



Geering Up: UBC Engineering and Science for Kids

University of British Columbia

February 2018

Researcher: Lyana Patrick, PhD (ABD)

University of British Columbia

**Nurturing Capacity
Founding Sponsor**



Preface

Nurturing Capacity: Building Community Success

Indspire supports communities to improve educational outcomes through the documentation and evaluation of their innovative practices. This community-led process is supported by an Indspire-funded Indigenous scholar, who works with programs on the ground to provide training on data collection and evaluation methodology.

For more info, please contact:
nurturingcapacity@indspire.ca | 1.855.463.7747 x230

Project Abstract

Geering Up UBC Engineering & Science for Kids is a non-profit organization with the mandate of promoting science, engineering, and technology to youth across British Columbia. In 2012, Geering Up initiated community outreach programs to First Nations communities in British Columbia consisting of one-week summer camps, with one community including an additional week of land-based learning. By 2017, the program had expanded to 30 First Nations communities, providing science, technology, math and engineering (STEM) education to an average of 15 children per camp. The evaluation found that hands-on activities that connect to real-life situations are most successful in sparking interest among children in science and engineering. It also found that bringing the camp out of the classroom and onto the land was important for all participants, particularly as an opportunity for children to share existing knowledge and instill self-confidence in STEM topics.

Project Holder

Geering Up

Contact person: Jakob Manning

Address: 5000-2332 Main Mall Vancouver, BC Canada V6T 1Z4

Email: geeringup@apsc.ubc.ca Telephone: 604-655-2634

Website Website: <http://www.geeringup.apsc.ubc.ca/>

Project Administrator/Lead

Geering Up

Contact person: Alistair Bryan, Outreach Director

Address: 5000-2332 Main Mall Vancouver, BC Canada V6T 1Z4

Email: outreach@geeringup.ca Telephone: 604-655-2634

Acknowledgments

The author would like to express sincere gratitude to the former Outreach Director Susanne Kim and current Outreach Director Alistair Bryan for their generous assistance with this evaluation process. Thanks also to the youth workers, community administrators and Geering Up staff and camp instructors who contributed their time and energy to give feedback on the community outreach camps. Special thanks to Patrick Dubois for an excellent job with the statistical analysis of surveys. Most importantly thank you to the children who provided feedback through interviews and surveys, and who attend these camps with enthusiasm and energy and provide much hope for bright futures.

Table of Contents

University of British Columbia	1
Preface	2
Project Abstract	2
Project Holder	3
Project Administrator/Lead	3
Acknowledgments	3
Executive Summary	5
Description of the Program	7
Context	8
Brief History of the Project:	9
Activities Accomplished	10
Materials Developed	12
Logic Model Used for the Project	14
Performance Indicator and Measures	14
Evaluation - Methodology	15
Outcomes: Most Significant Accomplishments and Lessons Learned	16
Qualitative Findings:	22
Next Steps for the Project	27
Appendix I: Logic Model	30
References	31

Executive Summary

Geering Up UBC Engineering & Science for Kids is a non-profit organization with the mandate of promoting science, engineering, and technology to youth across British Columbia. Geering Up is affiliated with the University of British Columbia, and offers summer camps, school workshops, clubs, programs for high school students, and community outreach programs year-round. All activities are designed, organized and operated by UBC students, blending hands-on activities, science demonstrations, mentors and design challenges to show program participants that science can be fun, exciting and relevant to their daily lives.

Recognizing that Geering Up camps were reaching only select groups of children, the outreach team expanded its scope to include First Nations communities. In 2012, Geering Up initiated community outreach programs to First Nations communities in British Columbia consisting of one-week summer camps. Half of the funding for community outreach is raised through on-campus summer camps, while the other half comes from Actua, a national organization that provides hands-on, interactive education enrichment experiences in STEM (Science, Technology, Engineering and Math) to Canadian youth aged 6 to 16 years. Actua's National Aboriginal Outreach Program provided funds for Geering Up to visit eight First Nations communities in British Columbia, three of which were chosen as case studies for this evaluation. Geering Up continues to develop its model of community outreach and findings from this evaluation will help focus and refine outreach practices.

This evaluation was conducted using qualitative methods through interviews with Geering Up staff and instructors, staff in community, and one focus group with youth participants. The Researcher also attended the camps and engaged in participant observation for several days in each of the three communities. The evaluation is further supported by surveys completed by youth participants in each of the three communities before and after participating in the camp. The evaluation covers three separate week-long camps held in July and August, 2017.

Major achievements of the program include:

- Promoting greater interest in STEM topics among boys by the end of the camp
- Over 50 per cent of children want to return to a Geering Up camp (with younger participants expressing more willingness to return than older respondents)
- Over 80 per cent growth in the number of First Nations communities participating in the program since they started in 2012
- Development of community-university partnerships to promote opportunities for STEM learning in First Nations communities.

Geering Up staff would like to have a dedicated community outreach team who are solely focused on developing partnerships with communities and creating curriculum unique to each community. They want to return to communities throughout the year to further develop the relationship and work towards incorporating more land-based and

traditional knowledge activities into design and delivery of the summer camps. An important finding from the pre- and post-surveys is that girls' interest in STEM topics decreases after the camp. Promoting Indigenous girls' interest and participation in STEM topics is extremely important and requires further study and follow-up.

Geering Up: UBC Engineering and Science for Kids



Geering Up instructor helps children with circuit project in Sts'ailes First Nation

Description of the Program

Geering Up: UBC Engineering and Science for Kids offers summer camps, school workshop, as well as outreach programming throughout the year. Half of the outreach programming is dedicated to First Nations communities. School workshops are available throughout the school year and are based out of the UBC Point Grey campus, as well UBC Okanagan in Kelowna and the Fraser Valley. Summer camps take place at UBC, as well as Kelowna and Surrey. In addition, Geering Up offers week-long camps in various First Nations communities throughout the summer.

The outreach camps take place from 9:00 AM to 3:00 PM (in Tsawwassen, the camp ran from 10:00 AM to 4:00 PM). Participants represent a range of students from Grades 1-12, and while most camps group children across a maximum of three grades, most of the First Nations camps have a wider age span. Camps usually have a maximum of 25 students. Each day is a dynamic mix of hands-on activities, demonstrations, tours, mentors, and design challenges. Camps are taught by experienced university students who bring passion and knowledge from a broad range of STEM (Science, Technology, Engineering and Math) fields. Participants also spend at least one hour each day participating in active games outside.

