ENGAGEMENT AND EQUITY WITHIN A SCIENCE CENTRE'S COMMUNITY-BASED PROGRAM FOR MIDDLE SCHOOL YOUTH

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Engagement and Equity Within a Science Centre's Community-Based Program for Middle School Youth

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RESEARCHER BIOGRAPHIES

Lydia E Carol-Ann Burke is Associate Professor of Science Education in the Department of Curriculum, Teaching and Learning at the Ontario Institute for Studies in Education (OISE), University of Toronto. Her research focuses on equity issues in science education and broadening participation in science by exploring the factors that marginalize youth from engagement with science education in both formal and informal settings. Prior to becoming a researcher, she worked for 15 years as a full-time science teacher. She is committed to supporting educators as they pursue the development of meaningful and relevant educational experiences for learners.

Athi Selvadurai is currently pursuing a Master of Education degree in Curriculum and Pedagogy in the department of Curriculum, Teaching and Learning at the Ontario Institute for Studies in Education (OISE). He centers his research and studies on the intersection of science education and communication practices, while focusing on informal education settings. Alongside his education work, he has been an active education practitioner at the Ontario Science Centre for over 10 years. As a BIPOC (Black, Indigenous, and People of Color) individual who found his STEM identity within the science museum space, he is actively dedicated to building and supporting equitable science programs.

Naomi Bender is an educator and researcher specializing in informal science education. With over six years of experience, she has designed and delivered science programs for youth and educators across Canada. Currently completing a Master of Arts in Curriculum and Pedagogy at the Ontario Institute for Studies in Education (OISE), University of Toronto, Naomi's research explores how science centres foster youth belonging in and identification with science. Her work emphasizes bridging science with community and culture to create learning experiences that resonate with the participant.

ACKNOWLEDGEMENTS

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EXECUTIVE SUMMARY

During the 2021/2022 academic year, the Ontario Science Centre (hereafter, the Science Centre) collaborated with Carol-Ann Burke at the University of Toronto to conduct a study entitled ***A Science Centre's Investigation of STEM Education Engagement Strategies for Minoritized Children and Youth*** (hereafter the *Minoritized Youth in STEM* report). The study identified how educators and program leaders working with youth from groups that are underrepresented in STEM careers and higher education promote equity in the Greater Toronto Area (GTA). The research generated a set of key principles and a set of important program elements that the educational leaders agreed were high priorities in equitable STEM education. To follow on from that study, a second collaboration was developed to explore in more detail what these principles and program elements look like when applied in the context of a specific community-based program, TeenSTEM (a pseudonym).

The TeenSTEM program was first piloted in 2021. Based on the success of the pilot, a three-year commitment was made, in partnership with a corporate funder, to extend and further develop the TeenSTEM program. The two-week program for youth aged 12 to 14, positioned the Science Centre as an integral component of the community for youth living in the low-income neighbourhoods that surround it. The program sought to strengthen the connection of the youth to the Science Centre and STEM in their own communities. The study summarized in this report explored three dimensions of the TeenSTEM program:

i) Youth engagement with the Science Centre and the TeenSTEM program
ii) The TeenSTEM program's enactment of equitable practices, as described in the *Minoritized Youth in STEM* report
iii) Community connections with the Science Centre and perspectives on the TeenSTEM program

Focus: Engagement, Equity, and Community

The research findings are based on data gathered across two sessions of the TeenSTEM program during Summer 2023. Data sources included: daily field notes made by a researcher/volunteer, daily youth surveys, youth background interest surveys, and interviews with youth, parents, program leaders, and program managers. This report outlines the research findings and provides insight into strategies and opportunities for informal STEM education institutions to develop more equitable and relevant community-based programs. Among the findings we highlight the importance of balancing the pace and duration of program elements to maintain interest. We also illustrate how connection with program leaders is deeper than merely sharing a cultural background with the youth; rather, it relies on the leaders demonstrating genuine interest in and care for the life circumstances of the youth while sharing something of themselves with the youth. We reflect on the potential for the community project to serve

as a strong means of connecting youth to both STEM and the Science Centre and suggest an approach that might unify the program elements in ways that make the overall purpose of the program more coherently reflected in its various parts. We end by considering the potential of the program to more effectively support the agency of youth attendees and the communities within which the Science Centre is situated. Harnessing the enthusiasm that the youth reflected in their engagement with the program, we suggest that these same youth be seen as program advisors and future program leaders so that the Science Centre is not merely 'serving' the neighbouring communities, but it is also being shaped in some way by those communities in its willingness to be responsive to the voices of community members, represented in the youth who are asked to consult on future iterations of the program.

INTRODUCTION

For the last two decades STEM (science, technology, engineering, and mathematics) has been a priority in Canadian education and employment. The government of Ontario recently affirmed the importance of STEM by including the development of STEM skills in the new Elementary and Grade 9 Science & Technology curricula. STEM skills are highly regarded across multiple sectors, including families, industries, and community organizations.[1] While schools are just beginning to formally include STEM education in their curricula, STEM education has a more established home within informal education spaces. These informal spaces often describe their key strength as engaging youth with STEM through their use of a variety of fun-based activities. This emphasis on engagement seeks to make STEM educational environments more relaxed and inclusive than formal schooling can facilitate.

Despite the focus on broadening participation in STEM, informal education spaces have continued to experience difficulties in attracting youth from demographic groups that have been historically underrepresented in STEM careers and higher education pathways. The TeenSTEM program (pseudonym), hosted by the Ontario Science Centre (hereafter, the Science Centre) was designed to expose youth from low-income communities to STEM knowledge, skills, and career pathways. The program sought to attract youth from low-income neighbourhoods surrounding the Science Centre and engage them in a range of activities that would help youth to see their place in STEM, while maintaining a strong connection to their local communities. The research described in this report identifies how the TeenSTEM program addressed issues of ***engagement***, ***equity***, and ***community*** in their drive to provide meaningful and relevant STEM education for youth in their immediate vicinity.

[1] Parkin, A., & Crawford Urban, M. (2017). The evolution of STEM education: A review of recent international and Canadian policy recommendations. Let's Talk Science. https://letstalkscience.ca/sites/default/files/2019-08/2017%20LTS_Evolution-of-STEM-short_0.pdf

STUDY CONTEXT

TeenSTEM was a two-week activity-based STEM program for youth aged 12 to 14. Three consecutive sessions were offered in Summer 2023, each accommodating 25 to 30 youth. Youth attending the program had to be resident in one of the low-income neighbourhoods surrounding the Science Centre (pseudonymously called Macdonald Oaks and King's Forest in this report). Applications were made when youth reached the end of Grade 7 or Grade 8. Applicants were selected at random from the pool of those who applied. All applications were submitted by parents/guardians who indicated a preferred session based on timing and their willingness for their child to be part of a research study.[2] The TeenSTEM program consisted of 5 program elements: visiting exhibits, listening to presentations, engaging in active experimentation, working on a community project, and participating in dedicated social/relationship building activities. It was important that youth attending the program were not held financially responsible for the cost of any of the experiences offered through the program so each youth was provided with transit reimbursement (if used), lunch at the Science Centre, and a daily stipend of $25; there were no program fees. The program ran for 9 consecutive days (excluding weekends and holidays), and youth were guided by five postsecondary youth leaders and two or three volunteers (including one researcher/volunteer, as described in the following section).

Program Particulars

The majority of TeenSTEM's daily programming occurred within a dedicated workroom where activities were run or organized by the program leaders. These activities included sessions focused on STEM skill/concept development (such as the introduction to coding skills or exploring the behaviour of non-Newtonian fluids), discussion-based workshops on broader life-impacting concepts (like STEM identity or financial literacy), invited speaker sessions by STEM professionals (both from within and outside of the Science Centre), and a small group community inquiry project (described in more detail below). Outside of their workroom space, youth also participated in exhibit exploration and behind-the-scenes experiences (such as visiting the museum's Live Exhibits lab).

While the activities, presentations, and workshops varied each day, the community inquiry project served as a daily constant. Youth were divided into small groups and supported to identify a problem within their community and develop a solution-focused representation of what should happen in their community. The projects and their solutions were driven by the youth, alongside mentoring from their leaders. These solutions were displayed as dioramas or other visual presentations during day 9 of the program and during the Community Showcase event later in the summer (attendance at the latter was optional; that event was not used to generate data for this report). Family members, friends, Ontario

[2] Parental consent was gained for each form of data collection within two of the three program sessions. The third program session was reserved for youth whose parents preferred for them to be excluded from all aspects of research data collection.

Science Centre employees, and funding partners were invited to the Showcase. To provide additional context, the general daily schedule is outlined in Table 1.

Table 1

General Daily Schedule of Activities.

Time	**Activity**
8:45 – 9:00	Check In/Welcome/Games
9:00 – 9:30	Games
9:30 – 10:15	Activity 1
10:15 – 10:30	Refreshment Break
10:30 – 11:00	Activity 2
11:00 – 11:45	Activity 3
11:45 – 12:45	Lunch Break
12:45 – 14:00	Activity 4
14:00 – 14:15	Refreshment Break
14:15 – 15:30	Activity 5
15:30 – 15:45	Wrap Up/Sign Out

Note. Some activity sessions were combined for more extensive activities or split into subgroups if necessary.

Community Characteristics

Participants in the TeenSTEM program came from the Macdonald Oaks and King's Forest communities (as determined by postal codes). Based on 2016 census data, each neighbourhood has the following characteristics:

- Accommodates a little under 1% of Toronto's total population
- The majority of households are occupied by renters
- Nearly 65% of occupants are immigrants (predominantly from Asia & Oceania)
- Nearly 80% of residents identify as a visible minority
- Around 70 to 80% of residents are Canadian citizens
- Over 50% have a home language that is not English (the most common non-English home language is Urdu)
- Has a higher percentage of unemployed and people in poverty than the regional average
- Has a median average income around $50,000 (regional median is over $80,000)
- Has nearly twice the regional average percentage of high-rise dwellers
- Has a higher percentage of commuting workers taking public transit and travelling for more than an hour to work than the regional average

Mean and median ages of people within these neighbourhoods are lower than the regional average, reflecting the relative high proportion of children, compared with adults, living in Macdonald Oaks and King's Forest.

RESEARCH APPROACH

The research was conducted using a case study approach that employed a variety of methods. Each of these methods was designed to capture a different dimension of the youth participants' interactions with the program. Quantitative data were combined with qualitative insights to create a comprehensive understanding of the TeenSTEM experience. The various data sources are summarized in Table 2 below.

Table 2

Research Data Sources

Data Source	**Details**
*Youth Daily Engagement Surveys: completed each day by each youth attending the TeenSTEM program**	Surveys contained 8 statements to which youth responded with one of 4 levels of response: YES!!, yes, no, NO!! In addition, each survey had a written, free response box where youth were invited to describe what they learned and how they felt about the activities that day.
Researcher Daily Field Notes	Field notes provided extensive chronological records of the day's activities and youth responses to them. The notes were written at the end of each day by the in-house researcher/volunteer and focused on youth behavior and conversation during the day's activities.
*Youth Background Interest in Science Survey: completed by youth participating in interviews**	Surveys contained 11 statements about background interest in science, previous experiences with science, and career interest in science; youth responded on a 5-point scale.
*Youth Small Group Interviews: completed by a subgroup of youth attending the program**	Interviews were conducted in-person in small groups (2 to 6 youth per group). Questions were presented in a conversation style and were based on youth experiences in the TeenSTEM program with particular emphasis on the 10 dimensions of equitable STEM programs.¥
Parental Interviews	Individual interviews were held by phone or videoconferencing with a subgroup of parents who agreed to provide feedback on the program based on what TeenSTEM youth attendees had said at home.
Program Leader Group Interview	A small group interview was held with a subgroup of daily staff of the program. These staff had different levels of experience with Ontario Science Centre Programs, but all were daily participants in at least 2 of the 3 TeenSTEM summer sessions.
Program Manager Group Interview	A small group interview was held with the managers overseeing the TeenSTEM program. All interviewees in this category were experienced program planners at the Ontario Science Centre but all were new to the TeenSTEM program.

Note. *Only the data of youth who had parental consent to be surveyed or interviewed were analyzed. ¥The 10 dimensions of equitable STEM programs are derived from the *Marginalized Youth in STEM* Report.

YOUTH ENGAGEMENT

Youth engagement was explored in this study in three ways:

1. A brief quantitative assessment of background interest in science using a single survey
2. A quantitative review of affective, behavioural, and cognitive dimensions of engagement using a daily survey
3. Qualitative analysis of small group interview transcripts to explore the youth STEM identity dimensions of agency, recognition and belonging

Each approach is discussed in turn to build a composite picture of the engagement of the youth.

