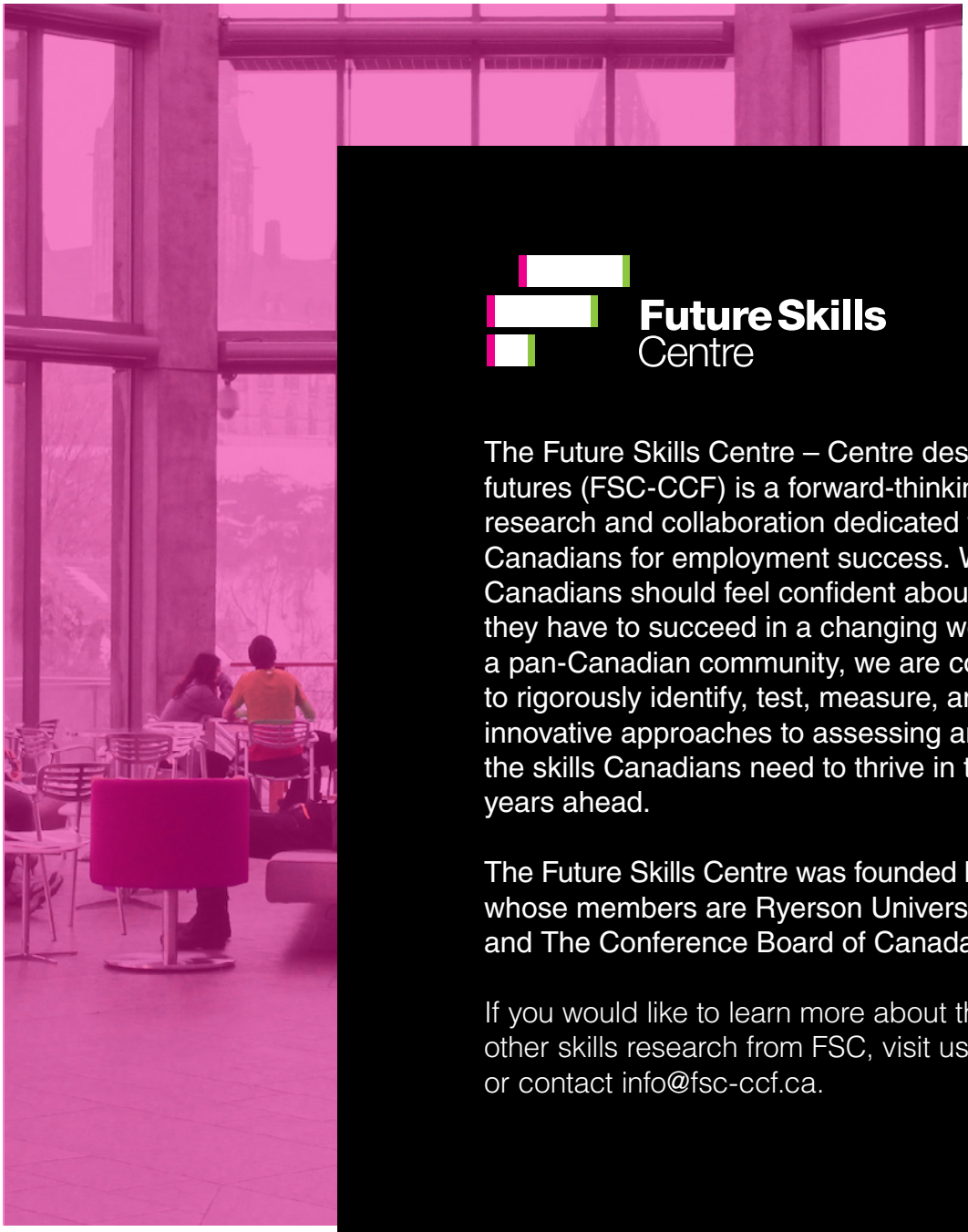
The Conference Board of Canada

In partnership with Future Skills Centre

Learning Together

STEM Outreach Programs for Indigenous Students

Impact paper | December 9, 2020



Future Skills Centre

The Future Skills Centre – Centre des Compétences futures (FSC-CCF) is a forward-thinking centre for research and collaboration dedicated to preparing Canadians for employment success. We believe Canadians should feel confident about the skills they have to succeed in a changing workforce. As a pan-Canadian community, we are collaborating to rigorously identify, test, measure, and share innovative approaches to assessing and developing the skills Canadians need to thrive in the days and years ahead.

The Future Skills Centre was founded by a consortium whose members are Ryerson University, Blueprint, and The Conference Board of Canada.

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In partnership with: Ryerson University, The Conference Board of Canada, blueprint

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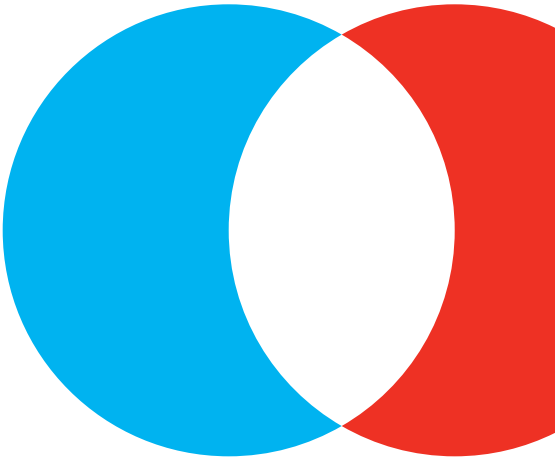


Key findings

- Outreach programs are trying to improve Indigenous education and representation in STEM (science, technology, engineering, and mathematics) fields. These programs are interested in exposing children and youth to STEM role models and career options in STEM fields.

- Outreach programs do increase participants' interest in STEM. It is not yet clear whether these programs have a long-term impact on education and career choices.

- A potential host community, school, or organization might choose not to take part in an outreach opportunity for a variety of reasons. These could include competing priorities, a lack of time, or a lack of trust.

- Organizations know it is critical to build respectful relationships from the start. Many are working with potential hosts—and some with the youth themselves—to develop their programs.

- Non-Indigenous organizations know it is important to have Indigenous staff. Organizations are hiring and supporting Indigenous staff and instructors. Including Indigenous peoples on advisory and governance boards and providing all staff with opportunities to learn about Indigenous cultures creates a workplace culture that can work effectively within communities.

- Not all STEM outreach needs to include Indigenous cultural knowledge. But outreach does need to use culturally appropriate learning methods and meet the community's needs.

- Outreach programs need community partners. Organizations require stable, flexible funding to build partnerships that respect the local and cultural context.

Introduction

Science, technology, engineering, and mathematics (STEM) outreach programs seek to engage people in interactive, real-world experiences. Facilitators of these programs are often post-secondary students studying STEM, STEM researchers or professionals, or science communicators.

Activities can include the following:

- in-class workshops
- after-school programs
- summer camps
- science competitions
- field trips
- on-campus events

Outreach in an era of reconciliation

In response to a national conversation about reconciliation, governments, the formal education system, and non-profit organizations are wanting to address educational gaps and improve the representation of Indigenous peoples in STEM with extra attention and resources. This awareness, combined with an increasing focus on equity issues in STEM, has increased efforts to bring STEM outreach to Indigenous students.

