CANADIAN TEACHERS' READINESS FOR STEM EDUCATION

Results from Actua's National Survey of Teachers

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HIGHLIGHTS

- Actua conducted a national survey of elementary and middle school teachers about STEM skills and knowledge, digital literacy, and opportunities for professional development.

- **9 in 10 teachers believe that STEM skills and knowledge are important to students' future education, careers and being an informed citizen,** and say that it is important for teachers to develop these skills among their students.

- **94 percent of teachers agree (46 percent) or strongly agree (48 percent) that there is room to improve their own STEM and digital skills,** but only 25 percent of elementary teachers and 42 percent of middle school teachers are aware of development opportunities currently available to them. Lack of awareness of opportunities is widespread, but especially acute among elementary school teachers.

- A little more than half of teachers participated in STEM or digital skills professional development of some kind over the past 12 months, including informal self-directed reading and learning. But only one third participated in more formal workshops, and only 1 in 5 participated in a course or conference on either STEM or digital skills.

- Teachers whose education included a STEM component are much more likely to have participated in STEM professional development than those without a STEM education.

- **Teachers would like to do more STEM and digital skills professional development but face barriers** – including limited opportunities (50 percent), lack of time (39 percent) and cost (32 percent).

- Teachers prefer in-person to online professional development, but 9 in 10 say that online formats would be very or somewhat helpful to their STEM and digital skills development.

Canadian educators know that science, technology, engineering and math (STEM) skills and knowledge, and digital literacy, are important to students' future education, careers and citizenship. While some students will pursue STEM-specific pathways and require advanced skills and knowledge, all students need a sufficient grasp of core principles and applications of STEM to succeed in life and careers – including using computers, software and other technologies effectively and safely.

While we know that youth need STEM and digital skills, we know little about Canadian educators' confidence and ability to teach STEM and digital skills. Nor do we know much about teachers' access to and participation in STEM professional development, the barriers they face, and the subjects and formats they would find most helpful.

Actua conducted a national survey in 2020 to fill in the gaps. We surveyed the perspectives of 507 elementary (Grades 1-6) and middle school (Grades 7-9) teachers from all provinces in Canada about:

- how important they believe STEM skills and knowledge are to their students' future education, careers and being an informed citizen;
- how well-equipped and confident they feel about their ability to teach STEM and digital skills in their classrooms;
- their interest in improving their own STEM skills and knowledge, and digital literacy, to better teach those subjects;
- their sense of the availability and quality of STEM and digital skills professional development opportunities and barriers they face to pursuing them; and
- their views about what additional STEM and digital skills learning opportunities and formats would best suit their needs and interests.

Having a clear picture of educators' interest in and opportunities to further develop STEM and digital skills for teaching allows us to better identify where more focused support and action is needed to improve options for teachers and students in Canada.

ABOUT THE SURVEY

Actua commissioned Abacus Data to conduct a survey of 507 elementary and middle school teachers (grades 1 to 9) in Canada. Responses were collected from April 29 to May 21, 2020 using a mixed-method sampling strategy, with participants recruited through a panel provider and LinkedIn InMail. The data was weighted to align with census data to ensure that the sample matched Canada's educator population by gender and region. The margin of error for a comparable probability-based random sample of the same size is +/- 4.3%, 19 times out of 20.

The respondent pool has the following characteristics:

- 78 percent are elementary grade (1 to 6) and 22 percent are middle grade (7 to 9) teachers.
- 40 percent have 5 or fewer years of teaching experience, 25 percent have between 6 and 10 years, and 26 percent have 11 or more years.
- About half (53 percent) are "general classroom teachers", while others identify arts education (11 percent), language arts or foreign languages (11 percent), or math or science (10 percent) as their primary teaching subject. The remaining 15 percent teach physical education, social studies, business studies, technology or another subject.
- 36 percent identified as men, 62 percent as women, and 2 percent preferred to not say.

We developed our survey questions to fill gaps in existing data sources and to allow for comparisons with two previous surveys – the OECD's Teaching and Learning International Survey (TALIS) and a survey conducted as part of the Toronto District School Board's (TDSB) K-12 STEM strategy.[1] The OECD's TALIS survey was conducted in 2013, sampled middle school teachers in Alberta only (n=1,773), and covered a wide range of professional and professional development topics. The TDSB's survey was conducted in 2016, sampled K-12 teachers in Toronto only (n=80), but focused more specifically on STEM education and professional development. Our survey, conducted in 2020, covers all regions of Canada and focuses specifically on STEM skills and knowledge, digital literacy, and professional development.