Background Interest in Science

14 of the 28 youth who participated in Session 1 (i.e., 50%) and 17 of the 27 youth from Session 2 (i.e., 63%) completed the Background Interest in Science survey. The surveys were adapted from Kier et al.'s STEM career-focused survey, designed for middle school youth.[3] The survey consisted of 11 statements that addressed science interest and self-efficacy, personal science goals and expectations, and science support systems. Survey responses were rated according to a 5-point scale: Strongly Disagree (assigned a score of 1.0), Disagree (score 2.0), Not Sure (score 3.0), Agree (score 4.0), and Strongly Agree (score 5.0). A summary of survey responses is presented in Table 3 and Figure 1.

Table 3

Background Interest in Science Mean Scores and Standard Deviation

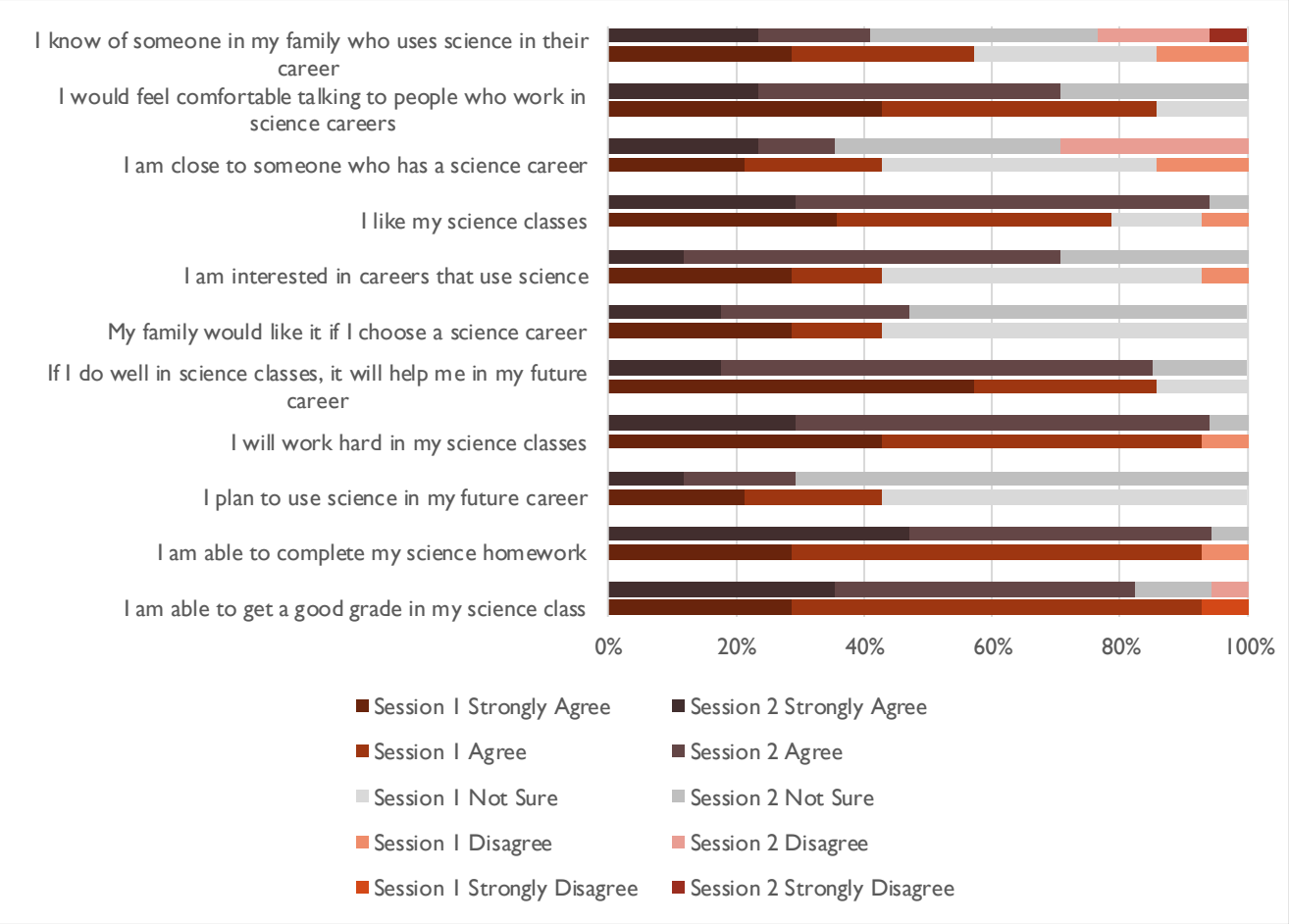
	Session 1 Mean Average	Session 1 Standard Deviation	Session 2 Mean Average	Session 2 Standard Deviation
I am able to get a good grade in my science class	4.1	1.00	4.1	0.86
I am able to complete my science homework	4.1	0.77	4.4	0.62
I plan to use science in my future career	3.6	0.84	3.4	0.71
I will work hard in my science classes	4.3	0.83	4.2	0.56
If I do well in science classes, it will help me in my future career	4.4	0.76	4.0	0.57
My family would like it if I choose a science career	3.7	0.91	3.6	0.79
I am interested in careers that use science	3.6	1.01	3.8	0.64
I like my science classes	4.1	0.92	4.2	0.56
I am close to someone who has a science career	3.5	1.02	3.3	1.16
I would feel comfortable talking to people who work in science careers	4.3	0.73	3.9	0.75
I know of someone in my family who uses science in their career	3.7	1.07	3.4	1.22

[3] Kier, M. W., Blanchard, M. R., Osborne, J. W., & Albert, J. L. (2014). The development of the STEM career interest survey (STEM-CIS). *Research in Science Education, 44,* 461-481.

All categories indicated a mean value above 3.0 so that, overall, a high level of background interest was indicated by participants in both sessions. This same pattern was reflected on an individual level where all but one of the participants indicated average scores above 3.0. The items with the highest overall agreement were those indicating a high level of science self-efficacy, science enjoyment, and commitment to doing well in science (items 1, 2, 4, and 8); overall, these responses indicate that these youth generally have positive experiences with school science classes. Responses to items associated with career aspirations and connections to people who work in science-related careers were more varied, resulting in lower mean averages and higher standard deviations. The responses to statement 5 (*If I do well in science classes, it will help me in my future career*), when viewed in the context of the trends stated above, indicate that, while the youth were interested and motivated to do well in school science, they were uncertain about the likelihood of pursuing a science-related career.

Figure 1

Mean Background Interest in Science



Note: The lower bar for each statement represents the Session 1 data and the upper bar is for Session 2

Affective, Behavioural, and Cognitive Elements of Engagement

47 youth participated in the daily survey portion of this study. The participants included 23 out of 28 youth attending Session 1 and 24 out of 27 youth attending Session 2 (a total of 85% participation in this portion of the research). At the end of each day of the program, youth completed a short STEM engagement survey consisting of 8 statements which participants rated on a 4-point scale (responses: YES!!, yes, no, and NO!!). The survey ended with a free response box where participants could describe what they learned from the activities and what they felt about the day.

The statements in the engagement survey were created by researchers in the US-based Science Learning Activation Lab for use after science-focused activities with 10- to 14-year-old youth.[4] The survey tool was designed to measure an individual's overall engagement in three dimensions: behavioral, cognitive, and affective engagement. Simply put, it describes the youth's ability to focus and participate in each task as described by what they do, what they think/reason, and how they feel. Each statement explores one of the three engagement dimensions as illustrated in Table 4.

Table 4

Survey Statements

Statement	**Engagement Dimension**
1. *During today's activities, time went by quickly.*	**Behavioural**
2. *During today's activities, I felt happy.*	**Affective**
3. *During today's activities, I felt bored.**	**Affective**
4. *During today's activities, I was daydreaming a lot.**	**Cognitive**
5. *During today's activities, I focused on the things that we were learning most of the time.*	**Cognitive**
6. *During today's activities, I was distracted by other things.**	**Behavioural**
7. *During today's activities, I felt excited.*	**Affective**
8. *During today's activities, I talked to others about stuff not related to what we were learning.**	**Behavioural**

Note. Survey items with an asterisk (*) are expected to have strong negative responses if the youth are very engaged. Considering the community-based aspect of this program, we anticipate that youth will spend time getting to know each other, so we did not view statement 8 as negative.

[4] Chung, J., Cannady, M. A., Schunn, C., Dorph, R., & Bathgate, M., (2016) Measures technical brief: Engagement in science learning activities. The Learning Activation Lab. http://activationlab.org/wp-content/uploads/2018/03/Engagement-Report-3.2-20160803.pdf

To generate the graphics in this section of the report, survey responses were converted into numerical values. For statements 1, 2, 5, and 7, a response of 'YES!!' would indicate a high level of engagement so is given a score of 4.0; 'NO!!' responses received a score of 1.0. For statements 3, 4, and 6 (statements where 'YES!!' and 'yes' responses indicate low engagement), 'NO!!' was given a score of 4.0 and 'YES!!' was scored 1.0. Since the community-focused TeenSTEM program encourages the youth to spend time getting to know each other and having 'off topic' conversation while developing new friendships, we did not see statement 8 as negative (as was intended in the original instrument) so we left its scoring on the positive scale and processed this data separately when comparing Sessions 1 and 2. Despite there being four defined response categories, some participants drew additional categories on their response sheets, indicating perspectives that fell between those provided on the survey form; these responses were given scores half-way between the two neighbouring categories. For example, a response between or encircling 'YES!!' and 'yes' for statement 2 was given a score of 3.5.

The findings presented below provide contextual information about each session alongside insights from the participants' written responses (some spelling and punctuation has been corrected for readability). Pseudonyms are used throughout for youth participants and leaders.[5] We have emphasized (in bold) the comments of two youth in Session 1 (Helen and Daye) to illustrate how individual engagement patterns shifted during the program. Graphs are provided to give snapshots of responses from various time points within each session (Figures 2 and 4) as well as an overview of average engagement scores across the two sessions (Figures 3 and 5). Figure 6 compares Sessions 1 and 2.

Survey Findings

Session 1: 17 July 2023 to 27 July 2023

Day/Main Activities	**Summary/Sample Comments**
Day 1 - *Human Edge Exhibit* - *Design Thinking: Egg Drop* - *Community Project*	Overall, engagement was high on the first day and participants were keen to see how the program would develop. The community connected project seemed to grab participants' interest. 95% of the participants indicated that they were happy and that time went by quickly. A few of the participants indicated that they had times of boredom and one was concerned about the efficiency of the washroom access system. • ***I am trying to talk to new people & getting used to the routine of [TeenSTEM]!*** [A highly decorated survey form with rainbows, hearts, and stars] (Helen)[6] • ***Today I learned that a lot of the people here are very friendly yet stubborn though I think we should get a doorbell for the door so that we know when someone's back from the washroom.*** (Bandu) • ***I felt happy about today learning about the neighbourhood and stuff.*** (Onil) • ***We learned about design thinking & community project & felt good about the activities.*** (Daye)[4]

[5] Youth self-selected pseudonyms but these have been renamed in a gender indiscriminate way, based on the names of tropical cyclones. Self-selected personal pronouns have been retained.

[6] Comments of Helen and Daye highlighted to illustrate how individual engagement patterns shifted during the program.