Organizations want to get involved and do it right.

STEM outreach programs require intensive partnerships. These relationships must recognize the unique strengths and challenges of each community. They rely on ongoing and respectful communication, trust, and consensus-building. The time, resources, and intercultural capacities required on both sides of this partnership should not be underestimated.

Our research on Indigenous learners in STEM

Our earlier work identified STEM outreach programs as one strategy being used to address the under-representation of Indigenous peoples in STEM. (See *Curriculum and Reconciliation Introducing Indigenous Perspectives into K–12 Science*.)

For the purposes of this research, we were interested in free STEM programs, not run by the formal education system, that target Indigenous children in Kindergarten to Grade 12 (K–12). We surveyed these programs across Canada to learn more about how they reach Indigenous youth.

We included responses from 50 organizations offering 103 programs that met the criteria for inclusion in our analysis. Many other programs also reach Indigenous youth, as a part of general programs for all children in Canada, as well as many initiatives run by the K–12 education system.

Staff from outreach organizations, Indigenous and non-Indigenous schools, and post-secondary institutions were interviewed.

See Appendix B for the research methodology.

Multiple motivations for engaging in outreach

The concept of STEM means different things to educators, scientific researchers, corporate funders, and governments. Outreach organizations use the term "STEM" to bring these meanings together under one umbrella to promote, fund, and justify their approaches.[1]

Most programs have multiple goals and focus on different aspects of STEM. Some of these are aimed at the short term and others target medium-or long-term impacts. The reported goals were most often related to careers in STEM. This includes informing students of their career options, sparking interest in pursuing a career in STEM, or finding workers for an industry. Hosts, funders, and program managers see outreach as an important way to reach children and youth before they make key choices about their future educational pathway.

1 Shanahan, Burke, and Francis, "Using a Boundary Object Perspective to Reconsider the Meaning of STEM in a Canadian Context."

Why are organizations doing outreach?

Our survey asked why organizations were doing STEM outreach to Indigenous youth. The responses below are grouped by theme and listed in order of the frequency of responses, beginning with the most common response.

Career pathways

- Increase awareness of and desire to pursue STEM careers.
- Encourage youth to take optional STEM courses in high school so they are eligible for post-secondary studies in STEM.
- Prepare youth for STEM careers through building knowledge and skills.

Attitude

- Generate interest and curiosity in STEM.
- Provide fun and engaging learning experiences that build a positive association with STEM.

Knowledge

- Support understanding of the science content that children are learning in school.
- Build knowledge of specific topics in STEM, particularly in ecology/conservation and technology/digital skills.

Bridging Indigenous and Western knowledge

- Foster greater understanding of Indigenous ways of knowing.
- Present Indigenous knowledge as equal with, and complementary to, Western science.

Foster belonging

- Connect Indigenous youth to STEM mentors and role models, particularly Indigenous ones.
- Develop camaraderie between youth interested in STEM.
- Build youth self-confidence and self-esteem in educational settings.
- Advance an understanding of Indigenous ways of knowing in STEM and cultural competency among non-Indigenous instructors, staff, teachers, and scientists.
- Expose Indigenous youth to the post-secondary world and reinforce that there is a place for them there.

Skills

- Develop transferable skills, particularly critical thinking and problem-solving.

Experiential learning

- Enhance classroom-based education with experiential, hands-on, and on-the land learning.

Support for schools

- Build capacity of educators and schools to teach STEM from Western and Indigenous perspectives through modelling teaching practices, access to field trips, and professional development.

Equity

- Provide access to educational opportunities to which youth might not otherwise have access.
- Address the under-representation of Indigenous peoples (particularly rural/remote and female Indigenous youth) in STEM fields.

Citizenship

- Empower youth to solve real-world and local problems using STEM.
- Inspire environmental stewardship and sustainability practices in all youth through exposure to both Western conservation methods and Indigenous ways of knowing.

Note: Respondents could provide multiple program goals.
Source: The Conference Board of Canada.

The context for delivering outreach programs

One of the most common challenges reported by survey respondents is communication with host communities to plan an event. While recognizing that each community and each school is different, we can try to understand in a general sense what might be at the source of this challenge.

We know that over half of Indigenous people now live in metropolitan areas.[2] Although some organizations are reaching youth in urban areas (such as visiting youth at a community centre or inviting youth to come to an urban university or college campus), most programs target youth in rural or remote areas. Only 15 per cent of programs that responded to our survey did not travel some distance to reach youth.

Schools are busy places

Schools are important places to reach students. They are critical for reaching all students, not just those who self-select to go to a science camp. Eighty per cent of the programs used schools as an access point for youth all or some of the time. This means there can be a lot of STEM-focused programs competing for a school's attention. Schools may face outreach fatigue as they try to accommodate these opportunities for their students—coordinating logistics, selecting activity options, adjusting school schedules, and providing evaluations takes time.

We have a lot of ... external agencies that wanted to get into the school and talk to the kids. And it would be over 80 a year. So that's every two days you have somebody knocking at your door wanting to come in and take students away from things.

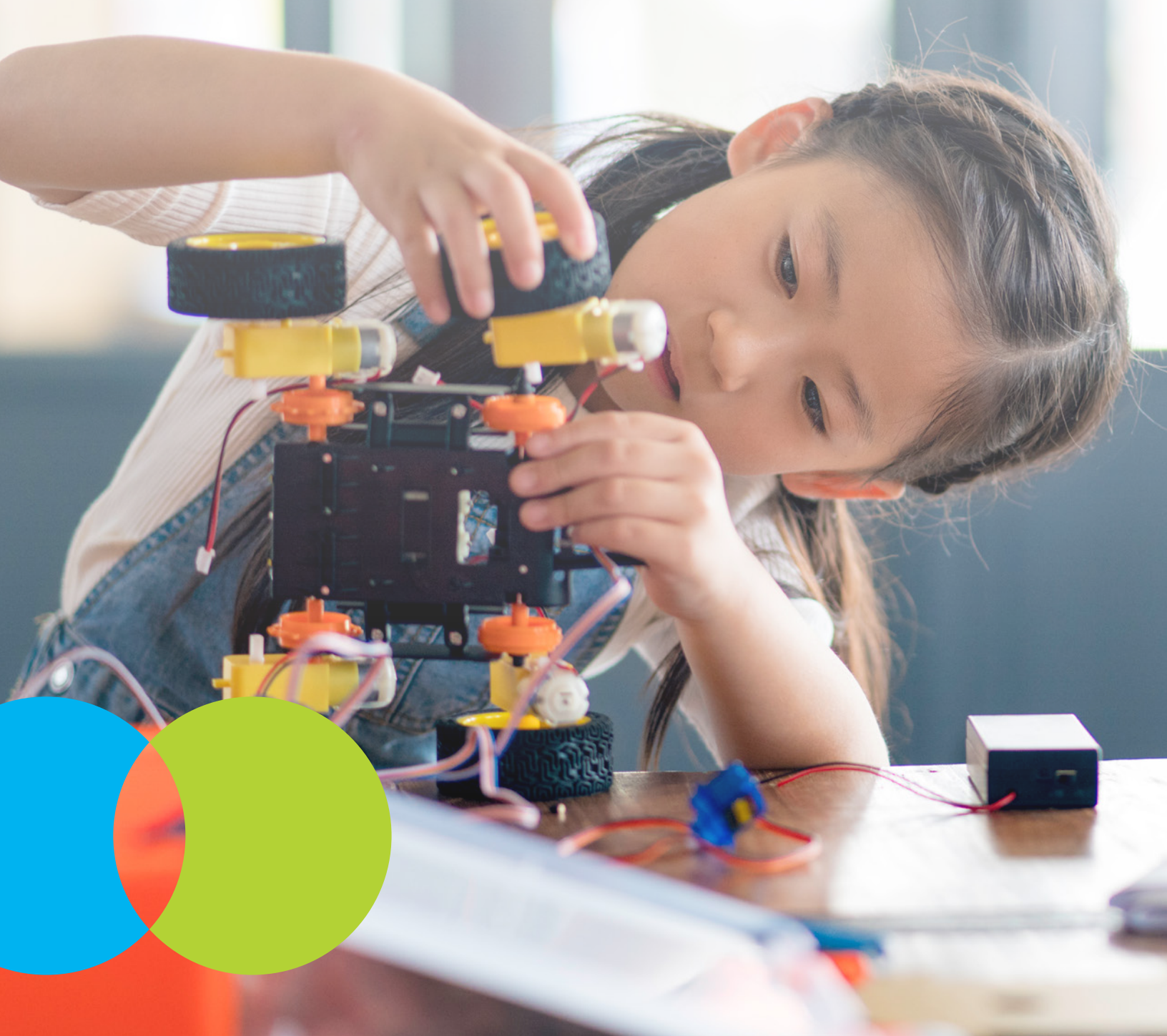
Department of Education Specialist, territorial government