This evaluation covers three communities: Tsawwassen First Nation, Sts'ales First Nation and Seabird Island First Nation. "Tsawwassen" means "land facing the sea." The community's traditional territory extends along the Lower Fraser River and out to the Salish Sea (Georgia Strait). The community has over 430 members with approximately half of them living on Tsawwassen land. The community of Sts'ales is located in the Upper Fraser Valley of British Columbia and has just under a thousand members. Seabird Island is part of the Sto:lo Nation and is also located in the Upper Fraser Valley with the Coast Mountain Range to the north and the Cascade Mountain Range to the south. It has over 800 members living on reserve.

Context

While research has shown that minorities and women are underrepresented in STEM fields, Aboriginal peoples are especially poorly represented. Despite being the fastest growing population in Canada, Aboriginal youth continue to experience significant barriers in secondary and post-secondary education. Around 33 per cent of Aboriginal adults aged 25 to 54 had less than a high school education compared to around 13% of the non-Aboriginal population. At the post-secondary level, one-quarter of non-Aboriginal adults had a university degree, compared to 9% of Métis, 7% of First Nations people and 4% of Inuit (Statistics Canada, 2015). Researchers in British Columbia looked at 2010-2011 enrollment and required examination data at the secondary level and demonstrated that Indigenous students were substantially under-represented, with low participation rates in science and mathematics courses (Yore et. al, 2014, as cited in Snively and Williams, 2016). It follows, then, that Aboriginal people in Canada are under-represented in science and engineering occupations (Battiste, 2002; CCL, 2007b; Canadian Education Association, 2016, as cited in Snively and Williams, 2016). Snively and Williams (2016) explain, in part, where this stems from:

"Until recently, almost all Canadian teachers were educated in Eurocentric systems that have dismissed Aboriginal knowledge as science, and they taught a silent curriculum that attempts to assimilate Aboriginal students into a Western Science framework—forcing some children to abandon their traditional ways of knowing and reconstructing in its place a new scientific way of knowing. The majority of these science-shy students resisted learning by not participating."

While low rates of achievement and participation among women and minority groups in science education has long been studied, less attention has been paid to the underrepresentation of Indigenous people in STEM. An increasing body of research is looking at the importance of culturally-based education as a framework for bridging western and Indigenous ways of knowing (Kawagley and Barnhardt, 2005; Carlson et. al, 2011). In the context of this evaluation, such findings are extremely important as the community outreach programs strive to connect with local resources and improve curriculum. As one instructor noted, "I wish we had more activities about nature, the level of knowledge [children in community] had was way higher than I had. I wish we

had incorporated more of this into the camps.” Drawing on existing knowledge within communities and ensuring that the curriculum is locally relevant and culturally-appropriate begins to redress the history of exclusion and lack of understanding about Indigenous scientific knowledge systems.



Geering Up projects made by children in the Tsawwassen First Nation

Brief History of the Project:

Geering Up: UBC Engineering and Science for Kids began in 1995 as a student-run initiative on the Vancouver campus of the University of British Columbia (UBC) on the traditional territory of the xʷməθkwəyəm (Musqueam) people. As a non-profit organization dedicated to promoting science, engineering and technology to children and youth, Geering Up engages in special outreach for those groups traditionally underrepresented in the sciences. Since it initiated Aboriginal outreach programming in 2012, Geering Up has reached out to over 1000 Indigenous children and youth around British Columbia. In 2017, Geering Up visited 30 communities through outreach workshops and camps, including the following First Nations communities: Kwadacha and Tsay Keh Dene Nations, Lax Kw'alaams, Kitimat Village, Tsawwassen First Nation, Sts'ailes Community School, Seabird Island Community School, Chetwynd, and Sto:lo Nation.

Two of the communities evaluated had between 6-12 children attending each day, while Sts'ailes had 29 participants. They ranged in age from 5-12 years old, with older cousins and siblings occasionally stopping by to participate in activities (see Graph 1: Age distribution of respondents). Each day was oriented around a variety of hands-on activities combined with science demonstrations, with breaks to play games and run around every two or three activities. All instructors were enthusiastic and friendly and did an excellent job engaging the kids. While the instructors do not design the curriculum (this is done by the community outreach team), they are often able to draw on their own knowledge and passion for STEM topics in explaining the science behind each activity. Sometimes the instructors did the activity with the kids first and then explained the science behind it, while other times they explained first and then led the activity. Efforts were made in each community to conduct activities out on the land, however these were not formalized in the curriculum but rather adapted by instructors and community staff throughout the week.

Activities Accomplished

Geering Up initiated its community outreach programming through Actua¹ which provides funding and guidance for staff to develop its Aboriginal outreach program. As one staff member described it, "Some of our first programs like at Comox or Tsleil-Waututh [First Nation] were funded by them and they held our hands through the experience. They have advisors and staff who helped us put together the budgets and find the contacts." All Geering Up instructors receive cultural awareness training through an Aboriginal representative from Actua, in addition to training on topics like conflict resolution and team building. Since 2014, the program has increased fivefold the number of communities with whom it partners (see Figure 1).

Outreach staff begin planning camps about a year in advance, contacting communities they've already been to and initiating partnerships with new communities. A team begins curriculum planning and working out camp logistics (hotel bookings, transportation, car rentals, instructors' meals, etc.) in late May to early June. Throughout the year, staff work out details of the camp with communities, including things like WIFI access, arranging lunch for the campers and if there will be an Elder present.

Camp sessions ran from 9 am to 3 pm (with the camp at Tsawwassen First Nation running from 10 am to 4 pm). Participants ranged in age from 5-12 years old. There was no registration process as the Geering Up camp was an activity offered within the structure of the communities' summer childcare programs. As such, numbers fluctuated each day with an average attendance of 7-9 children. There were usually two

¹ See Jamie Gamble's 2014 Nurturing Capacity report, "Case Studies on Actua's National Aboriginal Outreach Program November 2014, <http://indspire.ca/wp-content/uploads/2014/12/indspire-nurturing-capacity-actua-2014-en.pdf>.

instructors per camp, however, Sts'ailes had three instructors as there were 30 children attending the camp. Each day was filled with hands-on activities and science demonstrations that last 30 minutes to two hours (see Figure 2 for a sample schedule of the week's activities). Instructors offered regular breaks, frequently outdoors, although with the dangerously high smoke levels due to forest fires in southern BC, instructors limited this for the children in Seabird Island.

