which the

FIRE modules were positioned to address. The faculty member with a research position has worked in building and testing EDI trainings for fitness professionals, and brought this expertise to ensure that the development and testing of the FIRE modules was evidence-based. The graduate student brought a unique perspective of having been an undergraduate student at UBC, and helped the FIRE modules be designed in an engaging and student-focused manner.

This variety in knowledge and lived experiences allowed the FIRE course to be developed in a manner that would serve a diverse student population. Throughout the development process of FIRE, we collaborated with the services available on the UBC Okanagan campus that have expertise in developing EDI curriculum content, such as the Equity and Inclusion Office and Sexual Violence and Prevention Office. Working with these services who regularly engage with EDI content helped the team focus FIRE to a student level, and ensure that it was independent of resources already available to students at UBC. Universities are places where students of all different backgrounds are together in one space, therefore foundational EDI curriculum initiatives may be more applicable to the broad base of students if they are developed with a transdisciplinary approach.

Align your initiative with your institution

To build a curricular initiative that will have broad support for uptake, it is important that its goals align with those of the institution. Additionally, positioning projects with the school's values can potentially open up greater opportunities for funding capacity or institutional-level support for the development. For example, in the case of building the FIRE course, UBC has developed an *"Inclusion Action Plan"* (IAP) with the goal of building the university's campuses into a more equitable, diverse, and inclusive environment (UBC, 2020). One of the goals of the UBC IAP is to build EDI capacity in both individuals and the university as a whole. Specifically, the UBC IAP emphasizes the need to establish and embed EDI education and training programs within the curriculum (UBC, 2020). When starting the development of the FIRE course, the UBC IAP was used as a guide to ensure that the content within the course parallelled the IAP goals. Building the curriculum initiative around the UBC IAP goals provided the ability to speak directly to the IAP when proposing the FIRE course to department heads, deans, and funding agencies. Because of this, FIRE gained support from the institution, and increased the likelihood of it being embedded directly within the UBC curriculum. Since the development of the FIRE modules, UBC has created an additional guiding document, the StEAR Framework, which includes curricular changes that promote equity-informed teaching and pedagogy as an objective (UBC Equity and Inclusion Office, 2023). The FIRE modules are in keeping with the goals of the institution, because instructors are given a student-and-evidence-informed tool for embedding more EDI teaching within their courses.

In addition to aligning the initiative with this institutions' values, considerable reflection was also utilized to determine who is the intended audience for the FIRE modules, and how to best align them with their needs. The diversity of the UBC student body was a motivator for developing these modules to be at a foundational level, so it was also recognized that students from equity-owed groups may have different experiences completing the FIRE modules. Most of the content within itis designed to address the societal norms and ideologies that have privileged the dominant White, cis-, heterosexual, settler-colonial populations and have disadvantaged and discriminated against equity-owed individuals. The differing experiences that students may have while completing the modules was brought up in the focus group. A student shared how it was understood that the role and responsibility of disrupting heteronormativity in the institution, but

shared concerns regarding the concept of 'responsibility' presented in the modules because of how BIPOC and 2SLGBTQIA+ folx have been historically tasked with the 'responsibility' to advocate against discrimination. Based on this feedback and further reflection, the concept of responsibility to act within the modules was removed, and rather, presented with an importance of reflecting on one's position and privilege. The content presented within the FIRE modules may evoke different feelings, depending on each student's identity and previous experiences.

Revise iteratively

The following steps took place when developing and amending the FIRE course: (1) the primary developer of the content would go through the content and ensure that everything was related to the key learning outcomes to keep the content relevant and the course timely, (2) the course was sent to the other team members for feedback and revisions, (3) a group of 11 health and exercise sciences students and two nursing students, ranging from undergraduate to doctorate, completed the course and provided feedback in the format of a focus group, and (4) steps 1-2 were repeated, based on feedback from the focus group.