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[1] E. Sinay, K. Jaipal-Jamani, A. Nahornick, M. Douglin, STEM teaching and learning in the Toronto District School Board: Towards a strong theoretical foundation and scaling up from initial implementation of the K-12 STEM strategy. Research Report No. 15/16-16 (Toronto: Toronto District School Board, 2016); Alberta. Teaching and Learning International Survey (TALIS) 2013: Alberta Report. https://education.alberta.ca/media/1224454/talis-2013-alberta-report.pdf.

WHAT ARE STEM SKILLS AND KNOWLEDGE, AND DIGITAL LITERACY?

- Our survey asks educators about their confidence and capacity to teach, and their professional development opportunities to improve, STEM skills and knowledge, and digital literacy. But what are STEM skills and knowledge, and digital literacy?

- STEM is an acronym for science, technology, engineering and math. By **STEM skills and knowledge**, we mean an understanding of key principles of the scientific method and core insights and methods in each of the STEM fields. By **digital literacy,** we mean an understanding of the ways that technologies are designed and built, a capacity to design or improve digital technologies, and an understanding of how they can be used productively and safely. This includes, but is not limited to, coding. In both cases, one can have STEM skills and knowledge that range from basic to advanced - that is, from sufficient skills and knowledge to live and work generally - to skills and knowledge needed to pursue a career in a specific STEM-related field, such as medicine or engineering.

- Additionally, **STEM skills and knowledge, and digital literacy, refer to mindsets and ways of thinking that educators and students can bring to any challenge or opportunity.** This includes logical and computational thinking, measurement, analysis, testing and adapting, problem-solving and approaching projects and problems through an interdisciplinary lens that encourages integrated thinking, building and improving. Critically, STEM and digital mindsets and experiences help people recognize that many activities involve trial, error and re-trying and facilitate the development of patience and perseverance in the face of challenges.

- Living and working in a rapidly changing society and economy requires that all people have a set of basic science and technology skills and knowledge, as well as a capacity to learn new knowledge and skills throughout their careers and lives. It is also important that some people have advanced expertise in specific areas of science and technology to support basic research and applied excellence in health and medicine, infrastructure and engineering, social policy and programming, and innovation in industry, government and non-profit organizations.
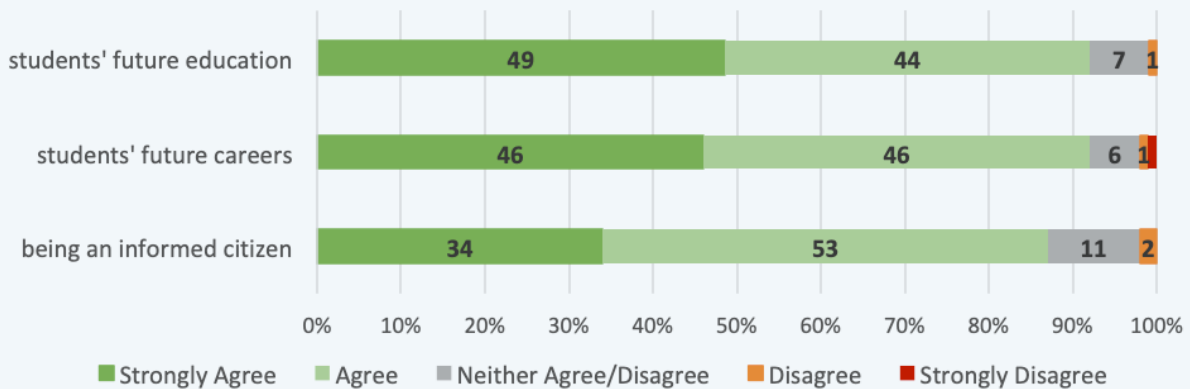
WHAT WE LEARNED