Teachers face curriculum demands

Many teachers in Indigenous communities are non-Indigenous, particularly high school teachers. Teacher turnover is high. At the elementary school level, teachers rarely have a STEM background, making science and math intimidating subjects to teach. Nevertheless, teachers must deliver a packed curriculum where science instruction receives only one to two hours per week. Combined, these factors make it difficult for many schools to keep up momentum in STEM after a visit.

2 Statistics Canada, "Aboriginal Peoples in Canada."

Activities that come pre-packaged and transplanted from another—often urban—location bring with them examples, values, and perspectives that might not resonate with rural and remote experiences.



Communities have competing priorities

STEM programming may not be a top priority. Following many years of imposed educational systems, Indigenous communities are working to revitalize their children's education with their own cultures, languages, and ways of knowing. Alongside this, they are working to improve the basic skills of literacy and math that will enable their children to move forward in all types of education and employment. In communities facing poverty, food insecurity, housing shortages, intergenerational trauma, and mental health crises (linked to the legacies of colonialism), ensuring that their children feel secure and healthy enough to learn is a large task.

Missing the mark for the local context

Activities that come pre-packaged and transplanted from another—often urban—location bring with them examples, values, and perspectives that might not resonate with rural and remote experiences.

> **This is a rural, Northern community.... A lot of what they're providing ... just doesn't have that relevance the students need to see and feel in order to engage with it. And the teachers know this. So, they're very selective about what larger STEM programs they allow in.**
>
> **Outreach coordinator, local outreach organization in remote area**

Systemic issues in STEM education

Indigenous children and youth are interested in STEM. One study reported that Indigenous youth in New Zealand and Australia had higher levels of interest in STEM topics than their non-Indigenous peers.[3] But once youth become interested in STEM, then what?

The path to study STEM in high school and post-secondary institutions can be complicated by a lack of course offerings in small schools and poor connectivity preventing effective virtual education. For many students, they must make a choice to leave the community for education (even high school) and indefinitely if their community does not have jobs in their career of choice. When Indigenous students do study STEM, they will be evaluated by a Western paradigm and may experience racism in the classroom.

> **The idea of becoming an engineer or a scientist or a doctor or any of the STEM professions can't even be realized, because there's no path for them to follow. So, one of the first questions that needs to be answered is how do we address and rectify the systemic barriers that exist, from Kindergarten to Grade 12 for Indigenous people?**
>
> **Métis STEM professional**

3 Woods-McConney and others, "Bridging the Gap?"

Distrust of mainstream education

Outreach programs may be viewed as agents of the mainstream education systems controlled by provincial and territorial governments. Past experiences with formal, Western education through the residential school system have been overwhelmingly negative, associated with forced assimilation, loss, and neglect.[4] Distrust of schools lingers. STEM education in schools today could be seen as another form of colonialism, where students are asked to assimilate into a Western or Eurocentric way of understanding the world to succeed in class.[5]

> **... the Elders and the Knowledge Keepers and the community members want their kids to be successful in the mainstream education system, but not at the cost of their cultural identity.**
>
> **First Nations outreach program, national organization**

Communities might decline to adopt programs that do not respect their protocols for engagement, or honour their knowledge, traditional teaching methods, or values.

What does this mean for outreach?

With these diverse contexts of school and community realities, organizations might be wondering how they can fit in.

Leading organizations are finding creative ways to both reach their mandate of STEM engagement and address community needs. For example, building a greenhouse with students introduces STEM topics such as ecology and engineering while also addressing food insecurity. Some programs are partnering with a language speaker to introduce vocabulary during a hands-on activity, which allows for cultural revitalization alongside STEM. Some organizations are providing workshops for teachers with the hope they can become more confident in STEM teaching.

Outreach organizations are building direct relationships with Indigenous leaders and residents in the communities they want to work with. These are the people who are more likely to know their community well, and more likely to stay and support an ongoing relationship. Innovative organizations are hiring local staff or sending a staff member to the community for an extended period to develop improved, lasting relationships. They are also building additional relationships outside of the schools, with other community partners.

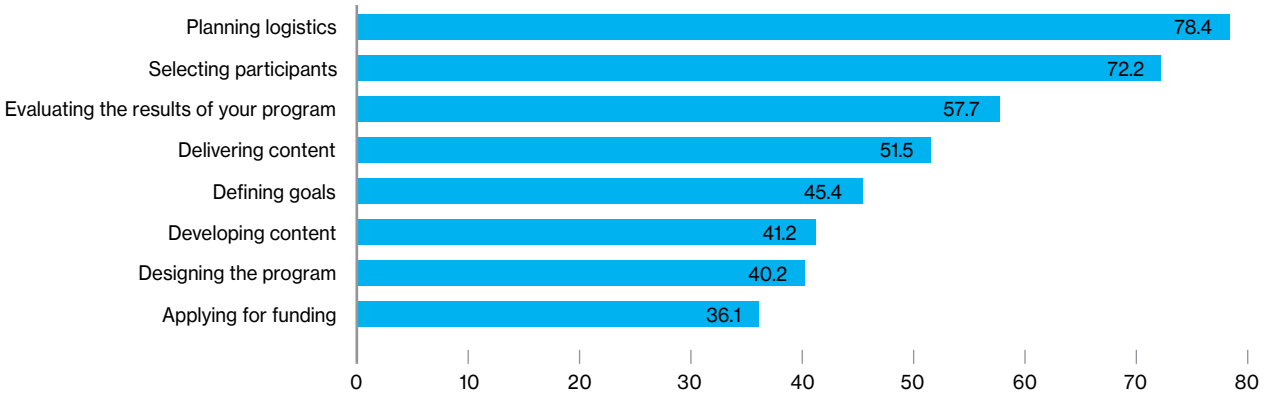
Organizations were more likely to involve communities in program implementation, such as selecting participants and coordinating logistics. Less than half involved the communities in aspects of program design, including setting goals and developing content. See Chart 1 for survey results on how respondents are working with host communities and schools.