Day/Main Activities	**Summary/Sample Comments**
Day 2 - *Science Arcade/ Living Earth Exhibit* - *Identity & Public Speaking Presentations* - *Community Project* - *Science Centre Presentation*	After a strong start on Day 1, overall engagement levels dipped a bit. 90% of the participants indicated that they were able to remain focused on what they were learning for most of the time. Participants continued getting to know each other. Unfortunately, one of the same participant who was bored on Day 1, remained bored on Day 2. • ***Boring again. But lunch was good.*** (Jai) • ***I feel more confident about Y4Y and even made new friends!! =)*** (Helen) • ***I observed other people's ideas and got to know them. I learned about scientists. I thought of ideas of why there needs to be more youth spaces. Interacted with more people.*** (Luban)
Day 3 - *Human Edge/Question of Truth Exhibit* - *Coding/Making a Video* - *Community Project* - *OMNIMAX movie*	Engagement scores began to recover after the Day 2 drop. Participant comments focused a lot more on the activities, particularly the community project. Participants did not write as much on Day 3 as on previous days. One participant was concerned about the food situation. • ***I felt really hungry for the first half of the day, I think it would be a better idea for lunch to be at around 11 o'clock*** (Helen) • ***Today we were doing film making & also we continued with our community project. I felt happy.*** (Daye) • ***It was really, really fun, I felt really, really happy*** (Arnab) • ***I learnt nothing. I feel alright.*** (Nilam)
Day 4 - *Voyage to the Deep Exhibit* - *Making a Video/Coding* - *Community Project* - *Heat in Action Presentation*	Participant written responses were very brief on Day 4 and had a rushed appearance (although there were many smiley faces drawn). Food remained a topic of conversation and many participants made comments about the Heat in Action Presentation. 100% of the participants indicated that they were happy. • ***Today I had big laughs with my friends & lunch was really good! =)*** (Helen) • ***happy, good, excited.*** (Thane) • ***I learned about temperature. :) yay*** (Rashmi) • ***Today we continued our community project & did a heat inquiry workshop with Martin. I felt happy*** (Daye)
Day 5 - *Financial Literacy Presentation* - *Rube Goldberg Machine* - *Community Project* - *Video Game Presentation*	Feelings were mixed toward the end of the week. Nearly half of the participants stated that time went by slowly on Day 5. A little over 75% expressed happiness and it seemed that the final activity may have left many of the participants with a negative perspective on the day as the overall engagement rating was lowest in all dimensions on Day 5. • ***I really enjoyed the community project group discussion. I found it really nice and informational. =)*** (Bandu) • ***Hungry again, lunch is too far away compared to my old school hard to do activities when hungry*** (Helen) • ***I don't like sitting in one place all the time it's better to move*** (Drake)

Day/Main Activities	**Summary/Sample Comments**
Day 6 - *Community Project* - *DNA/Micro:bit*	Engagement seemed to be revived after the weekend with Day 6 being the day of highest cognitive engagement. Many comments referred to the DNA and micro:bit activities. 96% of participants stated that they were focused on the learning for most of the time. The participants seemed to be more comfortable with each other but one participant described how relationship tensions were starting to creep in. • ***There's these 2 girls that keep giving me dirty looks and I kinda find that annoying but that's it everything else is nice*** (Fani) • ***Today we played with the microbit tinker & also extracted DNA from strawberries. I felt excited & it was awesome.*** (Luban) • ***Today was pretty fun I liked it, it was better than Friday*** (Thane)
Day 7 - *Oobleck* - *Van de Graaff Machine* - *Animal Care/Community Project* - *Spit for Science Presentation*	The overall engagement level remained high on Day 7. Over 90% of the participants indicated that they were happy. Participants mentioned enjoying the community project, the majority enjoyed the Spit for Science activities. Engaging with the Science Centre animals seemed to be a highlight for many (also see Day 8). • ***I hope they add kitties to the animal area but the bunny was so CUTE!*** (Helen) • ***We continued with our community project. I also spit for science. I felt happy.*** (Daye) • ***I was happy as always*** (Nisha)
Day 8 - *Code Emoji* - *Community Project/ Animal Care* - *Animation Presentation*	Positive and enthusiastic comments were made for both the code emoji and animation presentations. Staff were mentioned favorably in the survey comment boxes (Rumi was mentioned by name) as the participants began to see the session drawing to a close. • ***The zoetrope was cool & the animal care was awesome. I got to touch Fuzball (the bunny). I felt awesome*** (Daye) • ***I loved seeing the animals and the animation thingy. I will miss the staff and this place.*** (Akash) • ***It was fun, I liked the guest speaker.*** (Nivar)
Day 9 - *Deep Sea Adventure Show* - *Community Project* - *Showcase*	As participants reflected on the final session of the program, behaviour was focused on the showcase event. 100% of the participants described themselves as focusing on the learning for the day. Youth seemed to enjoy presenting and watching each other's presentations. Many participants greatly enjoyed The Deep Sea Adventure Show and there were expressions of sadness that the program was over. • ***Today I had a lot of fun presenting our diorama*** (Aila) • ***Today we finally presented our community project. I feel sad it's over but also happy at the same time.*** (Daye) • ***This was a fun program, I'll definitely be back*** [Small heart drawing] (Vardah) • ***Today was great I had fun but I'm sad that it's the last day. I hope I will see you again cause I plan on working here for at least a bit for experience.*** (Akash)

Figure 2

Snapshot summary of Session 1 survey responses from days 1, 5 and 9.

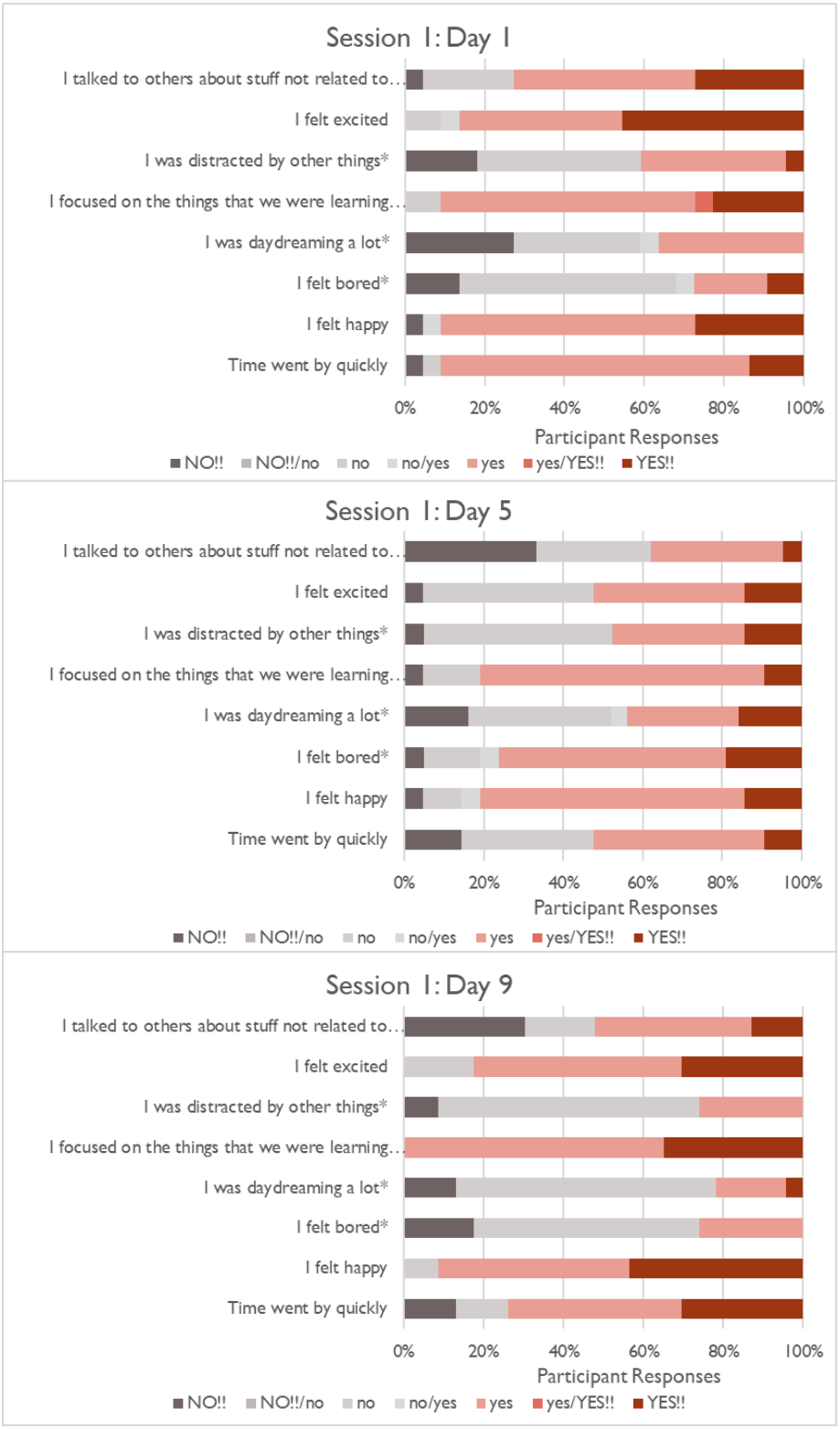
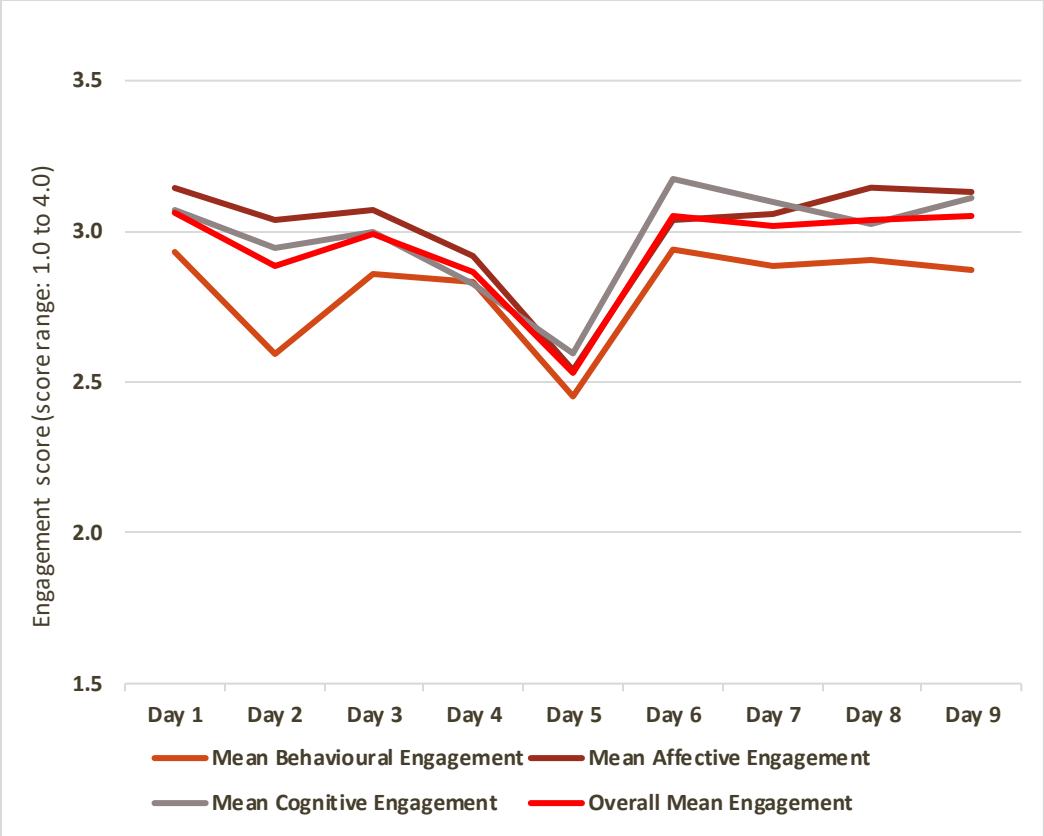


Figure 3

Session 1 Average Engagement in Affective, Behavioural, and Cognitive Dimensions Over Time



Session 1 Overview

Participants' survey responses indicated that the majority of youth ended each day with very positive feelings of engagement. 80% of responses for Session 1 indicated positive affective engagement at the end of each day. Indeed, the engagement averages for every day except Day 5 (which was a Friday for Session 1) indicated positive affective, behavioural, and cognitive engagement (a score of 2.5 represented a neutral response where positive and negative engagement responses were balanced). In all engagement dimensions probed, there was no significant difference between the responses of girls and boys (the only two genders reported by participants) with regard to overall engagement or feelings toward the individual activities. The only exception to this gender independent trend was seen on Day 5 when girls were a lot more negative in their response to the day's activities; boredom was the most common complaint on Day 5. The community project served to maintain the engagement levels of participants at times when their interest in the activities waned.

