

Building Reconciliation at the U of S

College of Arts & Science

Indigenous Success in the STEM Disciplines; Exploring Assets and Barriers to STEM Engagement for Indigenous Students

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INTRODUCTION

Indigenous students are strongly under-represented among University of Saskatchewan undergraduate STEM degree programs (4% and 3% in the Colleges of Arts & Science and Engineering, respectively, compared to 14% in social sciences, and 24% in education). The reasons for this are complex, but the outcomes are clear: fewer eligible applicants to professional colleges requiring a foundational degree (Medicine, Dentistry, WCVS); few Indigenous STEM professionals (including science teachers); a lack of role models to inspire young Indigenous STEM students; and a limit on the diversity, richness and social-relevance of the STEM disciplines among our provincial demographic.¹

Situated on Treaty 6 Territory in the Homeland of the Métis Nation, our university is called in the spirit of Truth and Reconciliation to ensure that Indigenous peoples have equitable access to educational opportunities (TRC 92.ii) through changes that welcome both Indigenous peoples and their ways of knowing into our colleges. Reconciliation in STEM disciplines includes working to ameliorate a long history of systemic and institutional racism that has limited the cultural-relevance of, and tangible access to, STEM for Indigenous learners.^{2,3}

We engaged in a consultation process with students, academic staff, program administrators, and cultural teachers within and beyond our campus community^(Table 1) to better understand the forces driving Indigenous student STEM participation in the prairie region. Our goal is to inform the development of post-secondary programming that will provide a sightline for Indigenous students to access diverse STEM degree paths, succeed within those programs, envision themselves as disciplinary leaders, and meet the challenges of the future as Indigenous STEM professionals.

OBJECTIVES

This research extends existing literature on Indigenous post-secondary student recruitment and retention in STEM disciplines, focusing on local contexts and the individual experiences of faculty and students. We engaged in a broad process of consultation to:

- identify barriers to STEM engagement for Indigenous learners;
- identify best practices in post-secondary science education for under-represented student cohorts;
- conceptualize a realistic pathway to support STEM degree engagement, retention, and attainment;
- consider how improved STEM access programming may benefit from and contribute to innovation in program delivery across our science departments (Arts & Science) and the professional STEM colleges.

MATERIALS & METHODS

Research was conducted between March 2015 and August 2016 (Table 1). Assessment of Indigenous student perceptions of K-12 STEM preparation, post-secondary directions, and career opportunities was conducted using a quantitative and qualitative adaptation of the MISO S-STEM Survey⁴ with additional questions around community and peer support for STEM engagement. Interviews with students, teaching faculty and program advisors at U of S and other institutions provided additional information and context to inform quantitative data analysis.

RESULTS

Unequal K-12 preparation in STEM subjects for students attending rural, remote, and First-Nations administered high schools, as compared urban provincial schools, was a strong barrier to successful post-secondary STEM engagement. The availability of 20 and 30 level STEM courses in rural, remote, and FN schools is limited by a STEM-teacher deficit and by an inflexible funding model.⁵ Currently, direct entry U of S students (G12 ≥ 70%) who have been unable to access pre-requisite 30-level math and science courses are directed to adult basic education and/or online course options. The challenges of enrolling in multiple institutions concurrently, as well as attrition to technical collegiate programs, do not encourage transition to U of S STEM degree programs. Students who access STEM degree programs with pre-requisites earned without requisite hands-on laboratory and problem-based learning experiences may also find themselves underprepared and experience first year courses as discouragingly challenging. Other key barriers and assets to STEM engagement are summarized in Table 2.

Student Data (U of S)

- **Unequal K-12 standards** disadvantage many Indigenous students (especially in 30-level STEM courses)
- **Culture shock** within the city, and university, contribute to a sense of intimidation for some students
- **Isolation as Indigenous learners within STEM degree programs** dissuades participation
- Some students **lack community support**, or are viewed as outsiders at home once they begin post-secondary STEM studies
- **Low expectations** impact student success
- **Low risk tolerance** regarding degree outcomes affects some students
- **Non-academic** variables include both **barriers** (financial, family responsibility) and **assets** (advocacy, motivation) for Indigenous students
- Students are excited by **possibilities in STEM**: research, problem-solving, giving back, and **reconciliation through education** were key themes