4 Truth and Reconciliation Commission of Canada, *Canada's Residential Schools*.
5 Aikenhead and Elliott, "An Emerging Decolonizing Science Education in Canada."

Chart 1

Communities are mostly involved in program implementation

(n = 97; percentage of programs)



Note: Respondents could select more than one option.
Source: The Conference Board of Canada.

Relationships are key

Building strong relationships is non-negotiable when working with Indigenous communities.

> **... to do anything together with Indigenous peoples, building a relationship is a requirement. It's not just a positive thing. This [initiative] isn't going to happen unless you've made an effort to build a relationship with us.**
>
> **First Nations STEM student**

This means building a personal connection before making an ask, admitting mistakes made, sharing in community events, being transparent in your motives, and being open to other viewpoints. Building trust takes time.

Recognize the diversity of communities

> **... It's not about us going in and saying, "here's a whole bunch of educational resources that we've included Indigenous ways of knowing into" and "here you go and use them all." It's just sitting down and listening to what they actually need.... It's not a one-size-fits-all kind of situation.**
>
> **Outreach director, urban science museum**

It is important to recognize the diversity of First Nations, Inuit, and Métis peoples, and diversity within communities as well. Each host will have different realities, capacity to engage, and educational priorities. Sometimes, it might not be the right time or the right program for the host to engage with.

Prioritizing Indigenous voices

Indigenous instructors are role models

Sixty-four per cent of programs reported working with Indigenous instructors to deliver their programming.

> **Feedback has been that one of the most important things is that the [instructor] who comes in is [Indigenous]—the fact that [this person they know] is the person teaching them ... sends a very powerful message to the kids.**
>
> **First Nations outreach coordinator, regional outreach organization**

Besides being important role models, Indigenous instructors and coordinators gain valuable leadership experience and extend their own scientific and cultural knowledges. Outreach can be a way to give back to their home communities, to share their studies or research with Indigenous youth and community members. However, it can sometimes be difficult to manage among other academic, extracurricular, and personal commitments.

Training for instructors, particularly who are doing intensive programs with youth, must go beyond the science content to include broader skills such as public speaking, mental health, wellness promotion, and how to be safe on the land. Instructors must develop confidence that they have knowledge to contribute.

Indigenous staff members

Fifty-six per cent of programs reported having Indigenous staff working on the development of the program.

One interviewee told us that it is important that they work for an organization that is truly committed to positive change for Indigenous youth. The organization must be working to build positive relationships with students and their communities and should value Indigenous perspectives at all levels of decision-making—including at the board level.

> **How do I engage in this work in a way that honours [my lived experience as an Indigenous person]? What are the outcomes and what does it mean when we say we want to, like, support youth, because is this [program] going to save them?**
>
> **Indigenous outreach coordinator, national organization**

As they look to work more with Indigenous communities, many organizations are hiring staff to fill Indigenous engagement roles. Although this is an exciting role to be in, it can also be a tough one—tasked with anything "Indigenous"—from developing Indigenized content to training staff, to developing organizational strategy, to building relationships with communities. It can be a lot for one person to do, and it can be a politicized role. The burden is lessened when colleagues throughout the organization have a good level of understanding and offer to contribute their own expertise.

Training programs improve organizational culture

Canadians now have a greater awareness of Indigenous histories and perspectives through the Truth and Reconciliation Commission's report and Calls to Action.[6] Staff and volunteers are keenly interested in learning more about history, cultures, and ways of knowing. After participating in training sessions, staff and volunteers are using more thoughtful approaches to work with Indigenous youth and communities.

> **After we developed the training and implemented it with staff and it's part of regular staff onboarding, people are more aware, they're more conscious of things.... They're looking back on what they have learned. Instead of "This is Indigenous, this is [not my job]," ... it's become a lot more ingrained across the organization.**
>
> **First Nations outreach coordinator, national organization**

Everyone in the organization will benefit from spending time listening and learning, not just those who are working directly with Indigenous youth and communities. Fundraising specialists need to know to prioritize partnership opportunities with communities and Indigenous organizations. Communications professionals need to know how to use appropriate terminology and avoid stereotypic representations in social media and written communications.

6 Truth and Reconciliation Commission of Canada, *Truth and Reconciliation Commission of Canada: Calls to Action*.

Everyone in the organization will benefit from spending time listening and learning, not just those who are working directly with Indigenous youth and communities.

Organizations are learning and collaborating

Despite different missions and goals, many organizations—Indigenous and non-Indigenous—are working together to provide rich experiences. Organizations support each other in a variety of ways, including providing content expertise for activity development, lending activity space or equipment, coordinating visits to existing camps, and sharing lessons learned.

Organizations also need to communicate and collaborate with one another—to share what is working for them and to coordinate activities to make sure no community is missing out on opportunities. With a collaboration-focused grant from the Natural Sciences and Engineering Research Council of Canada's PromoScience and support from Polar Knowledge Canada, the Aurora Research Institute and Let's Talk Science intended to host a pan-territorial gathering in Yellowknife in March 2020 (delayed due to COVID-19). The event planned to bring together individuals from over 20 organizations working in territorial communities to share ideas, resources, and lessons learned about working in Northern communities, and to identify opportunities to collaborate.

Tailoring and culture in STEM outreach

Engaging with cultural knowledge

Not all organizations need to, or should, bring Indigenous cultural knowledge into their programs. Indigenous knowledge is authentically transmitted only by Indigenous Elders or Knowledge Keepers. Effective engagement requires trust, relationships built at the local level, time, and funding. Moreover, it may not be the program's role to offer that Indigenous knowledge. For example, through communication with its host (a First Nations–controlled school), one program learned that rather than wanting a program based on teaching Indigenous cultures alongside Western STEM, the school preferred the program to support learning Western STEM content. The school wanted its students to learn about robotics technologies, while it provided cultural knowledge separately.

Culturally responsive teaching strategies

Focusing on Western STEM approaches does not mean ignoring the local and cultural context. Organizations are finding ways to customize their programs for the realities of the host Indigenous communities and for the children's learning styles and interests. (See Chart 2.)

Most of these strategies are based on strong teaching principles and will benefit all youth. We identified several culturally responsive teaching strategies that are working.

Attitudes of the instructor

Instructors who are informed, practise active listening, ask good questions, exhibit warmth, and share their own educational story are open to learning, and admit their mistakes create a safe and constructive space for learning. Guided by the principle of *Kiskiaumatowin* (or "two-way" in Cree) learning, the Science Ambassadors program in Saskatchewan has instructors from diverse backgrounds learn from the community and the youth while they are there to deliver STEM outreach.[7]

Highlighting Indigenous knowledge of STEM

We heard from Indigenous STEM students and professionals that it was important for them to have learned how Indigenous ways of knowing have many intersections and parallels with STEM teachings. Learning about Indigenous approaches to science and engineering reinforced for them that they belonged in these subjects.

