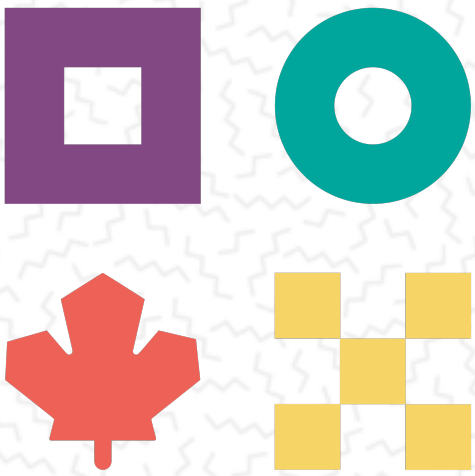
Teaching for the Digital Future:

Developing a Pan-Canadian K-12 Computer Science Framework

Industry Workshop

October 2019



Introduction

On October 9, 2019, the Framework Engagement and Development Team convened a group of 18 professionals with industry experience in education, technology, and innovation to discuss the future of Computer Science education in Canada.

The goal of this workshop was to collect feedback on our first Working Document, discuss the skills and competencies students should be learning to prepare for the digital workforce, and identify ways to collectively support the adoption integration of Computer Science in classrooms across the country.

Melissa Sariffodeen, Co-Founder and CEO of Canada Learning Code, began by welcoming participants to the workshop and introducing the project. Sariffodeen explained that Canada Learning Code launched the project based on the belief that all students should have access to high-quality Computer Science education. Sariffodeen explained that as technology becomes more embedded in the fabric of our lives, students need to be equipped with Computer Science skills in order to meet the needs of their time. However, she noted that current access to Computer Science education in Canada is inequitable. In some provinces and territories, all students are required to take a set number of Computer Science credits, whereas in others, some students take these classes as electives. In other instances, Computer Science courses are not offered as part of a curriculum at all.

Sariffodeen described that the Framework is an important first step to solving this problem. A Framework would create greater alignment in Computer Science outcomes for provinces and territories by presenting a vision for Computer Science education and providing a set of guidelines for what every Canadian student should know in order to navigate an increasingly digital world.

Laurie Drake, the Engagement and Development team lead, then explained how the Framework was being built. She highlighted that the Framework was being developed through an extensive engagement process that brought together people with a wide range of experiences including policymakers, teachers, and people who work in the tech industry.

Drake then reviewed the project's first working document, Teaching for the Digital Future: Developing a Pan-Canadian K-12 Computer Science Framework. She also presented the five core components that they had identified as being critical to their understanding of Computer Science education: Digital Artifacts, Computing, Big Data, Technology and Society and Design.

Following Drake's presentation, the participants had an opportunity to ask questions to both Sariffodeen and Drake.

For the remainder of the workshop, participants worked with a facilitator in groups of four or five to answer the following questions:

- How can we refine and improve our vision for Computer Science education?
- What have we missed?
- What Computer Science skills and competencies should all Canadian students learn?
- What is your most audacious idea for improving Computer Science education?
- How can we collectively support the adoption and implementation of Computer Science in the classroom?

A summary of their discussion follows.


Teaching for the Digital Future
Developing a Pan-Canadian K-12 Computer Science

Summary of Discussion

1) How can we refine and improve our vision for Computer Science education?

Demystify Computer Science

There is a preconceived notion that Computer Science is a scary, technical, and difficult discipline. Participants felt that these perceptions often dissuade people from studying Computer Science.

To address this issue, some participants suggested that this Framework be used as an opportunity to position the discipline as fun and creative. Some participants also cautioned against using the term Computer Science altogether in the Framework as they felt it was too technical.

Inspire Students to Pursue a Career in Tech by Promoting Opportunities for Mentorship

Participants thought it was important to give context to possible technology-related careers and suggested that this Framework should introduce mentorship opportunities to inspire students to pursue these careers. They pointed out that mentorship opportunities would also make Computer Science learning more relatable and help students to appreciate the breadth of career opportunities in the field (such as social media, video game development, project management, marketing, etc.).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2) What are we missing?

Help Students Become Better Consumers of Technology as well as Creators

Some participants felt that the Framework might be too focused on job-preparedness and needed to also articulate how it would improve basic digital literacy for all students - especially for early learners. They felt that this was an important consideration for the Framework's adoption across Canada given that most education systems in the country focus on teaching students foundational knowledge first from Kindergarten to Grade 9, and more advanced concepts and skills training are often only introduced in Grade 10 and onwards.