Teachers Believe STEM Skills are Important for Student Success

Canadian teachers believe that STEM skills and knowledge are important to students' **future education**, careers and citizenship. More than 9 in 10 teachers agree (44 percent) or strongly agree (49 percent) that STEM skills and knowledge are important to students' future education, and agree (46 percent) or strongly agree (46 percent) that they are important to students' **future careers** (Chart 1). 87 percent of teachers also agree (53 percent) or strongly agree (34 percent) that STEM skills and knowledge are important for being an **informed citizen.**

CHART 1

Teachers believe that STEM skills and knowledge are important to... (percent)

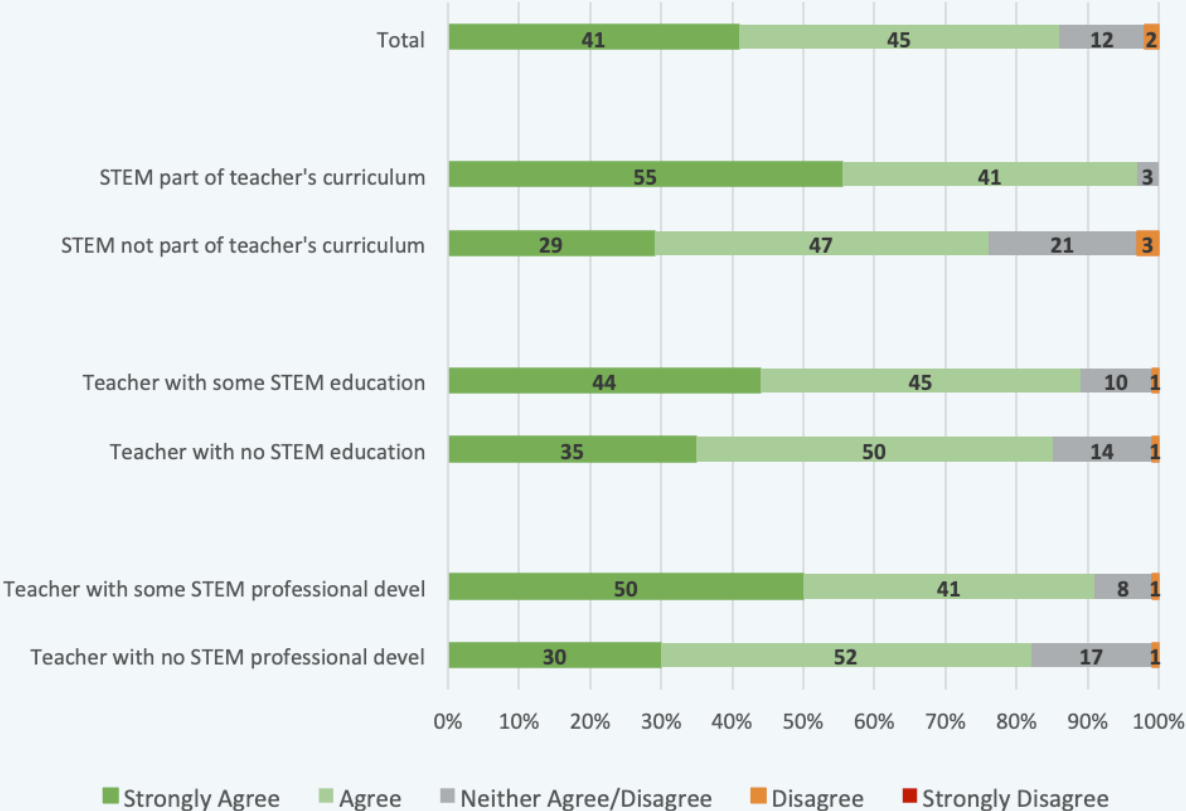|	Strongly Agree	Agree	Neither Agree/Disagree	Disagree	Strongly Disagree
students' future education	49	44	7	1	
students' future careers	46	46	6	1	
being an informed citizen	34	53	11	2	

9 in 10 teachers believe that STEM skills and knowledge are important to students' future education.

An almost equal number of teachers agree (45 percent) or strongly agree (41 percent) that **developing STEM skills and knowledge among their students** is important. (Chart 2). There are some differences that track teachers' unique experiences. For example, 96 percent of teachers whose curriculum includes STEM say that developing STEM skills among their students is important versus 76 percent of those whose curriculum does not include STEM. Similarly, while 91 percent who have participated in STEM professional development activities say developing STEM skills is important, this slips to 82 percent among those who have not participated in STEM professional development.