While instructors had a set curriculum for each day, everyone adapted activities to fit the needs and interests of camp participants. For example, several activities originally planned for indoors were taken outdoors which was tremendously beneficial for both campers and instructors. In Tsawwassen, an activity on making a diorama resulted in the group going out to explore the oceanfront right next to the community. In Sts'ailes, community staff provided recommendations and helped instructors find appropriate places to do activities outside. A staff member from Seabird Island said the day was long for many of the children, and that going outside more frequently would provide a way of re-energizing the children. Instructors paid close attention to the children's cues and tried as much as possible to incorporate physical activity with engaging demonstrations and experiments. They also quickly changed activities if they noticed a lack of interest or if the children were finishing quickly and looked ready to move on.

Figure 1: First Nations Outreach Camps and Total Community Outreach Program Attendance Data: 2013-2017

	2013	2014	2015	2016	2017
Number of First Nations communities*	3	5	7	17	30
Total number of participants (All community outreach camps)	N/A	103	185	340	632
*These camps average about 15 children per camp					

Materials Developed



Geering Up projects made by children in the Tsawwassen First Nation

Figure 2. Sample Geering Up Outreach Schedule

	Monday	Tuesday	Wednesday	Thursday	Friday	Legend
	<i>Sign In</i>					<i>individual activity</i>
9:00	<i>Ice Breakers</i>	<i>Marble Maze</i>	<i>Alka-Seltzer Rockets</i>	<i>Science Show</i>	<i>Popsicle stick flashlights</i>	<i>group activity</i>
						<i>demo</i>
						<i>Time Filler</i>
	<i>Survey</i>	<i>Burning Steel Wool</i>	<i>Dissolving Styrofoam</i>		<i>Scared pepper</i>	
10:00	<i>Recess</i>	<i>Recess</i>	<i>Recess</i>	<i>Recess</i>		
	<i>Community Mapping Activity</i>	<i>Bioplastic</i>	<i>Lava Lamps</i>	<i>Animal Adaptations</i>	<i>Survey</i>	
11:00		<i>Slime</i>	<i>Diet Coke and Mentos</i>		<i>Catapults</i>	
	<i>Epsom Salt Crystals</i>	<i>Elephant's Toothpaste</i>	<i>Rainbow paper</i>	<i>Bridge Design Challenge</i>	<i>Oobleck stress balls</i>	
12:00	<i>LUNCH</i>					
1:00	<i>Balloon Spaceships</i>	<i>Edison Bots</i>	<i>Owl pellet Dissection</i>	<i>Bridge Design Challenge Cont'd</i>	<i>Slow Zipline Race</i>	
	<i>Pass the Squeeze</i>			<i>Survival</i>		
2:00	<i>Acid Attack</i>	<i>Will It Burn?</i>	<i>Thaumatrope</i>		<i>Open House</i>	
	<i>Check on Crystals/Acid Attack</i>					
3:00	<i>Sign out</i>					

Logic Model Used for the Project

The logic model for the Geering Up Program shows the breakdown of planned resources, strategies, and intended results for the program's summer camps in three First Nations communities including short, intermediate, and long-term outcomes. The presence of Geering Up in the communities is the result of the communities' desire to increase opportunities for children and youth to participate in activities that promote science and engineering. Interviews with participants help identify the processes and goals embedded within the program delivery.

Performance Indicator and Measures

This evaluation focused on the short term and intermediate outcomes of the program. Over the coming year, Geering Up will be collaborating with the Social Sciences and Humanities Research Council (SSHRC) on a longitudinal study looking at the effectiveness of STEM gender-gap interventions, such as activities conducted through Geering Up programs. In the context of findings to be discussed in this evaluation, it is extremely important to include the First Nations Outreach camps in this study. Although beyond the scope of this evaluation, it is strongly recommended that the program work with partners to find ways to evaluate long-term outcomes such as whether there is an increase in number of Indigenous students choosing careers in STEM, the impacts of integrating Indigenous knowledge and perspectives into STEM, and importantly, the effectiveness of camps like Geering Up in sustaining interest among Indigenous girls in pursuing STEM fields.

Evidence from instructors and program staff indicates that hands-on activities and exposure to real-world application of STEM concepts had a positive impact on children. Results from the pre- and post camp surveys demonstrated greater interest among children in STEM topics after the camp, although interest decreased significantly for older respondents. Short and intermediate goals also included improved outreach to Indigenous students and communities, more teachers involved in promoting hands-on learning with STEM, improved links to the university within Indigenous communities around British Columbia, and better educational outcomes for children who attend Geering Up camps. Based on interviews with Geering Up staff and instructors, and staff members in community, positive outcomes were connected to some of these objectives. However, the limitations of a one-week science camp to achieve each of these objectives becomes clear in the analysis. This is described in greater detail below.

Evaluation - Methodology

Geering Up agreed to have its Community Outreach program evaluated in Summer 2017, through a combination of participant observation, interviews, focus groups, and surveys with children attending camps in three First Nations communities. Camp instructors, staff in community, children and Geering Up administrators all provided feedback on their experience with the camps. The questions were open-ended which provided some participants an opportunity to reflect on their experiences working at community outreach camps in other First Nations communities in British Columbia. These reflections are included to supplement findings from the three communities evaluated.

Geering Up staff assisted in setting up interviews with instructors and community staff. The researcher then worked with staff to interview youth workers and others in the community involved with Geering Up. Interviews and one focus group with children were conducted by phone and in person with the following:

- Project Holder
- Project Lead
- One-to-one interview with one additional Geering Up staff member
- Interviews with 7 Geering Up instructors
- 1 one-to-one interviews with nine staff members in community
- Focus group with nine children

Pre- and post-surveys administered by Geering Up instructors (with support from community staff) were obtained from 45 children. The surveys gathered demographic data and included questions to gauge interest in science and engineering, and attitude specifically towards the Geering Up camp. While open-ended questions were included in the survey, the information was not very useful in the context of this evaluation. One question (What was your favourite part of camp?) did show a wide range of responses, demonstrating that the children connected with many different activities, with the most popular being hands-on (e.g. How to make slime, n=11; Survival, n=4; making crystals, n=3).

Quantitative findings, however, provide an important snapshot into the experiences of children at three of the community outreach camps.



Children making circuit boards during Geering Up camp at Sts'ailes First Nation

Outcomes: Most Significant Accomplishments and Lessons Learned

Geering Up Community Outreach plays an important role as one of the few opportunities throughout the summer for Aboriginal children in First Nations communities to experience STEM topics in a fun and engaging format. It is therefore important for the program to be thoughtful and innovative in its approach to community engagement, curriculum design and delivery to First Nations communities. Overall, this evaluation demonstrated that Geering Up sparks interest among children in STEM topics and the program is viewed favourably by staff in community and instructors who deliver the content. However, results from the pre- and post-camp surveys with children showed two clear findings:

1. Though responses to whether participants would attend again or recommend the camp to others were generally positive, both these endorsements decreased significantly for older respondents.