Chart 2
Indigenous instructors provide local and cultural context
(n = 97; percentage of programs)

Note: Respondents could select more than one option.
Source: The Conference Board of Canada.

7 Bonny, "Effective STEM Outreach for Indigenous Community Contexts."

Prioritizing Indigenous learning styles

The literature and our research participants highlighted recurrent Indigenous strengths[8] that many Indigenous youth might share. The following learning styles are being used by many programs identified in our research.

Indigenous recurrent learning strengths:[9]

- holistic more than analytic
- oral more than written
- practical more than theoretical
- reflective more than trial and error
- contextual more than without context
- experiential more than passive
- relational rather than facts and algorithms
- storytelling more than didactic lessons

Because outreach opportunities tend to be more experiential, creative, and collaborative than most formal science education, they naturally offer a more culturally aligned experience.[10]

Connect to context and community

We also heard that asking children and youth to connect what they are learning to what they already know adds relevance. In addition, the inclusion of community members in STEM activities and celebrations demonstrates to Indigenous students there is space for their community in STEM.

Encourage perspective-taking

Acknowledging multiple ways of knowing a topic—and being explicit in what approach you are taking—allows for participants to learn the content and explore different viewpoints without having to give up their own perspective.

> **[The students] are going to hear sometimes conflicting or contradictory perspectives. For example, a trapper versus someone who's coming from an environmental perspective versus someone who's coming from an agriculture perspective. And so, we … talk about how we can listen with respect without abandoning our own perspectives.**
>
> **Outreach coordinator, local outreach organization in remote area**

8 Aikenhead and Michell, *Bridging Cultures*.
9 Ibid.
10 DeCoito and Gitari, "Contextualized Science Outreach Programs."

Mi'kmaw Elder Albert Marshall, from Unama'ki (Cape Breton, Nova Scotia), advocates for *Etuaptmumk*, or Two-Eyed Seeing. He admits it is not always easy. Two-Eyed Seeing relies on dialogue, learning from one another, and employing our physical, emotional, and spiritual strengths, as well as the intellectual, to come to *Kisutmauk*, meaning "we come to consensus so we can move forward because we have taken in these natural energies."[11]

Instructors as role models

Instructors who have studied STEM are well poised to talk about their journey through STEM education. Instructors who are Indigenous themselves illustrate to Indigenous youth that they have a place in STEM.

Engaging Elders and Knowledge Keepers

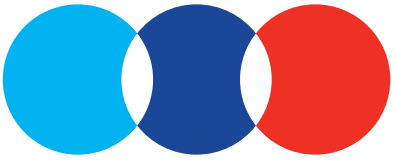
Some organizations are involving students in on-the-land programs, where they learn Indigenous and Western knowledge in an experiential and holistic way.

> **Land-based learning is Indigenous learning. Indigenous people have always known about STEM.**
>
> **First Nations outreach director, national organization**

Organizations involved in this sort of programming report that children feel more pride in their culture and start to see their Indigenous culture as a strength. Involving Elders and Knowledge Keepers in education fosters connection between generations, community cultural knowledge, and trust in formal education. Non-Indigenous students can also benefit from this type of learning.[12]

To introduce Indigenous ways in an authentic manner, programs must engage local Knowledge Keepers and Elders. This requires cultural awareness, trust, time, and funding, and therefore can be more vulnerable than formalized and funded Western STEM systems.

Outreach organizations are recognizing that Indigenous ways of teaching and learning differ from what mainstream teachers are used to. Teachers familiar with subject-based, classroom teaching can sometimes find it difficult to appreciate the Elders' holistic, indirect way of teaching. With changes to science curricula to include Indigenous knowledges, there is increasing demand for outreach programs to act as an intermediary between non-Indigenous schools and Elders/Knowledge Keepers. (See *Curriculum and Reconciliation Introducing Indigenous Perspectives into K–12 Science.*) There is an opportunity for outreach to play a valuable role in bridging these ways of teaching.



11 Marshall, Knockwood, and Bartlett, "The Best of Both Worlds."

12 Aikenhead, "A Synthesis of Research Into Outcomes Arising From Enhancing School Science With Indigenous Understandings"; Participant Interview.

Measuring program success

Success can mean different things to the different people involved in an outreach program. While a graduate student facilitator might want to inspire kids to do a graduate thesis like him or her, community leaders might prefer to inspire their local youth to apply STEM skills to local needs. While a parent might be happy that their child is having fun and learning during an activity, a teacher might want the activity to cover specific curricula.

A focus on short-term results

Most often, it is the outreach organization's expectations (and often those of its funders) that are prioritized in an evaluation. These often get measured at the level of inputs, activities, and short-term outputs. Longer-term outcomes and impacts are harder to capture.

The programs we surveyed are evaluating their results in a variety of ways.

Data collection

The most common method of data collection used is gathering immediate feedback—from the host teachers, community leaders, Elders, or partner organizations, and program participants—through **surveys, conversations, and interviews**.

Instructors' observations

When instructors observe students during the session, they may assess if they are expressing curiosity, participating in the hands-on activities, etc. **Instructors' reflections** on how the session went may cover what went well, what activities were most engaging, or what they should change to improve the program.

Activity metrics

Some programs measure success by assessing their **metrics** on inputs and activities, such as the number of participants, number of workshops, number of communities, or number of program hours.

STEM outreach engages children and youth, increases interest in STEM, and highlights STEM's connections to everyday life.

Outcome indicators

Organizations also use host **response to the program** as an indicator of successful outcomes. Do children and youth come back to camp every day? Are teachers requesting them back each year? Are students successfully completing the STEM projects they are doing for the program? Are more communities hearing about their program and inviting them in?

Impacts

Lastly, organizations report testimonials and **success stories** (e.g., a former participant attending post-secondary for STEM) as a credit to their program's longer-term impact.

Engagement is the main outcome

We know from recent research that STEM outreach engages children and youth, increases interest in STEM, and highlights STEM's connections to everyday life. Teachers report that during the visit, their students express enthusiasm and joy, are eager to use scientific tools, explore ideas physically, and persist in activity tasks.[13] Students can see themselves more as future scientists.[14]

As with other children and youth, Indigenous children and youth who take part in informal science activities are more engaged in STEM. This link is bi-directional—those who are already more engaged are more likely to seek out informal STEM opportunities.[15]

Culturally responsive outreach shows gains in STEM engagement but also in cultural identity,[16] an awareness of how STEM careers could bring benefit to their community,[17] connection to culture (particularly for children who did not start with a lot of cultural knowledge), and feelings of belonging.[18]

Nevertheless, the longer-term impacts of engagement and interest maintained over weeks, months, and years—and whether this means more students studying STEM in optional high school courses and post-secondary education—is uncertain.

There are many inputs into a child's educational and career aspirations

For program sponsors with very specific and ambitious goals, it can be frustrating when a program cannot directly attribute its desired outcomes, such as seeing those students enter a Faculty of Science or taking up professional careers with a mining company or engineering firm, to the outreach activities.