Whether students pursue STEM-specific education and career paths or not, teachers recognize that STEM skills are important for students' future success and agree that developing these skills among their students is part of their role as educators.

CHART 2

Developing STEM skills and knowledge among my students is important to me as an educator. (percent)

Category	Strongly Agree	Agree	Neither Agree/Disagree	Disagree
Total	41	45	12	2
STEM part of teacher's curriculum	55	41		3
STEM not part of teacher's curriculum	29	47	21	3
Teacher with some STEM education	44	45	10	1
Teacher with no STEM education	35	50	14	1
Teacher with some STEM professional devel	50	41	8	1
Teacher with no STEM professional devel	30	52	17	1

■ Strongly Agree ■ Agree ■ Neither Agree/Disagree ■ Disagree ■ Strongly Disagree

CONFIDENCE AND CAPACITY TO TEACH STEM AND DIGITAL SKILLS

Nearly all teachers say that STEM skills and knowledge are important and some believe they have the capacity and confidence to teach those skills. But there are also many who do not feel fully confident and competent. Improving confidence and competence is critical to ensure that students have well-equipped and confident teachers from whom they can learn.
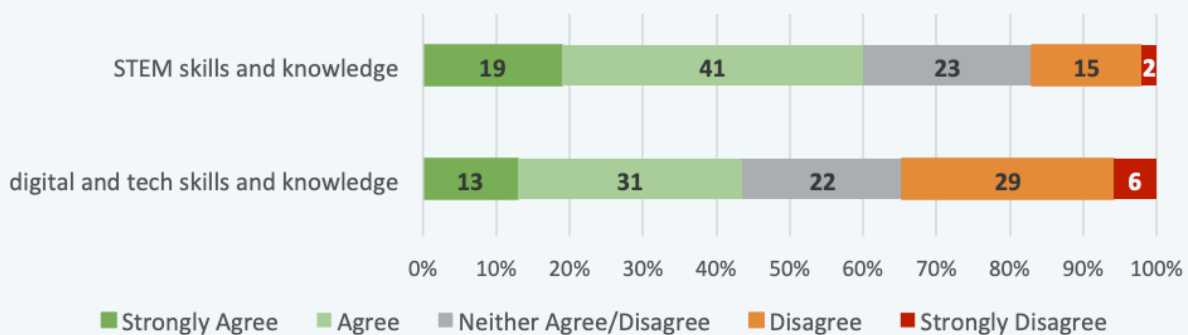
CONFIDENCE

60 percent of teachers say that they have the confidence to teach STEM skills and knowledge, while 17 say they do not, and 23 percent are unsure. (Chart 3). Differences in confidence track teacher characteristics, education and experience:

- Women teachers (20 percent) are **more likely to say they lack confidence in their ability to teach STEM** skills and knowledge than men teachers (7 percent).

- Teachers whose curriculum does not include STEM are **more likely to say they lack confidence to teach STEM** skills and knowledge (26 percent) than teachers who do include STEM in their curriculum (8 percent).

- Teachers with no STEM component in their pre-service education are **more likely to say they lack confidence to teach STEM** (22 percent) than teachers who do have a STEM education background (13 percent).

CHART 3

I am confident in my ability to teach my students... (percent)

Category	Strongly Agree	Agree	Neither Agree/Disagree	Disagree	Strongly Disagree
STEM skills and knowledge	19	41	23	15	2
digital and tech skills and knowledge	13	31	22	29	6

Legend: ■ Strongly Agree ■ Agree ■ Neither Agree/Disagree ■ Disagree ■ Strongly Disagree

Meanwhile, less than half of teachers (44 percent) say that they have the confidence to teach digital and technology skills and knowledge (such as coding) to students. (Chart 3). 35 percent say they are not confident and 22 percent are unsure.

Differences in confidence to teach digital and technology skills also track teacher characteristics, education and experience:

- Women teachers (39 percent) are **more likely to say they lack confidence in their ability to teach digital and technology** skills than men teachers (19 percent).

- Teachers who do not have STEM as part of their curriculum are **more likely to say they lack confidence to teach digital and technology skills** (45 percent) than teachers who do include STEM in their curriculum (23 percent).