When beginning the building of FIRE, the initial plan was for a few rounds of revisions before launching into undergraduate classrooms. The original intended timeline of the FIRE course was to have the whole course ready for delivery within undergraduate classrooms in the 2021-2022 academic year. While specific components of FIRE have been delivered in engineering, along with health and exercise sciences undergraduate courses, delivery of the whole FIRE course at the above timepoint was not successful, due to the revision process and the challenges of recruiting pilot participants. Piloting the FIRE course was an important step before it was used in undergraduate classrooms, in order to gain feedback, and then revise the course accordingly. Although the revision process was longer than expected, the iterative process was of benefit to the FIRE modules. Regarding the piloting of the modules, the intention was to have pilot participants from the disciplines of engineering, health and exercise sciences, and nursing. There was success in recruiting participants from both health and exercise sciences and nursing, however, the nursing cohort was small (n=2). While the feedback from these pilot participants was extensive, and resulted in revisions to the FIRE course, the lack of feedback from engineering students means that topics may have been missed, or content that STEM students in non-health related disciplines would view as important may not have been addressed. This repetitive process provided confidence in the relevance and engagement of FIRE when it will be launched in the 2022-2023 academic year.

Next Steps

At the time of this writing, step 4 of revisions, preparing FIRE to be launched in three courses in the disciplines of engineering, health and exercise sciences, and nursing at UBC Okanagan in the 2022-2023 academic year is in progress. There is a plan to complete a curricular evaluation on the successes and attitudes towards FIRE in both the students taking the FIRE course, and instructors delivering the course. This will help to understand why, or why not, FIRE is being delivered in courses, what disciplines are most often delivering the modules, as well as being able to share what was learned at the institutional level, in order to build support for the integration of FIRE within all undergraduate disciplines at UBC. This curricular evaluation will also help to know whether or not further revisions are needed regarding course content for students, or delivery/platform choices for instructors require modification. In future publications,

the plan is to share the evaluation results and the outcomes that the FIRE modules have on the UBC community collaborations, suggestions, and feedback from fellow researchers, institutions, and communities on the FIRE curriculum initiative, as well as similar projects, are encouraged.

Conclusion

To address the inequities within STEM and grow universities as inclusive and equitable spaces, there is a strong need for EDI training at a foundational level. Preliminary results from piloting the FIRE course show that students are willing to engage in EDI-related online learning, and find foundational level training to be beneficial and relevant. Working from a transdisciplinary approach, aligning content with the institution's values, and revising iteratively were all keys to the successful development of FIRE. Development of EDI curriculum initiatives, such as these, can potentially help to reduce the inequities, discrimination, and stereotyping of historically and persistently marginalized people within STEM.

Author Bios

Jenna A.P. Sim is a master of science in health and exercise sciences' student at UBC, Okanagan. Her research focuses on type-2 diabetes prevention, health equity, and behavioural change. Her master's research is exploring the need for type-2 diabetes prevention in individuals experiencing food insecurity. Outside of her thesis research, Jenna has also worked in developing and evaluating equity, diversity, inclusion, and cultural safety training for type-2 diabetes prevention program coaches.

Mary E. Jung is a professor in the School of Health and Exercise Sciences with the Faculty of Health and Social Development at UBC's Okanagan campus. Her research interest is developing evidence-based diabetes prevention interventions designed for community implementation and sustainability, with a focus towards improving equity, diversity, and inclusivity (EDI) in all research endeavours. In the classroom, Jung has developed curricula on cultural safety and inclusivity, and is co-leading a departmental curriculum overhaul to embed EDI competencies.

Rishma Chooniedass is an assistant professor of teaching in the School of Nursing with the Faculty of Health and Social Development at the University of British Columbia. She is the advisor to the Dean on Equity, Diversity, and Inclusion. Through her research, teaching, and service, Rishma strives to contribute to a more equitable and inclusive academic environment, inspiring others to join in the collective effort to advance social justice.

Jannik Haruo Eikenaar
Jannik Haruo Eikenaar is an associate professor of teaching in UBC's School of Engineering where he teaches communication and leadership. He has also served as an equity, diversity, and inclusion advisor on campus and leads several Truth and Reconciliation projects at UBC. His research, teaching, and service interests intersect through intercultural communication curriculum, accessibility and inclusion programming, and Indigenous community engagement initiatives.

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