Session 2: 31 July 2023 to 11 August 2023

Day/Main Activities	**Summary/Sample Comments**
Day 1 - *Design Thinking: Egg Drop* - *Community Project* - *Weston Family Innovation Centre Exhibits*	Participants appreciated that Day 1 was about introductions but they were very expressive in describing their enjoyment of the day's activities, including the games that were played. 100% of the participants indicated that they were happy and close to 90% stated that time went by quickly and that they felt excited. A few participants mentioned that they were already connecting well with leader Lowen. Two participants mentioned the temperature of the room: one said it was too hot, the other, too cold. • ***I really liked the egg drop it was really fun and I had a great time. I also liked the games that we were playing outside. =)*** (Asif) • ***As today was the first, there wasn't much to learn, however I learned of a metal called ninotine (I think) [nitinol] which reverts to its old shape when heated, and becomes malleable when cold. I got to see how to protect an egg with paper, and I enjoyed lunch.*** (Sira) • ***I felt really good about today's activities and had a lot of fun. I also learned some new games that were really fun and that I'll play with the kids that are in my neighbourhood*** (Sarrab)
Day 2 - *Question of Truth Exhibit* - *Community Project* - *Name Game/Identity Presentation* - *Science Centre Presentation/ Clothes Pins*	Again, participants were positive in their reflections about the day. Many focused on the games that were played and the opportunity to be outside (a few did not enjoy the games as much as being outside). 92% of participants indicated that they were happy and felt excited. • ***I learned that people are fun; sometimes in different ways! :)*** (Dana) • ***I learned that many, many jobs utilize STEM. I feel that the activities are great and engaging.*** (Dima) • ***I liked the "ideal" future idea quite a lot. I guess the name game with the circles was meh.*** (Darsah)
Day 3 - *Science Arcade Exhibit* - *Making a Video/DNA* - *OMNIMAX movie* - *Community Project*	The participants described the OMNIMAX experience enthusiastically, although some did not enjoy the movie. Learning about DNA seemed to be enjoyable for most. 92% of the participants stated that they were focused on what they were learning most of the time and over 86% stated that they did not daydream a lot all day. • ***I thought the dome movie about dinosaurs was a magical experience*** (Hamoon) • ***I enjoyed learning more about the past during the movie we watched at the theatre. The curved screen made it look great. I had fun while extracting the DNA from the strawberries.*** (Sira) • ***I liked making the video, and it was fun to finally start the slideshow for the innovation project. The movie was awesome, time went by so quick!*** (Faana)
Day 4 - *Human Edge Exhibit* - *DNA/Making a Video* - *Community Project* - *Heat in Action Presentation*	Again, all participants were happy and time went by very quickly for all but one of the participants, with very little daydreaming being recorded. The participants named other leaders that they were connecting with and described their enjoyment of all of the activities for the day. • ***It was fun to work on the community project and I loved the strawberry DNA experiment. I loved learning all those new things about our blood and I "liked" the human body exhibition (it was kinda creepy). Time did fly but it was fun.*** (Faana) • ***I learned about blood types which was cool. I rate today a 10/10 :)*** (Anbar) • ***The heat experiment was very exciting and fun. I wish we would get more break time. Not much, like 5-10 min more*** (Darsah)

Day/Main Activities	**Summary/Sample Comments**
Day 5 - *Micro:bit/Financial Literacy Presentation* - *Community Project* - *Video Game Presentation*	There was a dip in engagement on Day 5. This seemed to be associated with the activities of the day. Although 95% of the participants stated that they were happy, there were fewer 'YES!!' responses than seen on previous days. Participants still seemed to have enjoyed most of the activities. • ***Today was kind of boring I wish that we would do more experiments!*** (Dana) • ***I really enjoyed today and felt that the day started only a few minutes ago. I hope that I can continue to learn new things*** (Sira) • ***It felt fun learning to code, manage money, and videogames.*** (Reem)
Day 6 - *Van de Graaff Machine* - *Community Project/Animal Care* - *Spit for Science Presentation*	Participants were generally happy on Day 6 and time went by quickly for the majority. The extremes of responses were not selected as frequently as on prior days. The animal care activity was engaging for the majority and there had been little mention of the community project up to this point. • ***I loved helping Sick Kids hospital with the spit data. I felt like our community project was more like a task than an activity.*** (Hamoon) • ***I liked the spit for science and I got really scared in the animal exhibit.*** (Thara) • ***Today was really good especially the animals, the rabbit and chinchilla were my fav they were so cute!*** (Rukam)
Day 7 - *Voyage to the Deep Exhibit* - *Community Project* - *Code Emoji/ Public Speaking Presentation* - *Public Speaking Presentation/Code Emoji*	Comments from Day 7 were muted compared with other days, but most participants seemed to enjoy the activities. Participants, again, mentioned leaders by name and there was still little mention of the community project. • ***I really liked today when we did the shark tank thing with [Alex, leader] and [Ally, leader].*** (Sarrab) • ***Today was a excited day I learn how to make emoji.*** (Bahar) • ***I liked working on the emojies. I learned so much from coding, public speaking, and tic tac toe tactics. =) But can we go outside and play :)*** (Fanar)
Day 8 - *Deep Sea Adventure Show* - *Spit for Science Presentation* - *Community Project* - *Animation Presentation*	The participants may have got a little 'presentation fatigue' on Day 8. For some, the topics were really engaging (particularly animation), but others were just waiting to get back to their community project. The frequent changing of activity meant that even though individual activities may not have been very engaging, 89% of participants stated that time went by quickly. • ***I loved the show, I felt that it was really interactive. I thought the animation activity was boring.*** (Hamoon) • ***I liked listening to the guest speakers. Had fun doing animation and listening to the energetic presentation, felt fresh. And we finally went outside. =)*** (Fanar) • ***Today there were guest speakers (a lot) who came to talk to us. I mean although it was informational, I kinda got bored.*** (Thundi)
Day 9 - *Free Choice Exhibits* - *Community Project* - *Showcase*	There was an uptick in overall engagement on the final day, but some were disappointed in their own performance or the presentations of others. A number of presenters described themselves as being nervous. There were a lot of expressions of gratitude and desires to return to the program. • ***Today we presented our community projects and it was informative to hear about other people's solutions.*** (Thundi) • ***I am satisfied to be in this program, this is the kind of program youths like us need. I want to join again, but I'll be 15 =(Good job everyone =)*** (Reem) • ***This session of [TeenSTEM] was amazing. I learned a lot of things. And every day was jam packed with very cool things.*** (Rajani)

Figure 4

Snapshot summary of Session 2 survey responses from days 1, 5 and 9.

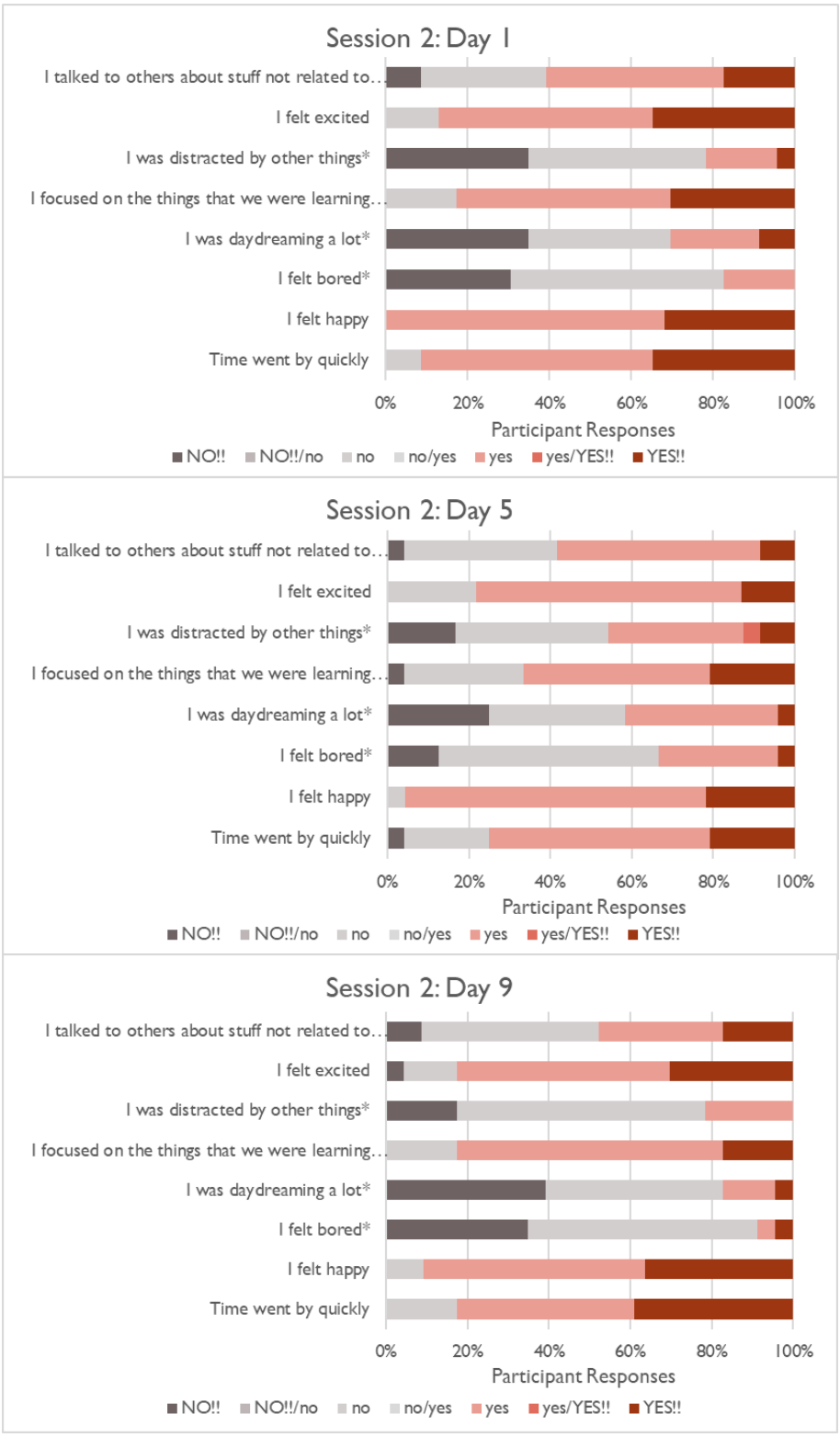
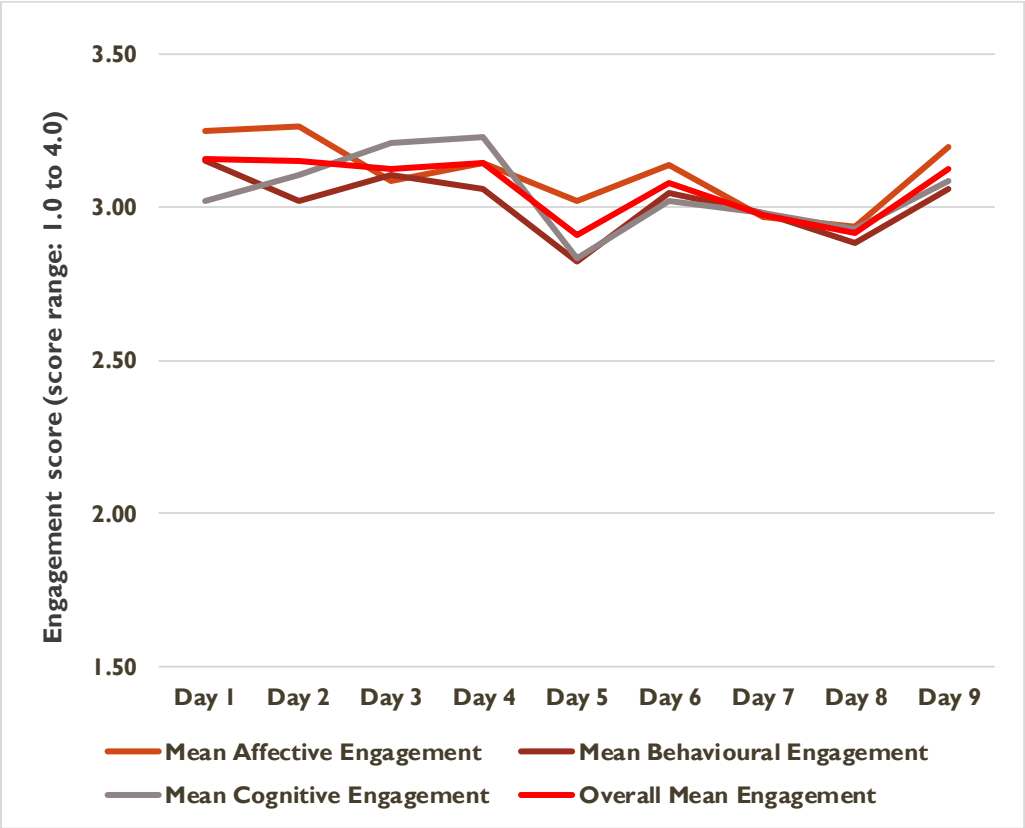


Figure 5

Session 2 average engagement in affective, behavioural, and cognitive dimensions over time



Session 2 Overview

Overall reports of engagement for Session 2 were positive across all days with over 70% positivity in all dimensions of engagement across all responses each day. 84% of responses for Session 2 indicated positive affective engagement at the end of each day. There were no particular peaks and troughs in engagement, although Day 5 (which was a Monday for this Session) showed a slight dip in all dimensions of engagement, as did Day 8 (the day before the showcase). Many comments referred to wanting to spend more time on the community project. The slight dip in engagement just before the final day may be due to anxiety associated with the presentation. There was no significant difference seen between the responses of girls and boys (the only two genders reported by participants) for any of the dimensions of engagement. There was a lot of positive commentary about the leaders for this session and a lot of appreciation for the variety of activities and the range of things to learn.