- Teachers with no STEM component or focus in their pre-service education are **more likely to say they lack confidence to teach digital and technology skills** (41 percent) than teachers who do have a STEM education background (31 percent).
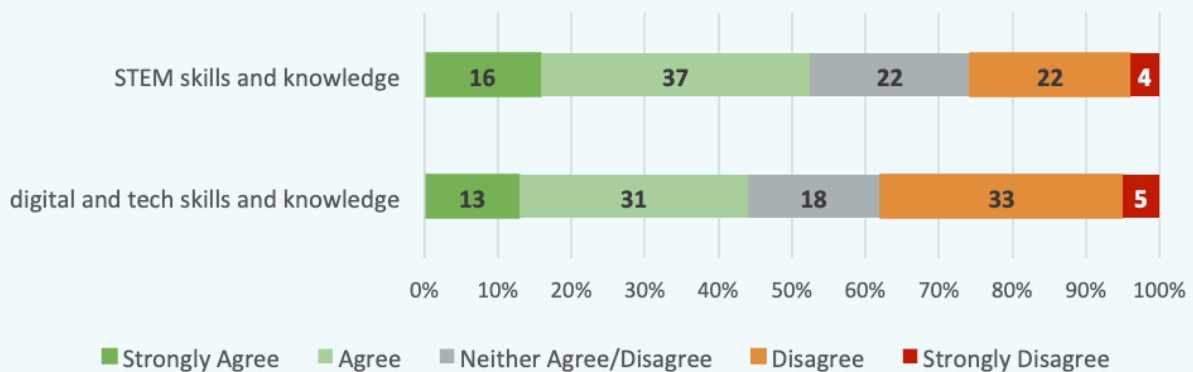
Less than half of teachers say that they have the confidence to teach digital and technology skills and knowledge.

CAPACITY

In some cases, teachers may not be especially **confident** about teaching STEM or digital skills, but nevertheless feel they are at least minimally **prepared** to do so. Overall, 53 percent say they feel **adequately prepared to teach STEM** versus 26 percent who do not, and 22 percent who are unsure. (Chart 4). But less than half (44 percent) say they feel **adequately prepared to teach digital and technology skills** (e.g., coding), versus 38 percent who do not, and 18 percent who are unsure. Similar to the confidence responses, women and those who have neither a STEM-focused education or STEM curriculum feel less prepared.

CHART 4

I feel adequately prepared to teach my students... (percent)

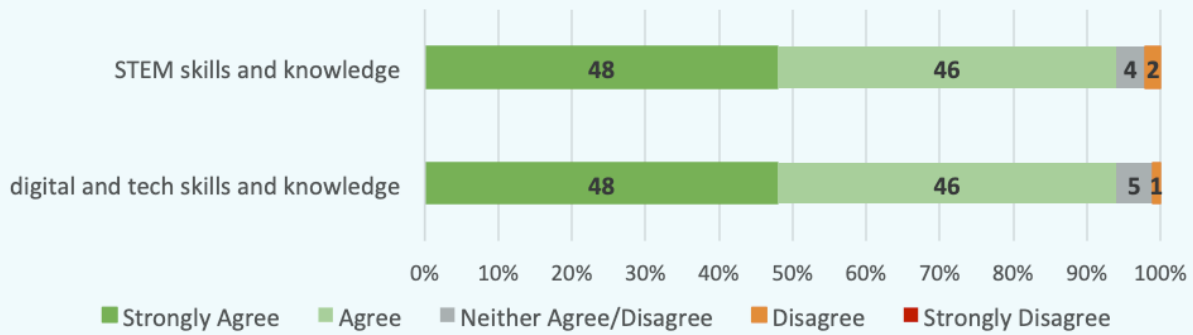|	Strongly Agree	Agree	Neither Agree/Disagree	Disagree	Strongly Disagree
STEM skills and knowledge	16	37	22	22	4
digital and tech skills and knowledge	13	31	18	33	5

ROOM FOR IMPROVEMENT

While some teachers feel confident and adequately prepared to teach STEM and digital skills, **nearly all (94 percent) say that they have room to improve** (Chart 5). This sentiment was expressed by teachers with no substantial differences across demographic characteristics and, notably, with no statistical differences between those with or without a STEM education background or professional development experience.