13 Natural Sciences and Engineering Research Council of Canada, *Evaluation of Science and Engineering Promotion Initiative*.
14 Laursen and others, "What Good Is a Scientist in the Classroom?"
15 Woods-McConney and others, "Science Engagement and Literacy."
16 Bernstein and others, *Evaluation of the Alaska Native Science & Engineering Program (ANSEP)*.
17 Kant, Burckhard, and Meyers, "Engaging High School Girls in Native American Culturally Responsive STEAM Activities."
18 Kowalczak, "Native American Students' Perceptions of the Manoomin STEM Camp."

Participant, educator, and facilitator feedback tells us about short-term results. It is difficult and sometimes impossible to track student academic achievement, graduation rates, or post-secondary enrolment years later. Even then, how could we disentangle the effects of a single program from the rest of the child's educational, home, and community experiences? Ideally, there would be many experiences contributing to a child's STEM engagement[19]—teachers, family members, curricula, TV shows, role models, etc.—and an outreach experience is only one part of this set of influences.

> **There's not a clear path of, you participated in this and now you have to go into this career. We have no jurisdiction there in terms of insisting that a student gets into this type of career.... What we've set out to do is providing those exposure activities.**
>
> **First Nations outreach coordinator, Indigenous organization**

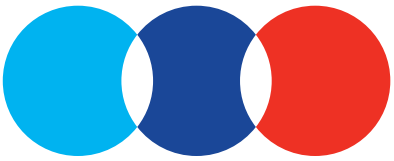
Engagement is weakly linked to achievement

The link between attitudes toward STEM and achievement in STEM is weak.[20] Rather, analysis from the 2006 Programme for International Assessment science results found that it was time spent on formal science study and a student's socio-economic status that was most associated with science proficiency in Canada.[21] This suggests that although informal science—including outreach—can increase engagement and interest (important motivators for sticking with STEM), equitable access to quality STEM education in school is key to STEM achievement.

Indigenous frameworks of success

Less than half (45 per cent) of survey respondents are working with their hosts ahead of time to decide on the goals of the program and just over half (58 per cent) are working with their hosts when evaluating the program.

Indigenous perspectives on research and evaluation place a high priority on place-based knowledge over theories and generalizations.[22] In this context, it matters who is asking the question and who is answering it. The results of a survey created by an organization that is not from the community, and completed by an educator who is also from outside the community, will give results that are influenced by their views of what engagement looks like and what successful outreach means. If outsider perspectives are privileged over those of the host community, they risk alienating the community and breaking their trust in the relationship.



19 Laursen and others, "What Good Is a Scientist in the Classroom?"
20 Woods-McConney and others, "Science Engagement and Literacy."
21 Ibid.
22 LaFrance, Nichols, and Kirkhart, "Culture Writes the Script."

Indigenous-led evaluations often focus less on achievement gaps and more on relationships, community self-determination, and alignment with community values.[23] At the start, the community should have input on which needs the program will address and how the impacts of the intervention will be measured.[24] Program evaluators need to think about how different community members need to be involved in the evaluation, and how those people can be made to feel truly welcome in the process.[25]

> **... one of the damages of colonialism historically has been people coming into communities and doing studies and then leaving the communities.... It needs to be a partnership that centres the Indigenous voices; otherwise it becomes a perpetuation of the colonial activities that have caused damage in the past.**
>
> **Métis STEM professional**

Evaluation efforts should balance the benefits of program improvements with the pressures introduced to communities to participate in the evaluation, and concerns for individual and community privacy. Too often it is non-Indigenous people conducting research in Indigenous communities, with results not returned to the community and direct benefits to the community not prioritized.[26] Indeed, we heard that some communities prefer that an outside organization refrain from evaluating the program with their youth.[27]

Funding

Providing outreach to Indigenous youth requires significant resources—to travel to rural and remote communities, provide staff compensation for developing and delivering culturally responsive programming, compensate Elders and Knowledge Keepers and increase access to programs by providing transportation, meals, or technology. For example, a one-week trip for two instructors to a fly-in community in Northern Canada (from a city in Southern Canada) could cost well over $10,000 in direct costs. Staff costs to build relationships, develop activity materials, train instructors, and go on the trip would be additional.

A complicated patchwork of funding sustains outreach

Outreach organizations consolidate funding from many sources. While this allows them enough money to operate, it can create a lot of uncertainty and potential confusion from year to year. Each funder operates on a different funding schedule and associated reporting schedule. Each will also specify unique deliverables, priorities, and special requests, which adds pressure on the organization receiving the funding. Overseeing the proposals, budgets, and reporting obligations for multiple funders takes time away from program delivery, particularly for small teams without support staff.

23 Mertens and Hopson, “Advancing Evaluation of STEM Efforts Through Attention to Diversity and Culture”; LaFrance, Nichols, and Kirkhart, “Culture Writes the Script.”

24 Mertens and Hopson, “Advancing Evaluation of STEM Efforts Through Attention to Diversity and Culture.”

25 Ibid.

26 First Nations Information Governance Centre, “The First Nations Principles of OCAP.”

27 Participant interview.

Indigenous and Canadian governments, corporations, post-secondary institutions, foundations, and individual donors are all funding programs. Larger, national organizations such as Actua and Let's Talk Science provide operating grants to their members across the country. These affiliate sites are often hosted at post-secondary institutions that provide additional financial and in-kind support.

The federal government's informal science funding program, PromoScience, weighs Indigenous programming favourably in the application process; a plan to reach Indigenous youth is an important criterion.[28] The federal CanCode program similarly requires its coding and digital skills programs to reach "traditionally under-represented youth," including Indigenous youth.[29]

Relationships with Indigenous communities require sufficient, flexible, and long-term funding

Outreach organizations often said that getting suitable funding is a challenge. Short funding schedules make it practically impossible to co-develop goals with host communities and deliver a program within the time allotted—and then there is no guarantee that funding will continue, even if the partnership formed has been a successful one.

28 Natural Sciences and Engineering Research Council of Canada, *Evaluation of Science and Engineering Promotion Initiative: PromoScience*.

29 Innovation, Science and Economic Development Canada, "CanCode Assessment Criteria."

I would say it's the biggest challenge with a grant-driven non-profit, where you have to continuously apply for new grants ... you're trying to develop those relationships but that ... is going to take five years. It's ... trying to meet goals and deliverables that you've just told a funder that you're going to create but while also being respectful of the nature of the relationship.

Outreach coordinator, local, rural outreach organization

Overly prescribed funding requirements limit a program's responsiveness to community needs. They can also compromise a program's need to develop a trusting and authentic relationship with host communities.