U of S Indigenous Student Experience

- Electronic survey (14)
- Interviews (6)
- ASAP program evaluation (4 x 60)
- Upper year conversation café hosted by the TMC (20+)

Administrative / Advisory / Instructional Experience

- Interview (26)
- Internal data analytics
- Past program and course review (MSEP, AFYEP, strategies within ASAP, individual instructional approaches)
- TMC / LC team consultation

Community & External Program Survey

- External program visits (U Manitoba, U Winnipeg, U Lethbridge, U Calgary, Mt. Royal U, Yukon College) and interviews (15)
- Interviews with community educators, transition coordinators, advisors to educational council (17)

Table 1. U of S Research Services BEH Certificate # 15-397

Despite barriers, Indigenous students do persist in STEM disciplines and current upper year Indigenous BSc. students expressed appreciation for cultural and advisory supports provided by the Trish Monture Centre and Aboriginal Student Centre. While some had accessed academic supports, all of these upper-year STEM students had been admitted with 30-level STEM pre-requisites, and many benefited from non-academic assets including financial advocacy, a sense of belonging to the campus community, and a sense of personal responsibility — they voiced optimism around education as a path to valued career and life goals, and are sustained by a passion for learning:

“To me, studying science is like... becoming a part of the future, do you know what I mean? It’s just got endless possibilities that I’m excited about- and excited about learning about.”

“My favorite thing right now about the university is how inclusive the university is!”

“When my son was sick, I wanted to go into the health fields. Just to help him. That became the reason why I want to learn more - to understand and help my people.”

“For me, I like the complexity of ideas, and turning them into an outcome. Trying to solve a problem, and just finding out if it actually works. That’s what interests me!”

Instructional / Advisory / Off-site Perspectives

- **K-12 preparation** is key for success in STEM
- **Lowering entrance requirements to STEM programs ≠ increased graduation rates**
- **Instructional strategies** matter to student success
- There is a need to **build cultural capacity** within the STEM colleges
- **Non-academic barriers** must be met holistically alongside academic program development
- **Instructors are willing** to embrace socially- and culturally-responsive approaches but some voiced a **need for guidance and support**
- **Both faculty and students benefit from small class sizes** which allow stronger **instructional relationships** and **flexibility in course design & delivery**
- **Instructors are excited** about opportunities to **increase diversity** in their disciplines

Table 2. Summary of Key Research Outcomes

Here’s a cool idea...
I heard of a program that...
Can we do that here?

Research interviews with faculty and staff often evolved into conversations about new ideas for STEM program design and course delivery, and excitement about serving a ‘new generation of learners’.

CONCLUSIONS

This research identified key elements of program design and delivery that support the engagement and retention of Indigenous learners in STEM degree programs.

1. Improved access to preparatory K-12 content is needed to increase eligible Indigenous student enrollment in STEM programs.
2. On-site preparatory courses (90-level) would improve students’ academic experience in first year, and provide a ladder in to STEM.
3. Culturally-responsive advising helps students navigate non-academic and cultural barriers to academic engagement.
4. Instructional strategies matter and small class sizes promote instructional responsiveness.
5. There is a need to build cultural capacity within STEM disciplines...
... to connect and support Indigenous STEM students
... and to highlight to relevance of STEM degree outcomes to Indigenous learners and their communities.

We are excited to apply results of this research to the development of a visible pathways model to support student access to, and success within STEM degree programs and post-graduate opportunities.

REFERENCES

1. Voice, Vision and Leadership: A Place for all (2013). Joint Task Force on Improving Education and Employment Outcomes for First Nations and Métis People, SK.
2. Aikenhead (2012). STEM Education & Related Employment in Saskatchewan; A Report for the Australian Council of Learned Academics, 57p.
3. Major Themes from “Building Reconciliation” National Forum (2015). University of Saskatchewan, 10 p.
4. Friday Institute for Educational Innovation (2012). *Student Attitudes toward STEM Survey – Middle and High School. Maximizing the Impact of STEM Outreach.* Raleigh, NC
5. Indigenous Affairs and Northern Development Canada (AANDC) (2015). Federal Funding levels for First Nations K-12 education; accessed 01/15/15.

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