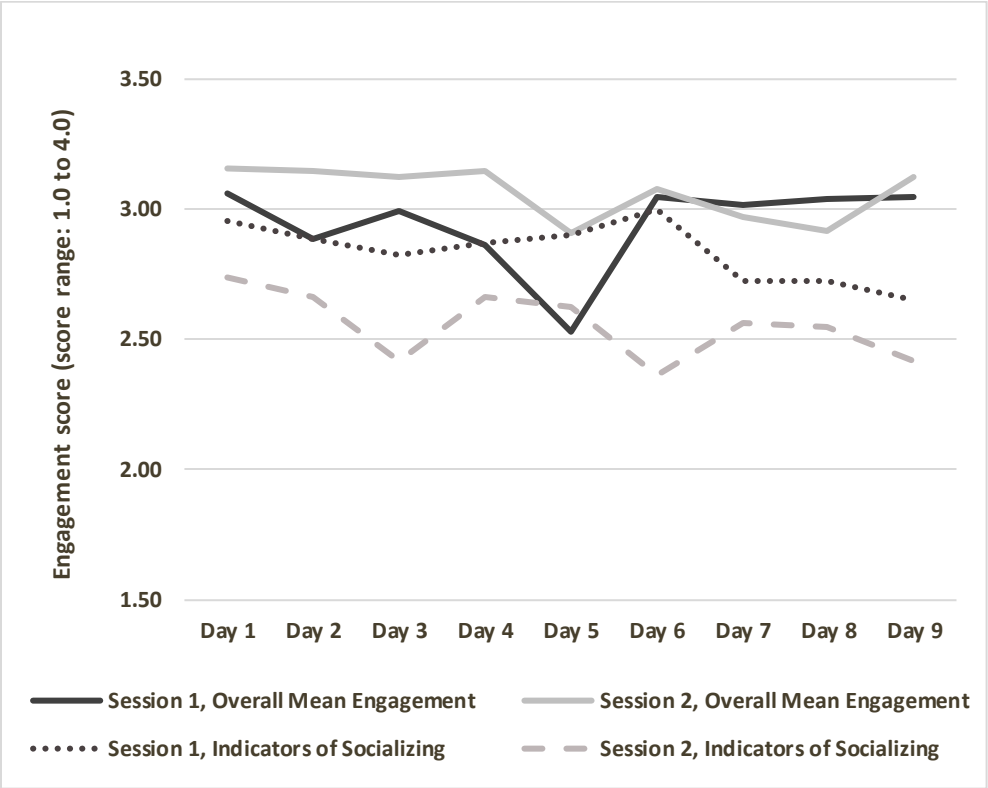
Quantitative Comparison of Session 1 and Session 2

The comparison of Session 1 and Session 2 responses provides a great opportunity to look at how personalities and day of the week might impact programming, particularly with respect to selection of activities and presentations/presenters. Compared with Session 1, the Session 2 participants were generally more expressive in their exit surveys. This might be due to the leaders being more prepared to end the day with this reflection activity (since this was the second time running the program). Completing the exit survey allowed youth to focus on what they learned and felt that day; for some, this seemed to help them reflect on day-to-day changes in their mood. Group 2 were more expressive in their descriptions of their relationships with the leaders, mentioning them by name multiple times. The community project did not seem to be emphasized as much during Session 2; this left some participants a little anxious during the final presentation. Session 2 participants described more of a uniform/consistent experience; this may have supported the youth in presenting a more balanced and reflective evaluation of each day's experience. On balance, it seems as if the pace was about right for both Sessions; participants were left wanting more, rather than being fed up with the experience.

Figure 5 illustrates the overall engagement pattern for the two Sessions. The overall pattern is similar for both, but Session 1 participants experienced more extremes of engagement; Session 2 participants reported a more even experience. Figure 5 also illustrates the overall pattern for statement 8 responses (*During today's activities, I talked to others about stuff not related to what we were learning*). We viewed statement 8 as indicating the degree of 'off topic' socializing participants engaged in. This was a higher average value across all days for Session 1 and the pattern for Session 2 was the inverse of the pattern for engagement for the group, i.e., the more engaged the participants were with the tasks, the less time they spend in socializing background talk.

Figure 6

Comparison of Session 1 and Session 2 average engagement and indicators of socializing over time

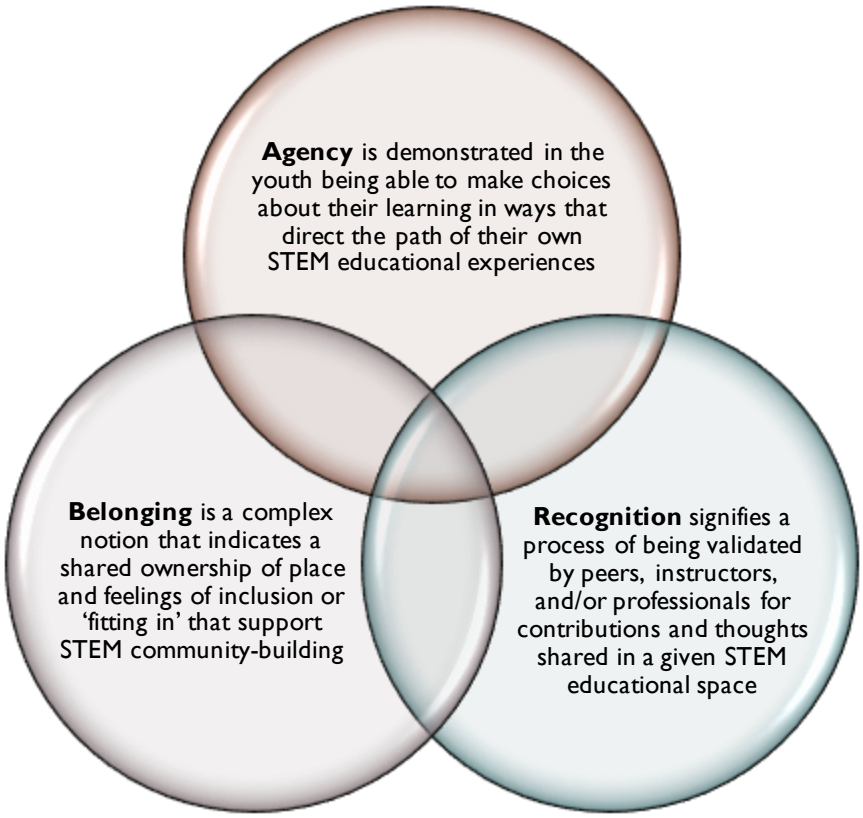


STEM Identity: Agency, Belonging, and Recognition

Small group interviews with youth took place on the weekday following the end of the program session (for Session 1, this was a Friday and for Session 2, this was a Monday). 14 youth from Session 1 and 17 youth from Session 2 (a total of 56% of the youth who attended Sessions 1 and 2) participated in the small group interviews. The youth were interviewed in small groups ranging in size from 2 to 6 youth. The interview questions asked the youth about their prior feelings about science, how they and important people in their lives felt about the youth being part of the TeenSTEM program, what relationships they developed during the program, and how they relate to science, scientists, and the Science Centre. The interviews ended with the youth making suggestions and recommendations for future iterations of the program. The audio-recorded interviews were transcribed verbatim and the interconnected engagement markers agency, belonging, and recognition were used to code the data to explore how youth identities played out within the context of the TeenSTEM program. Below, we provide a summary of some of the key program elements that nurtured youth engagement in ways that supported their identification with STEM. Figure 7 illustrates the dimensions of engagement used to explore STEM identity.

Figure 7

Framework for engaging STEM identities



Agency

Although the program was planned and timetabled by the program leaders, youth attendees were able to exercise a degree of agency in the ways that they interpreted the various activities, particularly the activities that contained competition elements, such as the Day 1 egg drop challenge and the Day 6 catapult-building warm up activity. Through these activities, youth used everyday items to plan, build, test and retest their models, while negotiating the dynamics of new peer groupings. In order to maintain pace and excitement levels during challenges, the program leaders would often provide youth with ideas, illustrations, or artefacts from other programs to get them started. Unfortunately, while youth often described themselves as exercising choice and making decisions during these activities, e.g., ***"Like, we built like a catapult with like a limited source of materials like popsicle sticks and a spoon and rubber band. And then we had to come up with, like, how to build it"*** (Rajani, Session 2), the research field notes described how providing these pointers tended to limit the abilities of the youth to engage their own imaginations and creativities, resulting in many similar approaches being taken and similar outcomes being generated.

It seemed to be particularly motivating for youth to be shown how to conduct experiments that could be replicated at home. The strongest example of this was the extraction of DNA from strawberries. Despite this process having a very specific protocol, the youth were equipped to exercise their agency as scientists when outside of the program space, a number remarking that they would like to repeat the experiment at home with the support of their family members: ***"I asked my mom about it and she tried to explain to me"*** (Keila, Session 1), and ***"[Shujana] said that it was really cool and that he could probably do it at home too … because a lot of the materials can be found at home already. He also added that his dad could help because he's a microbiologist"*** (Field notes, Session 2, Day 4). It was great to hear that some youth had opportunities to exercise STEM agency outside of the program due to existing community connections.

During activities where the structure was a little more relaxed, as with the micro:bit introductory coding session, youth were shown an array of things that could be done but were not given a procedure to follow. The field notes described some of the youth as struggling to figure out what to do. For some youth, the absence of a prescribed outcome and procedure resulted in them having space to tinker and explore (***"I also really love the coding. I always wanted to learn, and this year I've got like, you know, I got the basic stuff"*** [Asif, Session 2]), for other youth, the result was just confusion (***"Unfortunately, I could not relate with that because, once again, I am very bad at coding"*** [Faana, Session 2]).

Youth described their most passive (low agency) moments as being when they were receiving long, low-interaction presentations. For some youth, these presentations provided time and space for reflecting on possible career directions, for the majority, the energy level was just not high enough to captivate them: ***"One thing that I didn't really enjoy though, was like, like when people came in, I guess, like just like guests. Like, I guess it was kind of boring because they were just speaking, like, just, like, reading off the screen, basically"*** (Luban, Session 1). One illustration of this was during the video

game presentation. Although there were many participants who indicated that the topic was one of interest to them, the low energy delivery style impacted how youth related to the career of game design and to professionals who work in this field. However, for at least one participant, the rather labored, information-heavy delivery style provided him with space and insight to reflect on how someone with interests like his own navigates the place in STEM: ***"science encompasses a lot more than I originally thought, like game design … there was this one [a presentation] for the game designer where they like they went into like science and, like, went further on because they, like, they like games and they wanted to develop them. I like how fun that was."*** (Sira, Session 2).

The community project was an extended activity where youth described themselves as having a lot of freedom to explore the things that interested them and that were important within their community. The youth were guided in their selection of topics, according to themes that the leaders constructed first with and then for them. In order to represent their concerns and potential solutions, youth were able to use materials available in their workroom, or request specialist materials that the leaders would source (provided that they were relatively inexpensive). Youth seemed to have the impression that this project was allowing them to contribute to their communities through the work of the program sponsors (a large multinational financial organization), so they wanted to represent themselves and their community effectively: ***"I really felt like it was a job, like, something entitled to me, like, a responsibility that I had to do. So, like the presentation was, like, more, like, a community, like, job"*** (Hamoon, Session 2) and ***"Last year I was, I was, like, in because they also mentioned the Community project and I really wanted to have some sort of contribution to maybe offering a better way to improve our community here at [Macdonald Oaks]"*** (Bandu, Session 1). Another youth explained how that contribution might be made: ***"I think our project, like, [the funder] like, if they accept one of us, one of our projects and all the stuff, like, maybe there will be changes"*** (Arnab, Session 1).

Given this sense of responsibility to have their work represent community needs in an effective way, and the notion that they were working to get their project accepted by the funder, youth greatly appreciated the support provided by leaders in completing what seemed to be a competitive task. The project was described in a way that made it the focal point of the program:

> ***the staff, like when we were like doing the project. The community project like they were like, really supportive of us, like, they even helped us with the slides and all the project. Like they gave us stuff like, of course they would give us but, like, they were, like, they were, like, helping us and, like, they were, like, complimenting and that, like, that would, like, higher [raise] your confidence*** (Arnab, Session 1).

The community project will be examined in greater detail in a later section of this report.

Youth described their enjoyment of the freedom to explore the various exhibits, even if they were rather rushed in their explorations:

> ***whenever we would enter the place like a new place, for example, when we there, we would all be so curious, we would just run to see what it was there … but for, like, if we are going to, like, an exhibit, we're not really getting so much time to, you know, see more things we would like to just take 15 minutes?*** (Musqan, Session 1).

Youth described having visited the Science Centre multiple times as part of a school group, due to the proximity of their schools but, being part of an extra-curricular program seemed to carry an additional layer of freedom and excitement with regard to visiting the exhibits. One youth described how their desire to revisit an exhibit was satisfied: ***"there was an exhibit which we went to, I think on the first, on the third day, which I requested to go to again and on the last day they took us there"*** (Remal, Session 2). The element of gaining some behind-the-scenes access to exhibits, added an element to youth explorations that provided feelings of agency that had not been experienced through school visits.