94% of teachers agree or strongly agree that there is room to improve their own STEM and digital skills.

Clearly, teachers are interested in self-improvement regardless of their baseline skills and knowledge. The challenge is to provide learning opportunities that acknowledge and build on teachers' varying starting points, whether novice, intermediate or advanced.

CHART 5

There is room to improve my skills and knowledge to teach...
(percent)

	Strongly Agree	Agree	Neither Agree/Disagree	Disagree
STEM skills and knowledge	48	46	4	2
digital and tech skills and knowledge	48	46	5	1

■ Strongly Agree ■ Agree ■ Neither Agree/Disagree ■ Disagree ■ Strongly Disagree

STEM AND DIGITAL SKILLS PROFESSIONAL DEVELOPMENT: PARTICIPATION AND BARRIERS
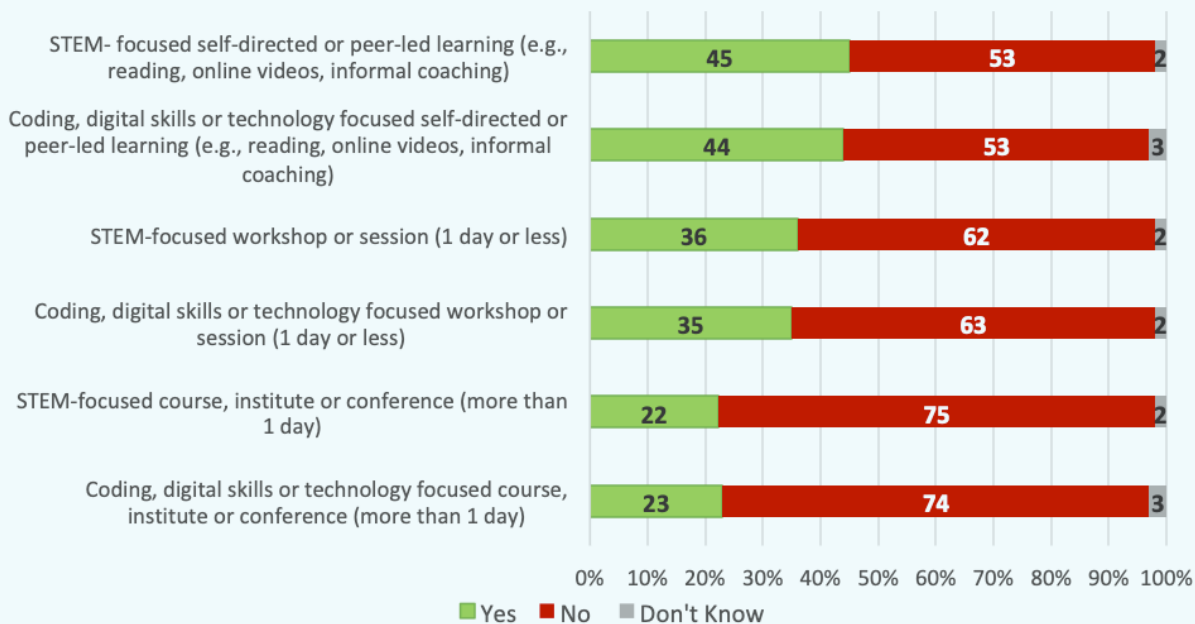
Professional development is an important and mandatory part of the teaching profession. Teachers frequently have opportunities to refresh skills and knowledge, or to learn new skills and knowledge, across a variety of subjects and professional activities - and a responsibility to do so each year. The means by which professional development occurs are varied – including courses completed after hours, full day workshops, short seminars, online learning, and self-directed and peer-supported learning.

The survey revealed that over the past 12 months, a little more than half of teachers engaged in some kind of activity to improve either their STEM or digital skills and knowledge. But the structure and quality of those activities varied widely. While many read and watched online videos to improve their skills and knowledge, only one-third of teachers were involved in structured STEM or digital professional development led by qualified experts. The need for more and higher quality STEM and digital professional development opportunities persists.