2. More girls than boys attended the camps overall, however, their attitudes about science and engineering became less positive after the camps, while the attitudes of boys became more positive.

These findings will be discussed in more detail below. The qualitative findings support the survey results and will help illustrate why older campers may not be as keen to return to Geering Up as younger children. While the qualitative findings of this evaluation do not specifically address the issue of gender in the Geering Up camps, gender gaps in STEM education are a widely known and studied phenomenon. Suggestions for how this can be addressed in the context of STEM camps delivered to First Nations communities are included in next steps and recommendations.

Geering Up staff and those in community all highlighted the importance of having hands-on activities that demonstrate real-life applications of science. One community staff member said, “[Geering Up] broadens their horizons, lets them know what’s out there, speaks interest to them rather than same old going to school and just sitting there and trying to learn. Where [in this camp] you get the hands-on experience of something different, something new, something exciting, I think is really beneficial for them for sure.” Combining hands-on activities with immersion in the local environment was also emphasized by everyone involved with the camps. Instructors were adept at modifying the curriculum when opportunities arose to take activities outside. While each camp receives the same curriculum package, instructors adapted the activities to suit the needs and interests of campers, which included taking activities planned for indoors to places around the community identified by youth workers and other community staff.

Everyone interviewed had positive suggestions for improving the program, and generally agreed that Geering Up brings value and benefit to the children and community. One community member said, “I think any learning is a benefit to the community as a whole.” Another community staff member described how the kids are out for summer “and they’re not really doing anything that involves a lot of thinking so it’s good to get their little brains going so it’s not so hard when they go back to school and everything. Makes it easier on the parents. It gets them interested in doing things, not just stuck inside playing video games or something.”

Many of those interviewed spoke to the importance of building relationships between Geering Up staff and communities they will be visiting. This was particularly important for instructors, many of whom mentioned their limited prior knowledge about the culture, community and environment of places they visited through Geering Up. One of the challenges of delivering the program in First Nations communities is the wide age range compared to camps that are delivered, for example, on the UBC campus. The survey findings reflect this challenge, in that by trying to appeal to a wide age range, the camp curriculum is not necessarily meeting the needs of older campers. Suggestions included breaking a bigger group up into smaller groups according to age, pairing older children with younger children to mentor and help with activities, and setting up a registration

process in larger communities so instructors can prepare appropriately for the age groups represented.

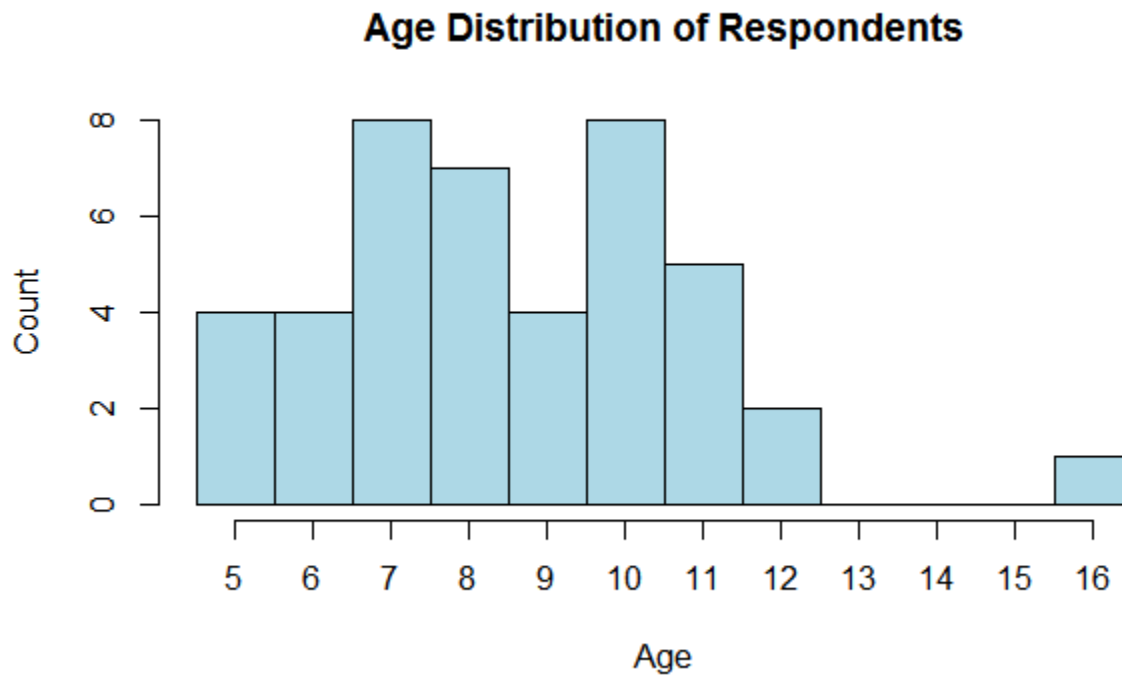
Survey Data

Surveys were administered in each of the three communities evaluated to each camp participant, at the beginning and end of each week. Some survey questions were open-ended (e.g. What was your favourite part of camp?) and the rest were evaluated using a 3-step scale or a 5-step graded response. Instructors in each community used a slightly different version of the survey, therefore some information was lost in combining the data. For example, some versions had questions with response options of Yes, No, Maybe and Not Sure. Because there were no clear instructions to distinguish the last two options, they are equated in this analysis, yielding a 3-step scale. To enable comparisons, responses were put on a similar scale and compared using a numerical translation as show below:

Value:	1	1.5	2	3	4	4.5	5
Scale:		No		Maybe/Not sure		Yes	
Scale:	I hate it		I don't like it	Neutral	I like it		I love it
Scale:	Not at all		A little	Neutral	I like it		I love it
Scale:	Very little		A little	Somewhat	A lot		For sure!
Scale:	Very little		A little	Somewhat	A lot		Quite a lot!

Data was collected for 45 pre-camp surveys, and for 36 post-camp surveys (all of which had pre-camp surveys). 58 per cent of respondents were girls, and 17 per cent were boys, with two not answering the question. Almost all (96 per cent) identified as Aboriginal. 13 per cent of respondents were not sure if they had attended a Geering Up camp before, 27 per cent said they had, and 60 per cent said they hadn't. The graph below shows the distribution of ages.