When asked about how they might improve the program for future attendees, Sira described the value of being able to help himself navigate through the day. He explained:

> ***I'm thinking like at the start of the day, they tell everyone what we're going to do for that day because they did that the first day when I first entered, they told us exactly what we're going to do on it, on the board. Well, not told us they left it there and I could see it. But then the days after that, they stopped doing that and I feel like it was something really helpful, right? Because if you knew something was about to end, and also if you got left behind by accident, you'd know exactly where you gonna head next.*** (Sira, Session 2)

The parent of one of the other youth reinforced this idea stating that they thought the program was excellent but requesting just one small thing:

> ***If, like, in future, like, programs, right? If we can, as a parent, if we can get summary. Like, OK, we conducted, like, these many activities, especially activity names. Not like much detail. OK, we did this activity, this activity, this activity on so and so, so day so, other than regular activities, yeah that will be useful so that we can say OK if this is the activity then … if end of the week we can get [that] then we may get chance to discuss with our children like how was this program? How is this program that program so that we may get some input.*** (Parent Interview, Session 2)

We found that, within this highly structured program, youth were comfortable with the leaders defining the program's structure and content, but the youth might have benefitted from more opportunities to exercise agency, bringing their own ideas and concerns into the space, particularly with regard to their completion of the community project. Youth described ways of extending their learning beyond the program space, with the support of family members. While youth found spaces to exercise agency, a little more intentionality could have provided opportunities for youth to make choices that would allow them to pursue personal interests as might be seen by selecting activities, having materials to take home, and being given the opportunity to discuss upcoming activities with family members so that their out of program support and within program supports were more aligned.

Belonging

As indicated earlier, many of the youth had a background interest in science, but this was not the case for all of the youth. For some of the youth, it was their parents' prompting, and the parental desire for their children to develop belonging in multiple dimensions, that brought them to the TeenSTEM program:

> ***I send my son to [the TeenSTEM] program for him to be able have exposure in such kind of program, learn and gain knowledge about the importance of Science in our life and also to improve his social being and new friends. He wanted to go when it was known to him about the program … He said that before he does not enjoyed [science] and found it boring subject but now he has interest in it*** (Parent, Session 1)

A number of parents interviewed described their prior connection with the program through previous enrollment of older siblings or information received through local community networks. These community connections seemed to raise the legitimacy of the program for parents:

> ***we are in a moms group and it's a group of moms that's basically from my community … it is Pakistan like basically South Asia, Pakistan and Bangladesh, India, we we have a mom group or WhatsApp group. We generally share all these programs that we find. So they might have found it out from … [The Neighbourhood Organization], it's for mostly for immigrants*** (Parent, Session 2).

The same Session 2 parent went on to explain how they personally felt that they had a positive connection with one of the program managers who was described as 'hands on' in the way that they ran the introductory Zoom briefing and responded quickly when messaged. Indeed, this parent described how the organized way that things were being run, made her son feel **"like a grown up"** (Parent, Session 2) as he was attentive and made notes during the briefing meeting. The comfort of the parents with the program, supported youth in gaining their sense of belonging within the program. Indeed, parents and youth requested that the program be made longer: ***"[referring to a conversation with***

their child] he's like, why couldn't you put me in for two months? I said. They're, they don't have it for two months" (Parent, Session 2).

> ***I would want to increase the time that we're here, honestly, like, for like three or four weeks because that would be way better, like, you know. Plus, like, like [Ward, another youth in the interview group] said, we like, kind of felt rushed with the community project because even though everyone finished on time, it was like still a little bit, like, uncertain, like, rushed, you know.*** (Nivar, Session 1).

Having a dedicated room/home base within the Science Centre supported youth in their feelings of belonging as the space was theirs and those outside of their group could not enter unless invited, due to the self-locking door. Some youth requested that, for future TeenSTEM programs, a sign be put on the door to indicate that the room is only available to attendees at the TeenSTEM program as sometimes members of the general public made attempts to explore what was happening in the room. This defined program space, along with the specially designed shirt containing the program logo, enhanced the affinity of youth attendees with the Science Centre. This desire to maintain a connection with the Science Centre was described by ***"Even if I was like 30, I would just like still be in the [the TeenSTEM program] and wear, like, the shirt"*** (Asif, Session 1). This comment from Asif illustrated the significance of the special TeenSTEM shirt in supporting sense of belonging within the program for the youth. Managers also remarked how the youth turned up in their special shirts to attend the final Showcase event, even though they were not told to do, the youth just seemed to want to maintain that association with the program and the Science Centre.

In addition to the dedicated program space and shirt enhancing a sense of belonging for the youth, access to other areas, behind-the-scenes at the Science Centre, boosted that feeling of being part of something special. As described by Musqan ***"we got like the VIP treatment you know, the VIP, everyone was just looking at us most of the time, the people. So that was like really nice too"*** (Musqan, Session 1). Describing access to the animal care area, the youth knew that they were given access to a restricted area: ***"I think only staff are allowed there, like, camps, special camps"*** (Arnab, Session 1).

Almost without exception, youth expressed their joy when reflecting on the relationships they had developed through the program. Most youth could identify at least one or two people they had known previously (or seen at various times within the community) but described quickly making new friends. One notable exception to this trend was one of the youth in Session 1 (Akash) who, from day 1, was recorded in the field notes as sitting alone or being upset as a result of interactions with youth she had known from school. Leaders had been informed by a parent that the youth might find it difficult to make friends, and leaders were challenged to find ways to connect with and support Akash throughout the program. One participant, Bandu, noted what was happening to Akash in her group interview:

> ***There was this one group. I don't know if you guys like saw whatever, but they were making one of their groupmates like cry, remember? … They were like, crap talking about her when she was crying. And they're like, oh, she's such a cry baby … I just felt that was really***

> ***insensitive, like, she might be going through stuff and, and all that. But, I felt that the staff handled it really well, like, in the end, they really just kind of put them in line and stuff like that.*** (Bandu, Session 1).

Youth described how they valued being able to make connections with each other and the leaders. These connections were described most vividly by the Session 1 participants (revealed above to be a little more social than the Session 2 attendees). To illustrate the exuberance of their feelings in this regard, we share just a small selection of the sentiments expressed by the youth: ***"we split into groups and there I was split with two people I didn't really know that properly; you know, it became really fantastic. So, it's a good social experience and a learning experience"*** (Keila, Session 1), ***"it was easy to be friends and you know what type of person they are so it was easy to, like, communicate with them."*** (Luban, Session 1), ***"I love how I made new friends while keeping the ones I had"*** (Dima, Session 2), ***"There wasn't, really anything I enjoyed the least cause it was really fun overall I made new friends"*** (Jai, Session 1), and ***"I came with my friend together, so we both came together and we were thinking we would just stick to each other. But the collaboration the staff made and everything. So I forgot those, we both forgot"*** (Musqan, Session 1). A number of the youth described a special relationship with the leaders that supported them in feeling comfortable within the program: ***"they [the leaders] made me feel like I'm friends with them. They didn't make me feel like I'm, you know, they're just doing their job. They made me feel like a friend, actually friends with them"*** (Thane, Session 1). Expanding on the reasons for this comfort with the leaders, youth explained that they were delighted to find that there were staff with whom they shared a cultural background or other connection. Important facets of this leader/youth connection included language, religion, ethnicity, and familiarity with the Macdonald Oaks or King's Forest neighbourhood: ***"his name was Lowen. He was Muslim and he kind of had the same interests as I did coming from religion, so it was easier to connect with him and to have a small talk to him … sort of a friendship"*** (Keila, Session 1),

> ***She's [Rumi] like my older sister because we were, like, both, like, we pray to the same God and, like, a lot of people like in this area, we don't have a lot of Hindus like in this area. So, it's like a connection.*** (Hamoon, Session 2)

> ***Lowen is, like, from the same place as me and same religion too. So, I really connected with him and like I don't feel lonely. Like I'm the only one because he was there too, you know.*** (Rajani, Session 2)

> ***There wasn't, like, awkward conversation between us and, like, it was really nice talking to him and like he felt, like, he was like also Muslim. He felt like we were like already friends. We were already close and we already knew each other, but we, we just met him*** (Onil, Session 1)

Onil also explained how he wished he could stay connected with the leaders and others in his interview group agreed: ***"the counsellors were really nice to us. Like some, like, we play cards. We crack jokes. And yeah, I hope we keep in touch. But right now, we don't have any of their contacts"***

(Onil, Session 1). Indeed, a number of the youth revealed plans to be like the TeenSTEM leaders and apply to work at the Science Centre, first as volunteers then as program leaders themselves: ***"I kind of wish that it would be like some sort of thing where now it would be like easier for me to volunteer as like a TeenSTEM counselor or something. Like, since I've been at TeenSTEM it would be … a stepping stone or something"*** (Nivar, Session 1). Program leaders suggested that their abilities to connect with the youth might have been due to the fact that, as leaders, they were generally younger than other educational leaders in the lives of the youth (such as their school teachers or parents) and came from the same kinds of backgrounds as the youth, creating a relatability.

One of the youth, Bandu, described the different types of connection that she experienced with the leaders: ***"[Jordan] was actually like half French and I'm half French, so I was like, I was like, wow, another Frenchie. It's great"*** (Bandu, Session 1). Describing another leader (Tasi) Bandu continued:

> ***he was telling us how he used to live in [nickname for their neighbourhood] and stuff like that, like, it was great to know that it's not. It's not like it's not like, for example, he lives, let's say, like downtown, he knows nothing about the community or like most of the stuff, like, pretty close or like around the area and I really kind of appreciate that. Like, I'm not saying that people who don't live in the area can't be great staff, but I'm saying like it was a great.*** (Bandu, Session 1).

However, while connections could be made based on commonalities, they were not enough to carry the relationships. Bandu was a little reluctant to talk about one of the leaders, Alex, who was

> ***kind of like absent, but like, he didn't want to be there, to be honest … He would help and stuff like that. But like just his facial expression. We're all he just, like, he sounded like super tired. He's like, oh, I don't want to deal with these*** (Bandu, Session 1).

Thane described the same leader as having a similar ethnic background to her but she was not able to make a connection. It seemed as if interest in the youth and care for their situations went a long way to helping them to gain that sense of belonging, particularly as it related to the leaders. Indeed, leaders were described as being caring mediators when interpersonal relationships between the youth got out of hand and they handled moments of inappropriate behavior with discretion and sensitivity.

The youth described a set of rules (introduced by the leaders as 'ways to have fun' that all program attendees signed) that were designed to support the sense of belonging that youth felt, particularly with regard to their interactions with each other and the need to respect differences:

> ***we couldn't swear in front of the counselors, obviously, that would have been bad because that was one of the rules. Like probably like. Yeah. Like I feel like once we were amongst each other like it was OK, as long as no-one heard us*** (Ward, Session 1).

These rules were regularly revisited during the program, particularly to address any issues that seemed to be getting out of hand. The youth seemed to accept the rules and appreciated the one-to-one treatment when rules were broken, rather than being made an example in front of the group:

> ***if you were doing something that they that that wasn't like that they that wasn't that you weren't supposed to, they would just be like they tap you on the shoulder and be like, and they tell you, they tell it to you instead of like announcing it to everyone in the room. Like, hey, stop talking like it's because that's embarrassing, right?*** (Bandu, Session 1)

One particular exhibit, the Van de Graaff generator, was described in the field notes as severely restricting the ability of youth to experience the sense of belonging. It is common for educators working within spaces with European scientific traditions to illustrate the effects of the Van de Graaff machine by encouraging learners to place their hands on the dome and watch as their hair stands on end. This activity was repeated in the visit of TeenSTEM youth to this exhibit, but embarrassment ensued as the youth, many of whom were wearing a hijab, braids or heavily gelled hair, demonstrated reluctance to participate. There were few in this community group for whom this experience really catered.

Overall, it seemed to be the sense of belonging that made youth, and parents wish that the program was longer. The positivity associated with the program was based on multiple factors that included the proximity of the Science Centre, the confidence and familiarity that parents and youth had in the institution, the prior interest of the youth in science, and the status of the youth within the institution (as denoted by their special shirts). One parental interviewer exchange captured many of these facets: I don't want to be greedy and say it's like double the session 20 days.

Overall, the distinctive TeenSTEM shirt, dedicated workspace, and supportive and relatable leaders encouraged youth to experience a strong sense of belonging. The fact that most of the program leaders had attributes that aligned with the community experiences of the youth, reinforced the abilities of the youth to see the Science Centre as a natural extension of their community. This connection made them feel comfortable as they moved around the Science Centre and in their interactions with each other and the leaders. Indeed, many of the youth expressed the wish to maintain a relationship with the Science Centre by volunteering in the future. This desire for a pathway into STEM work that uses TeenSTEM as a springboard is something that could be nurtured for these youth so that their enthusiasm for and connection with STEM spaces could be maintained.