Participants also pointed out that while many students may not pursue technology-based careers, all students will be expected to know how to *use* technology. Participants also felt that students should be acquiring skills in critical thinking and ethical decision-making, noting that as technology-use grows, people will be confronted with greater digital dilemmas relating to privacy, misinformation, and/or the inappropriate use of technology.

However, a few participants cautioned against an over-emphasis on digital literacy, noting that while it is important for students to learn how to use these tools, Computer Science education, which entails learning how these tools fundamentally function, should be the goal.

Computer Science Education is Versatile

Participants felt that this Framework could do more to promote the versatility of Computer Science learning. They noted that Computer Science can provide students with transferable skills, such as design, critical thinking, and analysis, which are used in many different professions.

Speak with Privacy Officers

Participants appreciated that the Framework is being developed in consultation with policy-makers, teachers, and industry professionals. However, given that this Framework entails wide-scale in-class adoption of technology, participants felt it was important to ensure that students and teachers fully understand the associated privacy implications of learning Computer Science in a classroom. They therefore

advised that the Framework Development and Engagement team speak with privacy officers, highlighting the important role they play in digital literacy.

3) What Computer Science skills and competencies should all Canadian students learn?

Based on the feedback we received, we concluded that students should be learning skills and competencies from the following **three** buckets:

a) **Concepts**
b) **Capacities**
c) **Dispositions**

a. Concepts

Data Literacy and Mathematics

Some participants felt that students require a stronger foundation in mathematics, data literacy, statistics, and research methods to be adequately prepared for a technology-related career. They felt that students often lack statistical thinking and logical reasoning skills that would enable them to excel in a technology-related career. Participants recommended looking at the mathematics curricula of other countries that produce a higher proportion of graduates who enter technology-related careers to better understand how we can integrate these concepts into Computer Science learning.

The History of Computer Science

To make Computer Science more accessible and interesting to students, many participants suggested that students should be learning the history of Computer Science and innovation and the ways these technologies were developed.

The Social Impact of Technology

Some participants noted that new technologies, especially artificial intelligence, have the potential to aggravate existing marginalities and inequities because they're often built on datasets that aren't representative of the full population. Participants therefore suggested that through this Framework, students should learn about social theories such as feminist theory or theories of class. Participants felt that this will ensure that future technology creators produce representative data sources and accessible digital tools. Teaching social theories also ensures that

students appreciate the value of diversity and representation at work. This is especially important within technology-related careers where diversity is often lacking.

Basic Digital Tools

Participants noted that many entry-level professionals currently lack a sufficient understanding of basic digital tools such as word processing and data management (spreadsheet) tools. They noted that all students, regardless of their careers, will be expected to know how to use these tools now and in the future.

Research

Some participants felt that students should learn how to be resourceful and where to find answers to problems. Other participants similarly felt that students need to learn how to articulate a problem and ask appropriate questions.

b. Capacites

Critical Thinking

Participants noted that through this Framework, students should be learning about the social, legal, ethical, and political implications of technology. Participants also felt that students should develop the skills to articulate how their daily lives are affected by technology, social media, and marketing.

Ethical Thinking

Some participants indicated that the technology sector is too focused on creating disruptive technologies while failing to understand their consequences. They felt that students should constantly be learning about how technology impacts society, what it means to be ethical users and creators, how to protect people from the dangers of technology, and how to make sound ethical decisions.

c. Dispositions

Curiosity and Discovery

Participants recommended that Computer Science education should inspire children to learn about and try to tackle real-world problems with technology. For early learners, participants noted that children are often driven by curiosity, which enables them to try new things and master new skills. They also noted that early

learners are often driven to solve problems at scale and care deeply about social issues.

Comfort With Failure

Participants suggested that Computer Science education promote resiliency and help students to become more comfortable with failure. Participants widely noted that the creation of good technology depends on a process of trial and error. However, too often students are afraid to fail because the education system is structured to prevent students from doing so and it even penalizes them when they do fail. This can make students more risk-averse and hesitant to try new things and can ultimately stifle innovation and the creation of new technologies.

4) What is your most audacious idea for improving Computer Science education?

Start Small

Many participants suggested the following ideas to establish early adoption of a Computer Science learning Framework:

1) Start with teachers: Participants noted the significant role that teachers will have as future end-users as well as their role in influencing education policy. They therefore recommended that this Framework be introduced early to teachers by providing them with tools that make it easy to bring Computer Science learning to the classroom.
2) Make it co-curricular: Some participants suggested offering Computer Science learning first as an extra-curricular option in some schools before adopting it across Canada.
3) Partner with private sector: Some participants suggested that private sector organizations should lead the implementation of this Framework by offering workshops to students.