Graph 1. Age distribution of respondents

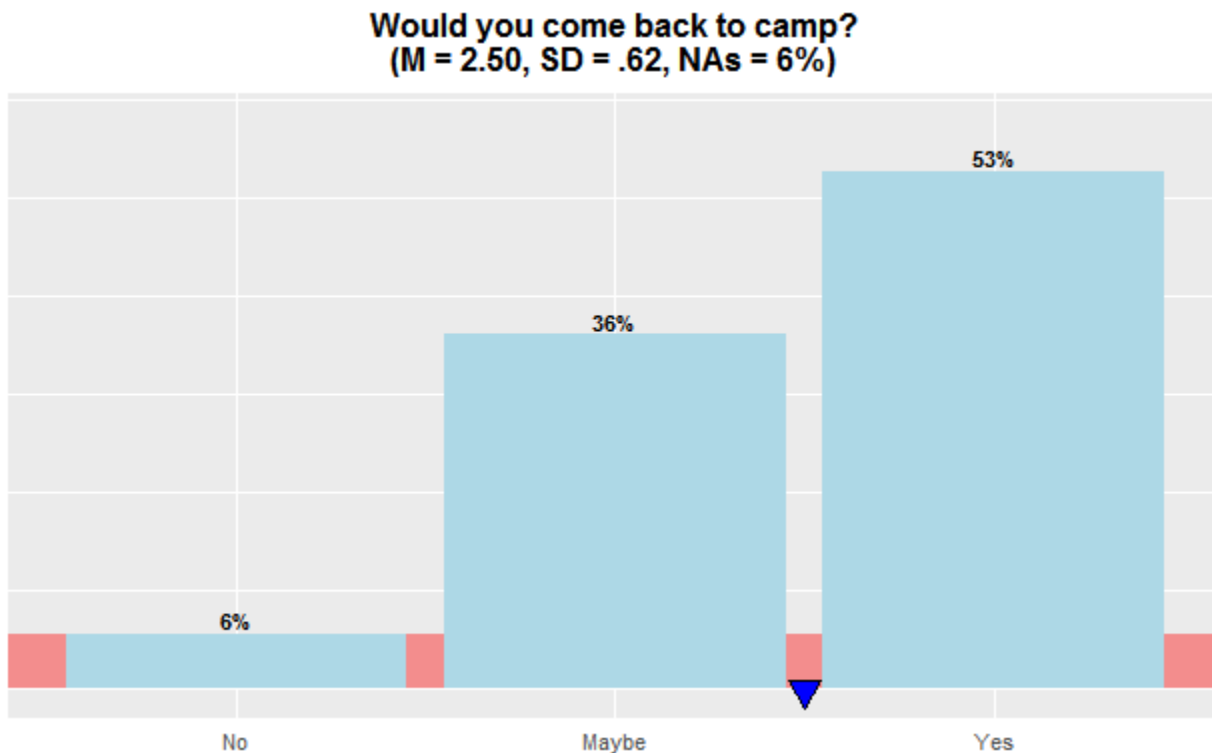


As mentioned, camp participants' enthusiasm for science and engineering showed a decrease with age, although over half of the respondents said they would come back to a Geering Up camp (see Figure 3).



Fun with baking soda at Sts'ailes First Nation

Figure 3. Q. Would you come back to camp?



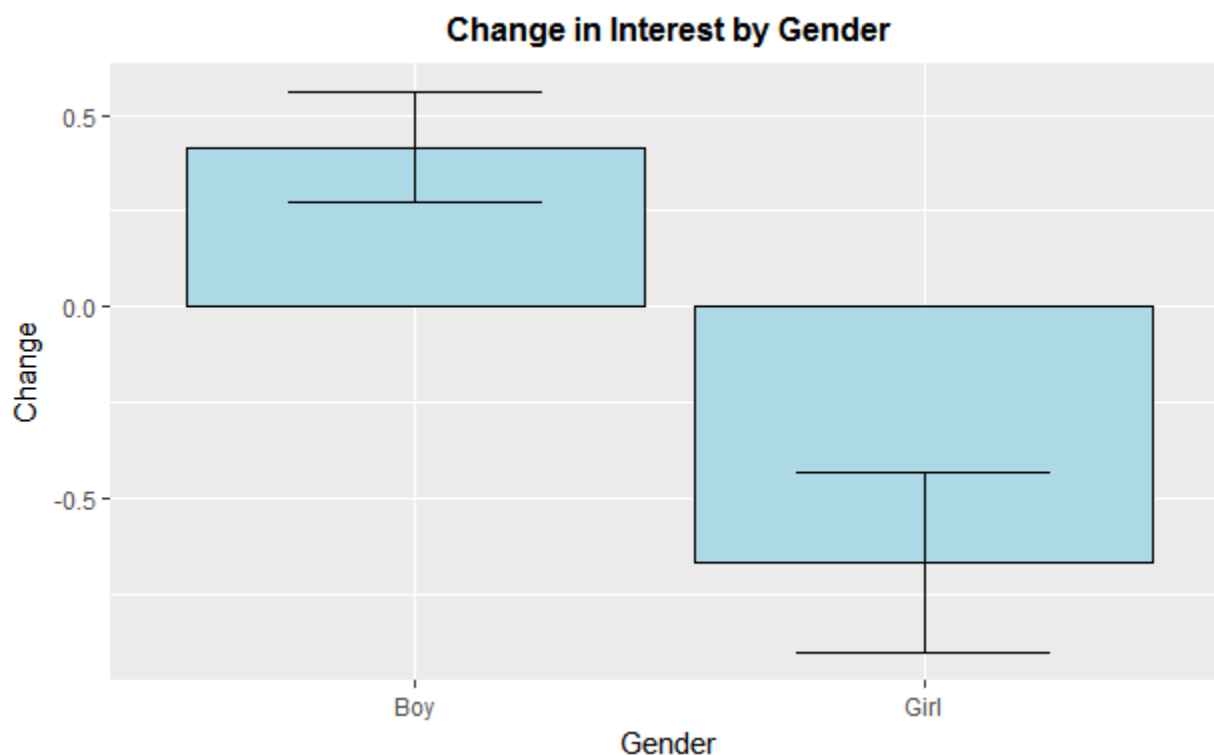
To better understand the camp experience for children, both pre- and post-surveys asked how much respondents liked science and engineering, and how much they would like to become a scientist or engineer. These responses were averaged together as a general measure of interest in STEM, and the pre/post difference calculated to assess change in interest. This difference measure (Change in Interest) can be used to gauge how the camp experience affected respondents' attitudes about science and engineering. This composite of four questions separated by time is a more meaningful assessment of camp impact than the single "would you come back?" question which children may be hesitant to answer honestly.