Recognition

The TeenSTEM program was established with a main activity (the community project) that foregrounded youth knowledge about and within their own community; therefore, the aim was to see youth being recognized or recognizing themselves for the ideas that they contributed within the program. During the small group interviews, youth were asked what other people say about them attending the TeenSTEM program and the responses were varied, depending on who they had spoken with. Many youth described

their parents being very happy that they had chosen to attend the program: ***"My mom was, like, happy that, like, it's something I took interest in. And she was like, just kind of like glad that I was, like, pursuing, like, my passions. So she was just happy I came overall"*** (Ward, Session 1). As with the majority of youth interviewed, Shujana described how the program was an extension of his prior interest in science; he went on to explain that he received important recognition of his learning each day when he returned home: ***"my mom asked, like, what did you learn today? Every day"*** (Shujana, Session 2). The active involvement of parents in support of their children's interest in science indicates a validation of the desires of youth attendees to continue their STEM learning. Indeed, many had found out about the program from their parents who heard and shared information about the program through their social/community networks. When referring to what peers thought about their participation in the program, many youth described their friends being either jealous that they got selected for the program or curious about what actually went on within the program. As described by Thane ***"one of my friends … they didn't get chosen. They signed up, but they didn't get chosen. And I got chosen. They were, like, very lucky you get to go there"*** (Thane, Session 1); similarly Jai stated ***"They ask if it's a job or if it's like, are you learning something in it? I think it's both. I think of it as it's both and like I really enjoy it because science is one of my favorite subjects"*** (Jai, Session 1).

Many youth mentioned being 'paid' to attend the program, and that seemed to raise participants' recognition of themselves as making important contributions to their community. The issue of being paid was mentioned numerous times during the interviews and, while youth were uncertain about exactly what they were being paid for, they seemed to gain a sense of pride in being selected to participate in a program that had a high profile because of the remuneration and the fact that it created connections with a highly recognized institution, the local Science Centre. The ability to use the experience to network was seen as important for the youth; as described by one parent:

> ***now she, she's saying that I'm very, very interested to just find a way to go … and work as a volunteer. I'm not sure about that, that sort of criteria, but she is still interested in to go there and work … She she's telling me that that I'm gonna go next year. I'm not sure that there is still such an opportunity, for the 8 grades in this area or not, this community or not. But she just ask me that you go ask the, the manager or whatever the staff who is working there. Ask that if it is possible for eight grades or seven grades, we gonna go to work there just three hours per day, you know*** (Parent, Session 1).

As described earlier, the notion of being paid raised the stakes for the showcase event. Youth responded by adopting more formal demeanors when placed in front of unfamiliar Science Centre staff and representatives from the funding organization. Youth worked hard to represent themselves well so that they would be recognized as knowledgeable members of their community. For some youth, this high-profile presentation context made them very nervous and critical of what they were able to achieve in two weeks: ***"we like kind of felt rushed with the community project because even though everyone finished on time, it was like still a little bit, like, uncertain, like, rushed, you know"*** (Nivar, Session 1).

The sense of responsibility that came with making presentations to funders seemed to shift how youth saw themselves within the program; some youth felt the pressure to present themselves as knowledgeable and mature, as described by the small group exchange below:

Rajani: ***I felt like a person who had, like, a responsibility, like he said. And then like, like, I was like a businessman making a presentation to, like, convince more people to take the solution, yeah.***

Remal: ***I enjoyed working on it. How kind of it felt like I had a deadline and something to do. Something that you work towards like kind of as a goal or something I had to finish.***

(Rajani & Remal, Session 2)

The STEM identity workshop presented by one of the program leaders was a great opportunity to reinforce the idea that 'science people' do not have to look a certain way; people from all walks of life can make amazing contributions to STEM. The youth were asked to draw a scientist (in order to reinforce the notion that scientists can look like anyone); it was unfortunate that, in their attempt to spark the imaginations of the youth, the leader provided prompts that reinforced stereotypes of a scientist in a lab coat and goggles. As described later in the leadership interview, leaders wished they had been more intentional about incorporating the names/work of scientists from non-European backgrounds; at the time of interview, leaders could not remember the name of the one ***"Islamic scientist"*** they mentioned within the workshop.

Leaders were generally very complimentary and encouraging of the youth's achievements; however, subtle language use would sometimes reinforce youth positionings as recipients of knowledge rather than knowledge builders in their own rights. As an example, the field notes recount an occasion where a leader was overheard telling one of the youth ***"it didn't need to be perfect because you're not an engineer"*** (Field notes, Session 2, Day 4). While we see that leaders making such comments were well-meaning, the remarks seemed out of place, and were rare, in a Science Centre context where youth knew that part of their 'work' was to position themselves as knowledgeable science participants, pitching a community-focused idea to funders.

As described earlier in this report, parents were keen to reinforce the value of the learning that their children were undertaking within the TeenSTEM program. Youth described their parents listening to them recount the day's activities when they got home. The invitation of parents to the all-session grand showcase event (not part of this research study) gave parents and other family members further opportunity to recognize their children as identifying strongly with their community and the Science Centre.

The brevity of this subsection indicates that there were fewer opportunities for authentic recognition as valid contributors to STEM than were seen in the belonging and agency elements of STEM identity. Although the youth received a lot of positive reinforcement of the value of their ideas and contributions within the program, there was no real change as a result of their 'work'. Youth gained the impression that their work was important, but it is unclear if this impression will be sustained in the absence of tangible impact. One aspect of recognition that was strongly reinforced throughout the program was parental acknowledgement of their child's enthusiasm for science and desire to stay connected to the work of the Science Centre.

EQUITY

This study responded to the *Minoritized Youth in STEM* report by exploring the enactment of the various equity priorities identified in the report. Program managers elected to track 5 out of the 10 program priorities identified in the report:

- Learners feeling supported and understood
- Nurturing natural curiosity
- Reinforcing real world connections
- Having relatable and representative role models for the learners
- Providing a sustained educational experience

To determine if or how these priorities were addressed within the program, the youth were explicitly asked about their experiences with each priority during the small group interviews. In addition, leaders and managers of the program were also asked about how they saw these priorities being demonstrated or incorporated into the design of the program. The comments for all participants were collated and are summarized below (priority was given to youth perspectives in each category). The final program priority (*Providing a Sustained Educational Experience*) was addressed using the program-long community project. Details of the project are provided in the *COMMUNITY CONNECTION* section of this report.

Learners Feeling Supported and Understood

- Very approachable program leaders who were not just seen as teachers but supportive in social and emotional ways
- Lots of praise and encouragement was given to the youth by program leaders; this affirmation was associated with the ideas that the youth expressed during all aspects of the program
- Youth were given encouragement to try things that might make them feel a little uncomfortable; this was illustrated in the pre-emptive group discussion that addressed how the youth might feel about presenting the findings from their community project
- Youth found the leaders very helpful and positive; this was not expected by all youth given that they were being paid to be there
- Some leaders were very intentional about learning names from Day 1 of the program
- Youth described feeling supported by peers, many of whom they had previously not known
- In a situation when peers were unsupportive, to the extent of making someone cry, intervention by the leaders was appreciated by youth who observed the situation, even if that intervention was a little late and was not initiated by the permanent program leaders
- Leaders worked hard to validate and reinforce any science-talk that the attendees had
- One youth felt comfortable enough to share that a family member had deceased during the program and openly discussed their complicated feelings with a leader

- Leaders confronted and banned the racially inappropriate language of one group of youth
- Competitive cliques had started to form within the first week so maybe it is good that the program did not last for more than two weeks; a longer program might require more switching of group configurations
- Leaders nudged youth toward completion of their projects in their own way, not necessarily in the directions that the leaders might have wished
- Leaders encouraged youth to get to know people they did not know before (the community project groups contained mixtures of old and new friends) and leaders helped the youth to navigate these new relationships by having multiple one-on-one conversations
- Leaders' abilities to understand the youth were often attributed to the leaders having similar cultural backgrounds or being familiar with the neighbourhoods where the youth lived
- As a leader, it was not enough to look the part, the leaders also had to be perceived by the youth as people who cared about the youth!

Nurturing Natural Curiosity

- Youth described seeing animals they had never seen before (some that they didn't know existed) and learning about them (e.g., sea urchin, chinchilla, snake, and turtle)
- Variety of relatively short activities allowed for varied interests to be piqued
- Community projects allowed for exploration of a particular topic that had relevance in the neighbourhoods of the youth
- Group configurations included a mixture of small group discussion (exploration among peers) and larger, whole group discussion (moderated by a leader who could ensure that a variety of voices were heard)
- Leaders were constantly probing to encourage participants to follow their interests and explore rather than just answering all their questions directly (giving them tools such as computer/Internet access) and positive reinforcement to find out for themselves as no leader would have enough knowledge to address all of their wonderings
- Following their own lines of curiosity was described by the youth as fun and not necessarily a deliberate quest to acquire knowledge
- Youth pursued numerous informal conversations with leaders and guests about science, STEM careers, and life (specific topics included discussions about university, being an engineer, experiences of being a volunteer at the Science Centre, etc.)
- Youth enjoyed moments of freedom to physically explore spaces within the Science Centre, sparking new curiosities about topics that they had never considered before, like the sea/ocean habitats, but found exhibit time too short
- Even if youth had participated in the program before, they found new ways to explore the activities and relationships they were developing at the Science Centre; leader expertise and preferences had a big impact on the planning and execution of activities for the youth

Reinforcing Real World Connections

- Youth treated the community project as a rich task with multiple starting points, lots of possible outcomes, lots of opportunity to investigate concepts they had not previously understood (like rent control and public transportation travel time/distance relationships), and opportunities to take an interdisciplinary approach (e.g., incorporating politics, environmental concerns, occupational links)
- Youth believed that they were presenting real community issues to people who could really do something about it but could have spent more time thinking about the feasibility/viability of their projects
- Youth had the opportunity to demonstrate knowledge they had gained from everyday life (like the high cost of rent, the plight of refugees, mental health concerns, parental job situations, immigration patterns, safety in school and in the community streets, etc.)
- Some of the workshops were specifically targeted toward real world experiences (such as finance, identity, public speaking, etc.); youth recalled some of the vivid illustrations like using balloons to illustrate juggling a range of life circumstances
- Some of the presentations built on interests that some youth already had (such as coding, gaming, or video production)
- Youth had opportunities to speak directly with people in the STEM field to understand what it took to get where they are in their careers
- Youth were able to talk freely with adults (program leaders and presenters) about the future stages in their trajectories (e.g., high school commitments, university stresses, household finances, etc.)

Having Relatable and Representative Role Models for the Learners

- Youth described having ethnicities that were similar to those of the leaders; this cultural connection seemed to support youth having confidence in being understood
- Some of the youth wanted to follow in the footsteps of some of the leaders, hoping to be leaders in the same way some day
- Many youth wanted to stay connected to the program leaders after the program had ended
- Some leaders/presenters were prepared to share vulnerabilities (such as academic failure) which youth found really relatable and authentic
- The program opened youth up to considering their potential in the careers of presenters
- One minority scientist was mentioned but this could have been expanded if intentionally planned
- Youth mentioned that shared cultural/religious backgrounds helped (i.e., the many Muslim youth in the group identified two Muslim leaders), but relatability was not reliant on racial/ethic connection, a vulnerability and sensitivity of leadership was required
- Leaders found that navigating the friend/leader space was challenging as some youth started being overfamiliar; youth were also looking to the leaders to resolve issues youth encountered with peers

COMMUNITY CONNECTION

In this section of the report, we focus on the community project that was designed to support the youth in seeing continuity between their interaction with the Science Centre and their lives within their community contexts. The data for this section came predominantly from interviews with program leaders and program managers but we reflect on perspectives presented by youth as described elsewhere in this report.

The Community Project

The community project was introduced to each cohort of youth by first recognizing the communities they came from (Macdonald Oaks and King's Forest), then throwing open a question about things that could be reduced, reused, or recycled within the community. After the large group discussion, youth were given time to work in small groups of 4 to 6 to come up with a list of things that concerned them within their community. Some of the concerns raised by youth included: gang violence and high crime rate, limited ability to access malls and grocery stores, school buildings that are old and crowded with limited equipment, the need for better recreation facilities, limited public transportation routes, poor access to electric vehicle chargers, insufficient ways to donate old goods, too many cars, poor housing, low number of clean water fountains, the Science Centre moving, high cost of household bills, limited access to medical professionals, drug use and the increase in the number of cannabis stores. Regarding this initial activity, one of the leaders (Rumi) explained that youth have differing levels of awareness of the issues within their community:

> ***Talking to a couple of the participants, there were some that, like, could define the problems, the equity issues that are in the community and, I think some of them couldn't. They're just not aware of it and that's really common for kids, like, this age. I grew up, like, in a similar neighbourhood with similar issues and parents, they either are very upfront with their kids about it, or they hide those issues right and they shield it because they don't want them to be very obvious to their children*** (Rumi, Leader).