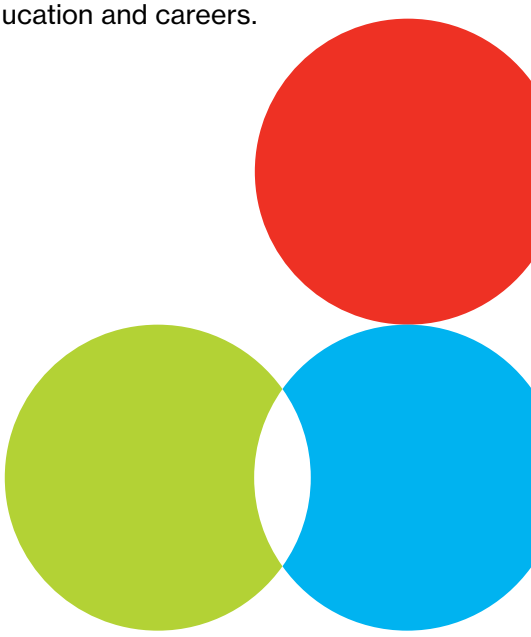
Outreach organizations often play an intermediary role between funders and communities. Funders can have their own specific goals that dictate the target community, program activities, and desired aspects to evaluate and measure. In this environment, an organization can find it difficult to address host community needs if the funder has already requested that it reach only a specific segment of youth (e.g., high school) and/or cover only limited topics (e.g., physical sciences). Sometimes, a funder will also want outreach opportunities for specific regions, communities, or schools and directs multiple organizations there. This can be problematic because it leaves some host communities overwhelmed while others miss out.

Conclusions

STEM outreach is one part of a wider set of influences and supports for Indigenous students who are considering a STEM educational and career pathway. Role models, curricula and teaching in the formal education system, and community and cultural supports also play big roles.

Programs are reaching First Nations, Inuit, and Métis children and youth in a variety of ways, from hour-long in-class workshops to week-long on-the-land camps. Although it can sometimes be challenging, organizations are finding creative ways to bring together the diverse goals of funders, communities, youth, instructors, and program staff to create engaging and inspiring programming developed and presented in culturally responsive ways.

Outreach programs are not a fix for systemic inequalities in education and socio-economic challenges that make it difficult for Indigenous students to find pathways into STEM post-secondary education and careers.



STEM outreach programs provide engagement, enrichment, mentorship, and leadership opportunities for Indigenous students—and valuable cross-cultural learning between academic and Indigenous communities. We heard about benefits for Indigenous—and non-Indigenous—students, teachers, instructors, staff, and community members involved in these programs.

Many programs are focusing on increasing awareness of the diverse career options in STEM and building student confidence and enthusiasm toward pursuing these pathways.

The "what," "how," and "why" of an outreach program should be decided in advance through partnership with the host community, whether an urban community centre, a summer camp in a First Nation, or a K–12 school in a Northern Inuit community. Indigenous voices should be prioritized. Strong, respectful partnerships require time, funding, an understanding of history, and an acknowledgement of different ways of knowing.

Appendix A
Participating organizations

The following organizations participated in the survey, had program(s) that met the inclusion criteria, and agreed to be listed (48). Many thanks to other organizations that participated but chose not to be listed, as well as organizations that responded that they did not currently have programs that met the inclusion criteria.

- Actua
- Aurora College, Aurora Research Institute
- Association québécoise autochtone en science et ingénierie
- Bamfield Marine Sciences Centre
- Bassin Versant Saint-Maurice (BVSM)
- Beakerhead
- Biosphere Institute of the Bow Valley
- Brilliant Labs
- Canada Learning Code
- CCTT en Design Industriel INEDI
- Chuntoh Education Society
- Connected North/TakingITGlobal
- Fusion Jeunesse
- Lakehead University, Niijii Indigenous Mentorship
- Let's Talk Science
- Let's Talk Science in Ottawa, University of Ottawa and Carleton University
- Let's Talk Science, University of New Brunswick
- Memorial University of Newfoundland, Grenfell Campus
- Mining Matters
- MindFuel
- Mount Royal University
- Mount Saint Vincent University, Two-Eyed Seeing Camp
- Ocean Networks Canada
- Pinnguaq Association
- Relay Education
- Riparia
- Royal Roads University
- Saskatoon Tribal Council
- Science World British Columbia
- Science North
- Science Timmins
- Scientists in School
- Shad Canada
- Skills/Compétences Canada
- Simon Fraser University
- St. Boniface Hospital Research
- Students on Ice
- The Confederacy of Mainland Mi'kmaq
- Trent University, TRACKS Youth Program
- University of British Columbia, Physics & Astronomy Outreach
- University of British Columbia, integrative STEM Team Advancing Networks of Diversity (iSTAND)
- University of Manitoba, STEAM lab
- University of Manitoba, WISE Kid-Netic Energy
- University of Ottawa, Engineering Outreach
- University of Regina, Educating Youth in Engineering and Science (EYES)
- University of Saskatchewan, SCI-FI Science Camps
- Verna J. Kirkness Educational Foundation
- Wilfrid Laurier University, Mama-Aki-Mother Earth Camp

Appendix B
Methodology

This impact paper is based on information collected through interviews and an online survey. These data were complemented by a literature search of relevant academic literature and grey literature, including organizational annual reports and media. This search focused on the Canadian context but also included international sources.

We designed and circulated an online survey in April 2020, in English and French. The survey was reviewed and modified based on suggestions from our Advisory Board and from contacts at outreach organizations. The survey was e-mailed to 176 organizations that were identified as having potentially applicable programs. Recipients were identified from online searches, lists of successful funding grantees, and suggestions from interviewees, advisory committee members, and survey respondents. The response rate was 30 per cent.

The inclusion criteria for the survey were:

K–12: The program was designed for children and youth in Kindergarten to Grade 12/CÉGEP.

STEM-based: The main focus was on STEM.

Indigenous: The program specifically reaches out to First Nations, Métis, and/or Inuit children and youth, to the point where the program is composed of a majority of Indigenous children or youth.

Funded: The program was funded and was free to participants.

Not school-run: The program was not part of the formal K–12 education system (i.e., not run by schools or school boards), although programs that visit schools were eligible.

Last year: To allow for variation in operating years, respondents were asked to report on their last completed operating year.

Survey analysis included responses from 50 organizations offering 103 programs that met the criteria for inclusion. Not every respondent answered every survey question. Responses from eight programs from seven organizations were excluded because they did not meet inclusion criteria.

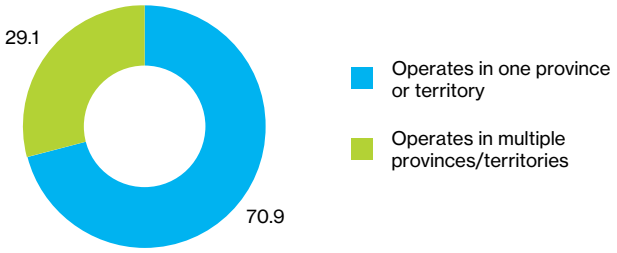
Fifteen interviews were completed with individuals from organizations involved with STEM outreach, including charities, school boards, post-secondary institutions, and Indigenous organizations. Seven hours of interviews, as well as qualitative survey responses, were transcribed, coded, and analyzed using qualitative data analysis software.

The author of the report is non-Indigenous, with experience in coordinating STEM outreach programs across Canada, particularly reaching rural and Indigenous youth.

STEM outreach program survey responses

Chart 1

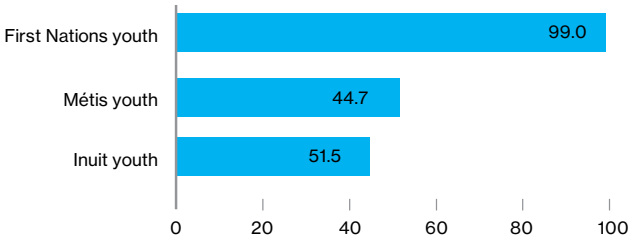
Most programs operated in just one province
(n = 103; percentage of programs)



Source: The Conference Board of Canada.