As shown in Figure 4, an increase in interest by boys is balanced by a (slightly stronger) decrease in interest by girls. From this data, it appears the camps have an encouraging effect on boys and older respondents, while having a discouraging effect on girls and younger respondents, with the effect being stronger for gender than age. Results from the focus group with children at Tsawwassen support this finding. On the last day of camp, they were asked if the camp made them more excited about science. The response was generally no, and when one girl was asked if she would come back to camp, she hesitantly said maybe. The data also showed a significant difference in "Change in Interest" by community, but this can be explained by the different gender compositions of the camps.

Research from the United States found that student interest in science and mathematics was about equal for boys and girls at the fourth-grade level, but starting in middle school, girls' interest declined, and greater numbers of boys were found to complete courses in physics (Hayden et. al., 2011). In Canada, only 22 per cent of all people working in STEM are women. The Government of Canada launched a campaign in February 2017 to encourage young women to enter STEM fields, with opportunities being created for youth, including young women and Indigenous peoples. Resources aimed specifically at encouraging girls to pursue science are still limited, however, initiatives like the federal government's "Choose Science" help draw attention to the inequities within STEM fields. Findings from this evaluation support the need to pay closer attention to the persistent gender gap in STEM education. They also illuminate the important role camps like Geering Up can play in reducing that gap.

The qualitative findings detailed below will help flesh out this data and discuss areas for improvement by drawing on elements of the camps that have been effective in getting both boys and girls excited about STEM.

Figure 4. Gender and attitude change



Qualitative Findings:

Through interviews with Geering Up staff, instructors, community members and community staff, it was clear that science-based camps play an important role in bringing awareness to Aboriginal children about STEM fields. Many instructors described a growing confidence among children as the week went on, as well as a clear sense of pride and accomplishment when they completed activities they didn't know they had the skill to complete. As one instructor noted, children also discover the areas that inspire them which can shift the entire experience: "...one of the kids yesterday, we did the ecosystem diorama and he says to me – he was one of the kids that was not interested really or inspired by anything we had done – he goes [on to say that] this is my favourite activity."

Having student mentors, community staff from youth programs, and highly capable instructors created positive conditions for children to feel comfortable and safe to engage in science and engineering activities. Both instructors and staff in community talked about the importance of having youth workers present who know the children, can help them with different activities, and who provide a bridge to the new faces coming into the community. At least one child described her favourite part of camp as meeting the instructors. Several staff members talked about how they appreciated the flexibility of camp instructors who were willing to adjust the schedule to meet the interests and needs of the children. Geering Up staff mentioned this as a priority: "I think when we send the instructors over we try to send out the best, people who can really connect with kids and be flexible and versatile and just being able to only come in for a week and...join in on that community for a little bit."

The following quotes from instructors, community staff, and Geering Up administrators demonstrate the importance of STEM in First Nations communities, as well as the challenges of delivering such programming and opportunities for growth and change. In sharing the full breadth of experience that each participant brings to this evaluation, it is hoped that a greater understanding of the program's impact will be realized.

Geering Up Instructors:

Importance of community involvement in curriculum design:

"The activities that worked best were the ones where you could have a clear tie in to the location we were in, and, also through having someone that was First Nations there able to tie it into their culture to some extent. That is a big emphasis. Land-based learning is a big emphasis when we're doing these First Nations outreaches and they are the activities that are most successful."

"It does take resources, but I would have greatly appreciated the opportunity for many of these communities to be able to personalize to some extent what we were doing. Because we don't know very much about these communities, we don't live in them, we're not from them. And that severely limits how relevant we

can be. To have the input from people who are members of the communities, a lot of the programming can be a lot more effective.”

“I think it would be a lot more helpful for the instructors to actually speak with either the Elders in the community or whoever is going to be in contact with the program in the community and just kind of discuss different activities, maybe, and what kind of knowledge they are okay with, what kinds of topics they are okay with us discussing, and how they feel that fits with their own values. Because you certainly don’t want to encroach on any of that.”

Real-life application of STEM:

“Sometimes I just feel like we come in and show them all these cool activities, but we don’t tie it in to what life as a scientist would be like... Some of the older kids that we had in the Haisla community² that were 13 or 14 and were really into the activities, I’d like to get them more a picture of if they decided to pursue this, here are some of the options that are open to you.”

“Yesterday we made little LED flashlights that you can turn off and on. It’s a fairly simple activity but the kids are seeing a product that they’ve made, and I think activities like that have been the most successful in terms of getting them excited and engaged with the topic.”

“We talked this morning about structures and how they’re built to be earthquake resistant and I think that’s really cool, that they get to think about oh we’re doing this small-scale project but also it’s really applicable in like everything we see. I think that’s a huge benefit when connecting some activities.”

“Even for myself, the whole concept of science and engineering and the STEM fields is a little bit intimidating. It always seems like something grown-ups do. I think that bringing science to a level that’s fun and exciting is a really great take away. Maybe science is something that I do care about. Maybe it’s more than just people building computers. It’s actually lots of things that I use in my everyday life.

Importance of land-based learning:

“The activities that worked best were the ones where you could have a clear tie in to the location we were in and, also, through having someone that was First Nations there able to tie it into their culture to some extent. That is a big emphasis. Land-based learning is a big emphasis when we’re doing these First Nations outreaches and they are the activities that are most successful.”

² Haisla Nation was one of the communities visited by Geering Up through its community outreach program.

Instilling confidence:

One camper [name] yesterday afternoon I think she was tired after lunch and we were doing a maze and there are these little robots that follow a line you drop, so they would use pieces of paper to make a track along which the robot rolls. And [name] was really stressed and she did something wrong because she didn't realize she would have to connect her piece of the track with someone else's piece of the track and she started crying saying 'oh I don't know what I'm doing wrong. I don't know what we need to do.' And I said, 'okay we'll talk through it, we'll go over it,' and when I explained what the activity was, she said 'well I don't know how to fix it.' And I said 'okay we'll find out together. If you get stressed out, we won't do it.' She slowly calmed down and then we did it and she actually put the robot down and made it go through the entire maze which I thought was pretty cool. She was still engaged with the activity after some of the campers were over it, and I think it's because she decided to not give up on it."

"The variety of activities is the most effective and the most beneficial is the type of activity where we're quite open-ended. We work towards a goal and there's something to show for the labour. You're able to say that that is something you are capable of doing and have done and for many reasons is an impressive thing."