Nevertheless, youth were readily able to relate to the concerns raised by others and were able to stay focused on their experiences within local community spaces when exploring the parameters of this project.

The leaders collated the suggestions made by the youth and assigned youth to smaller groups (of 2 to 4) based on the following themes: health, environmental pollution, environmental overcrowding, housing, electricity, transportation, schools, and vehicles. Youth worked within their individual project groups to refine their topics and investigate a more specific concern to which they could then propose a solution.

Each day of the program, time was dedicated to working on the community project. Field notes for both sessions indicated that most of the youth were unable to effectively evaluate the feasibility of the solutions they were suggesting and were not explicitly prompted to do so by the program leaders. Despite the challenges inherent in such an open-ended task, the youth approached the project with enthusiasm, as

they had many of the design challenges within the program, and they were eager to complete the task assigned.

The youth made their project presentations in front of program leaders, and other Science Centre staff on the final day of the program. An additional showcase event, to which funders and family members were also invited, was held later in the summer; youth from all three sessions were invited to present. The second showcase was not a data source for this research report. TeenSTEM community project topics for Session 1 and Session 2 are listed below.

Session 1 Issues/Solutions

- Poor quality housing/Eco-friendly apartments
- Pollution/Recycling incentive schemes
- Lack of safety on public transport/Security personnel
- Not enough youth spaces/Multipurpose youth recreation building
- Stress-related mental health issues/Youth therapy centre at the Science Centre
- Not enough youth hang out spaces/Dedicated recreation building
- Dangers while walking in the neighbourhood/Improved street lighting
- Trash on community streets/Community clean up team
- Violence in schools/Classroom redesign

Session 2 Issues/Solutions

- Transportation challenges/E-bike transportation
- The prevalence of dehydration/ Community water fountains
- Rising rent costs/owner and tenant support strategies
- High use and cost of bottled water/Homemade water filters
- High energy use/Solar panels
- High cost of housing/Ban on foreign investors
- Vehicular pollution/Energy reduction strategies
- Overcrowding in classrooms/Increased use of portable classrooms
- Lack of youth programs/Programs to build the social and life skills of youth
- High cost of public transportation/4 months free travel for youth aged 13-16

When considering the themes presented in the final showcase event, it is hard to find a clear connection between the STEM focus of the program, as reinforced by the program's location within the Science Centre, and the resultant products of two weeks of STEM exploration by the youth. In our interviews with the leaders and managers, we wondered if there was an intent to have a project that did not readily connect with the STEM theme of the other program elements. We asked about the overall purpose of the program and appreciated that each leader and manager had a slightly different perspective on the central goal of the program; to illustrate we share a few leader/manager perspectives:

> ***From my perspective, the aim of the program was to develop better and deeper ties with residents of our local community, the geographic local community, neighbours, and also to demystify some of the experiences the Science Center has to offer because of known or perceived distances between the local community and the Science Center itself that we are***

not attracting them as an audience. How can we invite them into our building and integrate them into our experiences" (Marion, Manager).

I think for me, personally, it was, it was to provide them with programming around the STEM base, but also provide them with the opportunity to connect with career paths that aren't traditionally known as STEM careers (Sam, Manager).

I think with the Community project and the themes we saw, like a lot of common themes throughout all the sessions and many of them were very similar and we didn't shut them down because it's like, obviously their experience, right, a kid in the first session sees littering as a problem, and they might have the same solution that the kid from session two has, and we didn't shut any of those down (Rumi, Leader).

While we see the value in each of the perspectives shared by program leaders and managers, we see how the youth (and perhaps some of the leaders) may have missed the STEM connection in the community project. We also see that each leader or manager had their own particular perspective on the aims of the program as it is likely that the focus when preparing the program was on what should be done, rather than making sure that all planners understood why the program was designed. Setting aside what appeared to be the absence of clear goals, the enthusiasm for youth to do something for their communities was evident:

> ***One thing I noticed was at the beginning when they were choosing an issue, and they chose it, it was kind of like, like, this is something we have to work on, but as they got further into the project and we started talking to them, they started like ramping it up, kind of like they got so passionate about it by the end and they really wanted to share it and it just, it forms a deeper connection between them and the issues in the community, because they have a further in-depth knowledge of it now and how it works, how to fix it*** (Jordan, Leader).

The leaders and managers also spoke about the youth attendee perceptions that funders were likely to select one or more of their projects for implementation. As described by one of the managers, the focus on funders and having the winning project may have obscured some of the goals of the activity:

> ***I think the idea that this is something you're gonna have to pitch to [the funders] was really heavily emphasized by the staff that were delivering the program. So, at some point, it felt more like, OK, how can I get [the funders] to give me money? More than it became, more than like, how can I benefit the community? … I think some of the more practical elements of the of the projects that they were working on were a little lost on them focusing on how do I get a donor to really buy into this project*** (Frankie, Manager)

We saw a missed opportunity for the youth to work with their communities by conducting community-based research with their own friends, family, and other connections so that community knowledge could be brought into the Science Centre to facilitate reciprocal learning. In addition, we saw that many youth were attempting to find solutions to 'wicked problems', for which there are no simple answers; working more closely with community members might also support youth in thinking through some of the issues in a more informed way.

IMPLICATIONS & RECOMMENDATIONS

This report summarizes our findings from a multi-method approach for exploring the strategies used by the TeenSTEM program to engage youth in an equitable, community-responsive way. We investigated program engagement from a youth-centred perspective and layered insights from parents, program leaders, and program managers to derive a rich picture of the experiences of youth within the program. Below, we reflect on the findings outlined above, and present thoughts that might inform TeenSTEM and other programs for future planning.

The daily/weekly schedule

The structured yet relaxed program environment helped youth to gain a sense of order while being in a more flexible space than school settings allow. The community contract regarding behaviour within the program was viewed by youth as a set of fair rules; when these are co-constructed and agreed upon by all parties, they can be effective ways to support a shared understanding of the guiding principles of engagement for the program. Leaders were intentional about giving youth opportunities to both connect with people they had known previously and build relationships with new friends. Each day contained a variety of activities, each of which was no more than 75 minutes in length; this kept the program interesting for the youth with few opportunities to get bored (unless the energy of the different activities was not balanced across the day). The end of the day reflective practice of completing surveys was a good way to help youth recall and reinforce what they were learning and would serve as a useful tool to help program leaders respond more flexibly to youth concerns from one day to the next. It might be useful to outline (in the first session and/or as a timetable that youth receive in their hands) a little of what the youth should expect in terms of variety and pace. This timetable could be accompanied by strategies the youth might employ if/when their concentration may be waning. Parents would benefit from having this kind of information upfront or as a means of reflection at the end of the program so that they can continue building on youth interests once the program is over. In addition, many youth and parents requested that the program be made longer, but the program demands a lot of the leaders who stated that two weeks was just about the right length to explore what is available at the Science Centre; perhaps, this also left the youth wanting more rather than running the risk of boring them. Leaders suggested that the program could be extended by one week if it incorporated visits to community sites and other locations outside of the Science Centre.

Selection of activities

The youth encountered a variety of activities that included ice-breaker games, small group experiments, workshops presented by internal and external speakers, exhibit exploration, behind-the-scenes experiences, and daily development of the community project. Varying the timing of each category of activity from one day to the next was helpful in keeping the program lively; however, there was scope for this timetable to be even more varied from day to day as we noted that many days ended with a fairly passive activity. Pacing and sequencing of activities is critical to maintain high engagement. Program

planners should consider scheduling more than one up-tempo activity on Fridays and alternating activities of differing pace and type throughout each day. The youth noted one or two presentations that for many ran too long, but we note that the youth were most engaged with presentations where the presenter shared insights into their journey through the STEM field, and where the youth felt that the presenter had passion for their chosen profession. As researchers, looking in on the program from the outside, we were not always able to see the coherence in the program and noted that there was no record of a central theme or objective being explained to the youth. As was expressed in the managers' interview, the program was somewhat disjointed and, while youth enjoyed all of the program's components, they did not really know why they were engaging in this particular combination of activities. We surmise that the program's purposes were to expose youth from two low-income communities to the range of STEM activities performed at their local Science Centre, allow them to explore a variety of STEM career pathways, and engage the youth in a project that will strengthen the connection between the Science Centre and neighbouring communities.

Relationships with program leaders

Youth connected with leaders due to the approachability of the leaders and their abilities to relate to the backgrounds and life experiences of the youth. The fact that leaders were youthful in appearance and attitude was also appreciated by the program attendees and supported relatability. The program leaders were valued by the youth for their roles as mentors, counsellors, friends, confidants, and a host of other roles. Most leaders served as role models to the youth (as stated by the youth); the rapport built during their informal conversations helped to build youth confidence in talking about sensitive issues such as their hopes, aspirations, and concerns in life. There were times when the leaders had to place their 'buddy' persona on the back burner so that behaviours could be addressed and the respect level within the program maintained. We note the importance of thoroughly preparing leaders to handle the socioemotional challenges that come with this early teenage stage of life.

Community connections

Participants enjoyed having dedicated time (particularly at the end of the day) to work on their chosen community projects. This block of time could be a fixed, predictable part of each day but we saw how varying the timing supported the overall balance of activities for each day. For many youth, anxieties were raised when thinking about presenting their project ideas to the program's funders. Many youth appreciated the opportunity to grow in the area of public speaking and their abilities to make presentations. Youth described a strong sense of pride in representing their communities and sharing their needs and concerns with the funders. As researchers, we were concerned to hear that so many of the youth thought that their projects might effect change within their communities and that the funders were attending the showcase in order to judge what projects to fund next. This miscommunication was very unfortunate, but youth seemed to connect the significance of the presentation to the stipend that they received for attending the program. It was regrettable that the two elements that brought the youth the greatest recognition for their participation (the funder presentation and the stipend) were the most misunderstood aspects of the program. Indeed, it was not just the youth who were confused about the purpose of the stipend; the program managers also described interactions with youth and parents asking

about payment. Managers explained that the stipend was provided to offset any costs that the family incurred or lost by sending the youth to the TeenSTEM program. This is a message that could have been conveyed more clearly to the youth and the leaders (all of whom seemed to be confused about the stipend's purpose). The other confusing aspect of the program for the research team was the fact that the community project did not have a STEM connection embedded. We understood that it might be challenging to emphasize a STEM focus if the program is also introducing youth to the various facets of STEM, but we wondered if it might be possible to get a little more coherence in the various elements of the program if the project and other activities were drawn together under a single theme. As an illustration, we saw that the components could be linked if the project required youth to design a new community-focused mini-exhibit for display within the Science Centre (we understand that something of this nature may have existed in a previous iteration of the program). All of the activities they experienced through the program, combined with their behind-the-scenes knowledge, could help them to gather insights into their design; the youth could canvass community input/ideas by having an activity where they ask a number of community members what kind of exhibit would represent their community's relationship with STEM. The project artefacts could be displayed somewhere in a free access area of the Science Centre so that community members could view them for a set period of time. Fundamentally, we encourage program managers to consider ways in which the program could become more responsive to the community and provide greater agency for youth and community members to influence the structure and fabric of the program. We saw how members of the community were invited into the Science Centre, but we wonder how the Science Centre might also go into the neighbouring communities and learn from the expertise that exists there.

Next steps for the youth

The program served as an excellent way to establish the place of the Science Centre in the lives of youth from the Macdonald Oaks and King's Forest neighbourhoods. The close connection of the community project to their everyday lives seemed to solidify the significance of the Science Centre in their communities. Youth and parents were keen to maintain the trajectory of this relationship by seeking further opportunities for the youth to engage with the Science Centre once the program had ended. Managers suggested that, outside of the summer camp season, it might be wise to consider how more sustained programming could be provided in afterschool or weekend timeslots throughout the school year. Youth suggested that they would like to volunteer or work at the Science Centre as soon as they are old enough. We wondered if there might be any pathways that would allow TeenSTEM alum opportunities to volunteer in programs designed for young children at the Science Centre. Youth interviewed in this study suggested that they would be keen to volunteer and then work in the same capacity as the leaders who had inspired them so much. Many of the youth attending the program were members of newcomer families in Canada and parents described seeing this opportunity as important to help their children make connections with Canadian professionals, both for the youth to be inspired and to start building their professional networks. While reflecting on the energy that youth brought to the program and their participation in the various aspects of this research, we wonder if the stipends might not be better used to 'employ' youth to be consultants or advisors for the Science Centre's TeenSTEM

program within their own communities. The youth attending this program demonstrated love for their communities and the Science Centre so, as a research team, we see how a delegation of these youth might work to support the Science Centre in their desire to become more responsive to the neighbouring community. The youth would be well situated to contribute to program planning and program support for future iterations of TeenSTEM and related programs.