Embed Computer Science with Other Subjects

Some participants noted that Computer Science should improve how other subjects are learned and taught. For example, a few participants recommended that Computer Science be embedded in other subject areas such as English and Science as a learning tool.

However, a few participants cautioned that it may be unfair to expect non-Computer Science teachers to fully integrate Computer Science into existing subjects. They instead suggested illustrating possible connections between these subjects and Computer Science learning.

Shift Away From The Traditional Teaching model

Many participants felt that the traditional lecture model of teaching needed to be altered to provide a more hands-on and collaborative learning experience. They made the following suggestions:

- Some participants cited the particular value of hack-a-thons within the private sector and suggested adopting this method within the classroom as a collaborative learning tool to understand and address real-world

challenges. Others also suggested having hack-a-thon competitions between schools.

- A few participants endorsed facilitating the creation of mentorship opportunities for students across Canada.

Prototype the Framework Early

The fact that no one province or jurisdiction has introduced a comprehensive Computer Science curriculum was seen as a benefit by some participants who suggested that we prototype it, test it, and refine it as we're promoting its implementation.

Build a Pet Robot

Participants noted that students enjoy creating and building artifacts and suggested that students in early grades should build a robot together. In addition to learning how to code, this particular activity will enable students to see the physical rewards of their work, envision the potential of technology, learn to work collaboratively together, and spark further curiosity to pursue future Computer Science classes and subjects.


Discussion Questions

5) How can we collectively support the adoption and implementation of Computer Science in the classroom?

Teach the Teachers

To ensure the adoption of Computer Science in the classroom, participants suggested offering workshops targeted at existing teachers to teach them how to bring Computer Science learning to their classrooms.

Equip Schools with Technology

Participants noted the importance of having technology (such as computers, tablets, updated software, etc.) in classrooms to enable Computer Science learning. Some participants recommended establishing programs to donate technologies to schools while others suggested partnering with private sector organizations.

Establish Peer Education and Mentorship Programs

Some participants noted the significance of peer education and the impact it has for early learners. They suggested that peer education programs be established to bring Computer Science learning into the classroom. Other participants noted that these programs should also include mentorship opportunities for students.

Develop a Strong Public Engagement Plan

In discussing the implementation of the Framework, some participants noted the importance of raising public awareness of Computer Science education to ensure public buy-in. They felt that it was crucial to clearly communicate how Computer Science improves student performance in all subjects and how it prepares them for future work.

Encourage the Private Sector to Lead

Many participants felt that the private sector could play a particularly important role in implementing a Computer Science education Framework. They noted that as creators of big technology, it is their responsibility to prepare future workers and future consumers. Some participants suggested connecting with groups or companies already working with schools to improve digital literacy and teaming up with them to test early lesson plans or material.

However, a few participants felt that Computer Science learning should be the responsibility of professional educators who are not driven by profit but rather, the prospect of instilling life-long skills.

Other Suggestions and Comments:

- Grade 10-12 skills and competencies should be flexible enough to meet the economic needs of a future which are not yet known.
- The Framework Development and Engagement team should also speak with Parents.
- For early education:
    - Focus on and somehow integrate tactile learning opportunities to teach basic Computer Science concepts.
    - Use science fiction to excite students and motivate them to learn about Computer Science and the "art of the possible." This will encourage them to think creatively about the future.
- Students should also be learning the following topics:
    - User experience
    - Design thinking
    - Logic
    - Sequencing
    - Storytelling
    - Stepwise thinking (solving a problem by working backwards).
- Make life-long learning a key principle of the Framework.
- Reconsider the term "digital artifacts" as a core learning concept.

Next Steps

The feedback gathered from this session will help us refine our First Working Document and will support the development of the Second Working Document, which we will publish in 2020.

All feedback collected throughout the project will ultimately help us create Teaching for the Digital Future: A Pan-Canadian K-12 Computer Science Framework, which we will release in Spring 2020.

If you have any questions or would like to contribute to the engagement process, send us an email at: csframework@canadalearningcode.ca

For more information about the project, please visit our website: k12csframework.ca

Check out our other reports at k12csframework.ca:

- Teaching for the Digital Future: Findings from our Staff Engagement Workshop (July2019)
- Teaching for the Digital Future: Findings from TeacherCon Workshops (September 2019)
- Teaching for the Digital Future: Online Survey Feedback (October 2019)


Discussion Questions

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