Community Staff:

Importance of community involvement in curriculum design:

"We don't know what to expect, how it's going to roll out, we don't know anything until it actually happens. Even if they're engaged while doing it or not. That's something that should be looked at more afterwards [a debriefing]."

"Right now, for this week, as the supervisor of my summer students, I feel like a sitting duck in the blind asking me what's going on and I'm like, I don't know you gotta ask UBC people...and the parents are asking me and I'm like "it's Geering Up tomorrow." What are we doing? I don't know. It's their program and we won't step in front of them but at least being able to help where needed and knowing what's going on so I can explain it to parents when they're asking what's going on."

Importance of land-based learning:

"Because any ideas that [Geering Up instructors] have or that they wanted to do, [name] could have had. The canyon idea could have come up sooner and the forested area could have come up sooner. We also have our own beach down here on the water. So, if there's a meeting set up and they're requesting certain things, maybe it could be set up prior to the activities so we're not inside the majority of the time. Because the kids are staring at the windows outside and it's nice and hot."

"[Going to the beach] they got to really think about the ecosystem around them and we found cool stuff and [name] explained a lot of stuff to the kids. They found a coconut shell and he was talking about how oh back in the day coconuts were actually growing pretty much everywhere at one time. And just explaining facts about the world. I thought that was cool."

"I think the owl pellet thing was really cool too for the kids. It's an animal from around here right and I feel like they don't know a lot about the animals around here because they're not crazy cool right, like tigers. Not cheetahs and stuff like that. For them to appreciate the stuff that they have around them they need to learn about their ecosystem and the animals that live in their community."

"With the children at Seabird, they all like being outside. If it was more being able to go out and explore, even talking about for example running and speed. If they could go out in the field and run a bit, like after lunch time if they're feeling down and bored it would give them something to do."

Increased interest in STEM:

"[An older boy who came by the camp] participated in previous two years and he's super into computers and stuff now, like circuits and all that kind of stuff and he really enjoyed it. He's super into science too."

"A few parents came in throughout the week and they said oh the kids love this. I was just talking to a parent she was picking up her kids outside oh they keep talking about all the science and they're having so much fun and they want to do stuff at home."

"...[the kids] ask a lot of questions. They're interested in figuring it out. Might be a couple of things where you lose them a little bit. They're pretty enthusiastic. It's surprising how much some of them already know too."

Geering Up Administrators:

Nurturing community connections:

"We will continue to refine our curriculum. I think as we build relationships with each community, we'll get to know what resources they have local there. Is there a gymnasium where the program is held next to the beach? Is there something we can pull on from there? What community members would like to get involved and how would they like to be involved. And then in terms of content, we bring, I hope, like there's a special challenge to developing a camp curriculum that can be brought on the road. I hope we can keep building on that."

“[Community involvement in curriculum development is] something we’ve been talking to, but would love to do that with more communities. It requires close relationships with community and having the right contacts in place.”

“I wish we could return to communities more frequently throughout the year. I wish we could attend for longer periods of time. I was talking to [name] who helped organize the programs at Tsay Key Dene and Kwadacha³ and he wanted to bring that model of bush camp to other communities and I definitely see interest in that.”

Inspiring confidence:

“When a kid starts off, they sometimes think I can’t do this and it’s so hard. And they can do something at the end and they made something. They learn that it’s not just being born able to do this and it’s something that can be learned.”

“I think it’s all about connecting them with this is how cool science is and then once they realize that and are more interested in the topic then they’re more engaged in class and they’ll learn more and it’s a cycle of learning.”

Importance of land-based learning:

“One thing that stood out doing the land based camp [at Tsay Key Dene/Kwadacha] was how much we incorporated the land into it. As we keep going back, we need more people [in community] and [to keep] trying to incorporate the environment into the curriculum.”

“Kids know a lot more about nature in First Nations communities than in the city...I wish we had more activities about nature. The level of knowledge [children in community] had was way higher than I had. I wish we had incorporated more of this into the camps.”

“Incorporate more land-based learning would be great. We were good about that for our Tsay Keh Dene/Kwadacha camp. I would love for more of that to happen in all of the Aboriginal camps if possible.”

Significant accomplishments include:

- Promoting greater interest in STEM topics among boys by the end of the camp
- Over 50 per cent of children want to return to a Geering Up camp (with younger participants expressing more willingness to return than older respondents)

³ This was another community outreach camp held earlier in the summer through Geering Up. Students did one week in the classroom and then a one-week camp in the bush.

- Over 80 per cent growth in the number of First Nations communities participating in the program since they started in 2012
- Development of community-university partnerships to promote opportunities for STEM learning in First Nations communities.

Next Steps for the Project

In the introduction to her article on 21st century Aboriginal learners and STEM, Michelle Hogue writes:

“For many Aboriginal learners, whose ways of learning and coming to know are grounded in practical, hands-on, learning-by-doing first, the current Eurocentric model of theory before practice results in a paradigm clash (Aikenhead, 1997, 2002; Aikenhead & Michell, 2011; Cajete, 1999). As a result, the majority of Aboriginal students do poorly in science and mathematics-related courses as they progress through school, resulting in high attrition rates from such courses and often, consequently, from school (CCL, 2006a, 2006b, 2007; Statistics Canada, 2005, 2008, 2012).”

In considering the role a program like Geering Up can play in Aboriginal communities, it is vital to understand the impacts curriculum can have on Aboriginal youth. Many of the suggestions put forward by camp instructors, staff in community and Geering Up, as well as results of participant surveys, represent important interventions that will better serve Aboriginal youth and ensure that their exposure to STEM is positive and inspires confidence. As one instructor said:

“I honestly think the best thing is just them having fun and thinking science is something cool. Because I don’t think every person who comes to this camp is going to decide tomorrow that they’re going to become an engineer or even that they’re all going to go into sciences. But I think that’s important to have them thinking now that science is something good and cool and fun and something I can look into in the future and know about, even if it’s not my specialty...science literacy is important in general.”

Land-based learning is central in efforts to engage Aboriginal learners. Geering Up is already creating opportunities for “practical, hands-on, learning-by-doing first.” The more the program can shift that learning out on the land, the greater the potential for engaging all learners, boys and girls, young and old. Several community staff members described the need for more structured breaks and opportunities to go outside. Moving the learning outside will address this challenge while encouraging children to share what they know about the community, which can also potentially instill greater confidence in their ability to do STEM.