Chart 2

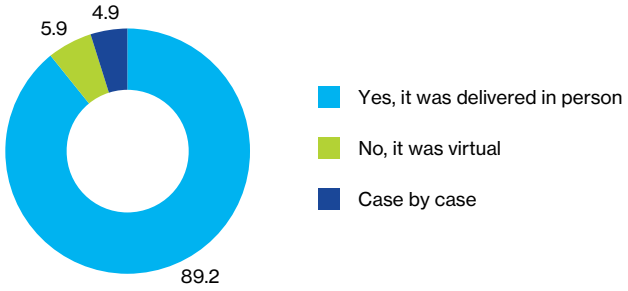
Fewer programs reach Inuit and Métis students than First Nations students
(n = 103; percentage of programs)



Note: Indigenous identity as reported by the responding organization.
Respondents could select more than one option.
Source: The Conference Board of Canada.

Chart 3

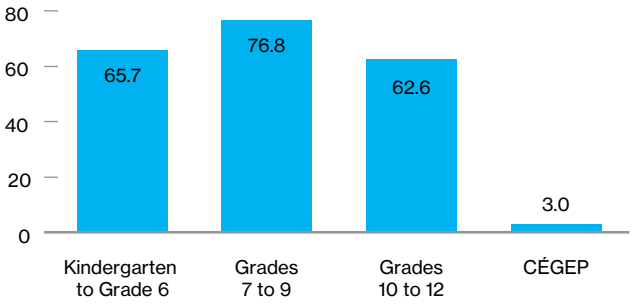
In-person delivery predominates
(n = 103; percentage of programs)



Source: The Conference Board of Canada.

Chart 4

Organizations work at all grade levels
(n = 99; percentage of programs)

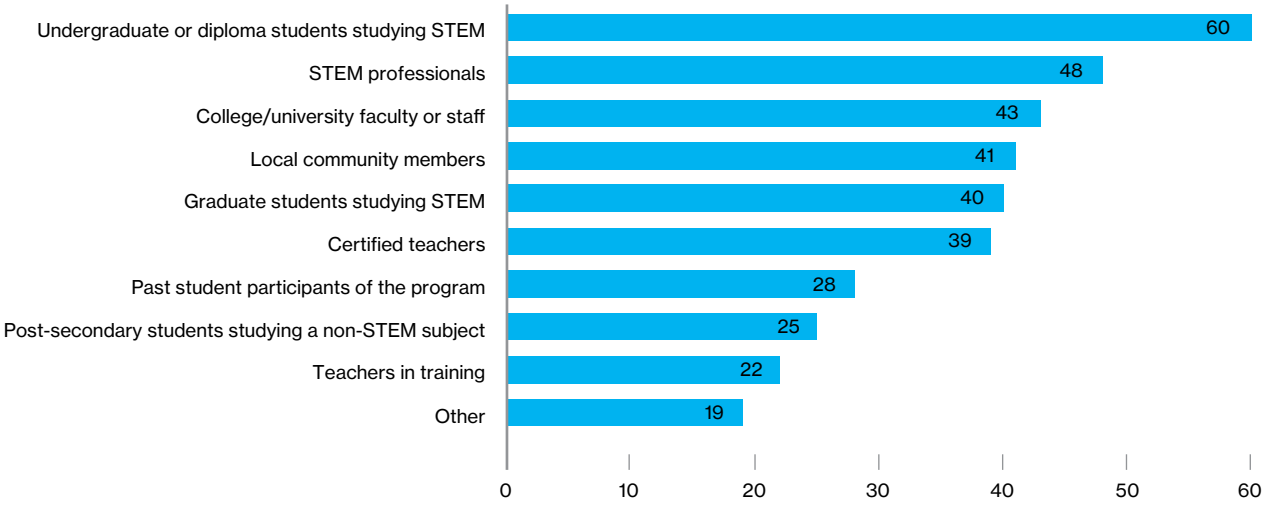


CÉGEP = Collège d'enseignment général et professionnel
Note: Respondents could select more than one option.
Source: The Conference Board of Canada.

Chart 5

Undergraduate STEM students predominate as instructors

(n = 100; percentage of programs)

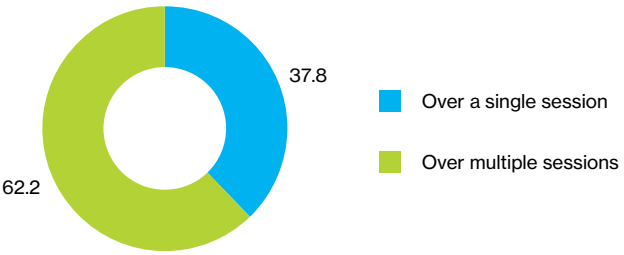


Note: Respondents could select more than one option.
Source: The Conference Board of Canada.

Chart 6

The majority of programs have more than one interaction with students

(n = 103; percentage of programs)

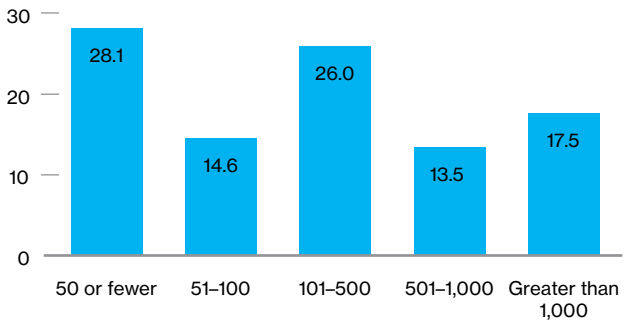


Source: The Conference Board of Canada.

Chart 7

Programs range in the number of students reached

(n = 96; percentage of programs)

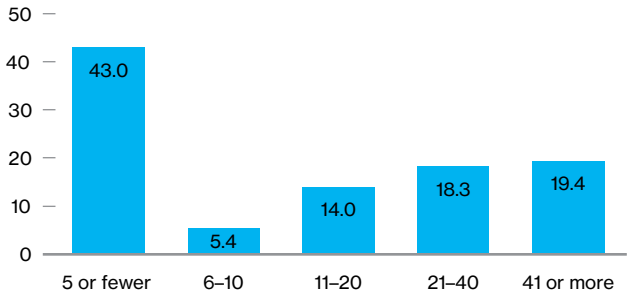


Source: The Conference Board of Canada.

Chart 8

The majority of programs offer over ten hours of programming

(n = 93; percentage of hours of programming)



Source: The Conference Board of Canada.

Table 1

Differences in number of youth reached

(n = 96)

Median	200
Minimum	1
Maximum	40,000

Note: Programs varied widely in the number of youth reached, from a pilot program at a single location to a national program working across Canada.
Source: The Conference Board of Canada.

Table 2

Hours of interaction time varied widely

(n = 92; hours)

Median	12
Minimum	1
Maximum	800

Note: Programs varied widely in length and depth, from one-hour classroom workshops to 800-hour STEM-based internship programs.
Source: The Conference Board of Canada.

Appendix C
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Erin Macpherson

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