Many of the community outreach camps have participants from a wide age range. This was identified as a major challenge by many of those interviewed. Creating a mentorship model in which older children are paired with younger children is one way of addressing this challenge. Assistance from older children can help sustain the interest and attention of younger children while providing an opportunity for older children to volunteer and share their knowledge and skills. From the survey data, it was clear that while older children enjoyed the camp, they're not necessarily motivated to return. Geering Up should consider designing activities for older children that are open-ended and have real-life applications. Children could be grouped by grade levels as happens in other Geering Up summer camps, with the groups coming together at key points in the day. In addition, craft-oriented activities appeal to many children, particularly younger children, but as one instructor pointed out, "kids get done with crafts when you do one or two or three every day." In trying to appeal to as many children as possible, the curriculum is engaging some, while potentially alienating others. Again, this could be addressed by designing curriculum for specific age groups and – as will be described below – working closely with community to create locally-relevant and culturally-appropriate curriculum.

Preparations for delivering community outreach camps begin a year in advance and involve intensive planning and coordination. Much of this work is focused on important logistics, such as hotel bookings, transportation, car rentals and WIFI availability. Several people mentioned the importance of having a dedicated Aboriginal outreach team to design and deliver programming. This would facilitate opportunities to work more closely with community partners in designing curriculum tailored to the community, in addition to working out detailed logistics. In 2017, only one or two Elders participated in the camps. Having an Aboriginal outreach team would make it easier to develop close community relationships that could be drawn upon to identify potential Elders and youth volunteers, for example, as well as places on the land to deliver activities. One instructor described how nice it was to have Elders present and that it helped "connect education and the entire community together."

Each participant in this evaluation spoke to the challenges of delivering curriculum that can travel with the instructors and still appeal to a wide age range. A goal of the program is to focus on curriculum development, how to address the learning curve when instructors who didn't create the content have to nonetheless deliver the curriculum, and how to continue developing good curriculum that can be brought on the road. While communities will vary in their capacity to take on curriculum design and development, their involvement nevertheless can help address some of these challenges by identifying local resources instructors can incorporate into their curriculum. Community staff and youth workers are in the best position to provide guidance and advice on children in the community. Nurturing these connections throughout the year can improve the camp experience for instructors, staff and children alike.

Additional recommendations for the program:

- Develop curriculum that explicitly addresses gender and STEM, and consider how to foster interest specifically among Aboriginal girls.
- Work closely with Actua to further develop orientation materials for working in First Nations communities; additionally, tailor orientation materials to the community so instructors are aware of the local culture as well as logistics (e.g. if there is cell phone service in the area).
- Recruit staff from rural communities in British Columbia who are interested in and willing to travel to rural and remote communities.
- Create feedback mechanisms for community partners to provide to instructors immediately after the camp.
- Establish contact between instructors and community partners prior to the camp so that everyone feels comfortable with the knowledge that will be shared and there is an opportunity for last-minute adjustments or suggestions for the week's activities.
- Prepare additional activities (beyond experiments and demonstrations) for times when children are not engaged in a specific activity. On the UBC campus, for example, when children get bored with activities there are projectors available to watch short videos. Secure AV resources where possible in communities.
- Work with on-reserve schools/education programs to find a dedicated contact who can be more closely involved in designing camp curriculum.
- Work with Actua and other funders to improve marketing, recruitment, and advertising, particularly aimed at recruiting Aboriginal youth as instructors.
- Establish a registration process in larger communities to enable better planning for different age groups. This also provides an opportunity for instructors to get information about the children in advance, for example if there are children with special needs or different learning styles that can be accommodated.
- Provide opportunities for caregivers to find out what their child is doing during the week, for example, an open house built into the curriculum at the end of the week (letting caregivers know in advance), or a take home project that children can share with other family members.

Appendix I: Logic Model

← **Planned Work** → ← **Intended Results** →

Inputs: Resources Human & Financial	Strategies / Major Activities	Outputs or Performance Indicators	Short Term Outcomes or Objectives	Inter-mediate Outcomes or Objectives	Ultimate Goal/ Impact
<ul style="list-style-type: none"> • Geering Up program supports/staff • Teachers and parents involved with Geering Up • Meals provided (TBC) • School resources, including facilities, transportation (To be confirmed with individual communities) 	<ul style="list-style-type: none"> • Week-long summer camp • Follow-up activities for teachers/principals 	<ul style="list-style-type: none"> • Students are interested in STEM topics (science, technology, engineering and math) • Students are confident in their ability to engage with STEM • Teachers are motivated to include hands-on activities in their classrooms • Parents are engaged and involved with their child's education • Student success in STEM as they proceed through school compared with children who did not attend the camp 	<ul style="list-style-type: none"> • Improved outreach to Indigenous students and communities • More teachers involved in promoting hands-on learning with STEM • Improved links to the university within Indigenous communities around British Columbia • Better educational outcomes for children who attend Geering Up camps 	<ul style="list-style-type: none"> • Increase in number of children accessing STEM educational programs • Stronger connections between academic institutions and on-reserve schools • Increased awareness of opportunities within STEM 	<ul style="list-style-type: none"> • Increase in number of Indigenous students choosing careers in STEM • Respectful and supportive connections between reserve-based schools and academic institutions • Valuing of Indigenous knowledges/perspectives in STEM

References

Barnhardt, Ray, and Oscar Kawagley. (2005). "Indigenous Knowledge Systems and Alaska Native Ways of Knowing." *Anthropology and Education Quarterly*, Vol. 36, Issue 1, pp. 8–23.

Carlson, Stephan, Alisha M. Hardman, and Mary S. Marczak. (2011). "Connecting the Dots for Youth Development in American Indian Communities: A Story of the Reach for the Sky Project." *Journal of American Indian Education*, 50(3), 80-91.

Government of Canada. Choose Science.

http://www.ic.gc.ca/eic/site/013.nsf/eng/home?open&WT.mc_id=Women-in-science-2017_news.gc.ca_Choose-science-Optez-sciences_en

Hayden, K., Ouyang, Y, Scinski, L., Olszewski, B., & Bielefeldt, T. (2011). Increasing student interest and attitudes in STEM: Professional development and activities to engage and inspire learners. *Contemporary Issues in Technology and Teacher Education*, 11(1), 47-69.

Snively, Gloria, and Wanosts'a7 Lorna Williams, Eds. (2016). *Knowing Home: Braiding Indigenous Science with Western Science: Book 1*. University of Victoria.

Statistics Canada. (2015). *Aboriginal Statistics at a Glance*. Retrieved from <https://www.statcan.gc.ca/pub/89-645-x/89-645-x2010001-eng.htm>