For example, teachers were more likely to report that they pursued less structured professional development formats such as reading and online videos (45 percent in STEM and 44 percent in coding and digital skills) than more structured options, such as workshops (36 percent in STEM and 35 percent in coding and digital skills) or courses and conferences (22 percent in STEM and 23 percent in coding and digital skills). In other words, **if we remove less structured, self-directed STEM and digital skills development activities and focus only on structured workshops, courses and conferences led by others, we find that only one-third of teachers were involved in STEM or digital skills professional development over the previous 12 months.**

CHART 6

Participation in STEM and Digital Skills Professional Development (percent participated in past 12 months)

Category	Yes	No	Don't Know
STEM- focused self-directed or peer-led learning (e.g., reading, online videos, informal coaching)	45	53	2
Coding, digital skills or technology focused self-directed or peer-led learning (e.g., reading, online videos, informal coaching)	44	53	3
STEM-focused workshop or session (1 day or less)	36	62	2
Coding, digital skills or technology focused workshop or session (1 day or less)	35	63	2
STEM-focused course, institute or conference (more than 1 day)	22	75	2
Coding, digital skills or technology focused course, institute or conference (more than 1 day)	23	74	3

0% 10% 20% 30% 40% 50% 60% 70% 80% 90% 100%

■ Yes ■ No ■ Don't Know

Teachers whose pre-service education included STEM were more likely to say they pursued STEM or digital professional development opportunities in the 12 months prior to the survey than those whose pre-service education did not include STEM. This was true even for teachers whose area of teaching is not necessarily STEM-focused. It appears that teachers' pursuit of additional STEM or digital professional development depends on prior interest and instruction in STEM.

- Among teachers whose pre-service education included STEM, nearly 7 in 10 participated in some form of STEM professional development, while 3 in 10 did not.

- By contrast, among teachers whose pre-service education did not include STEM, fewer than 4 in 10 participated in STEM professional development, while 6 in 10 did not.

- Among teachers whose pre-service education included STEM, approximately 7 in 10 participated in some form of coding or digital skills professional development, while fewer than 3 in 10 did not.

- By contrast, among teachers whose pre-service education did not include STEM, approximately 3 in 10 participated in some form of coding or digital skills professional development, while 7 in 10 did not.
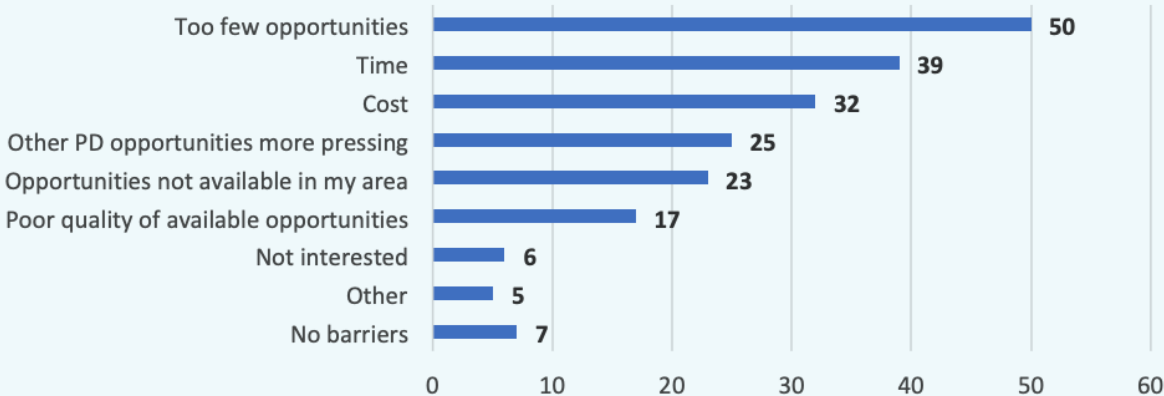
BARRIERS

Given that nearly all teachers say they have room to improve their STEM and digital skills for teaching and many are interested in pursuing more, something must be preventing them from doing so. When asked what barriers they face to STEM and digital skills professional development, half of teachers said that there are too few opportunities available. (Chart 7) The next most-frequent barriers are time (39 percent) and cost (32 percent). Only 6 percent said that they are not interested in STEM and digital professional development, while 7 percent said that they face no barriers at all.

CHART 7

Barriers to STEM and Digital Professional Development

(percent citing barrier; respondents could cite more than one barrier)

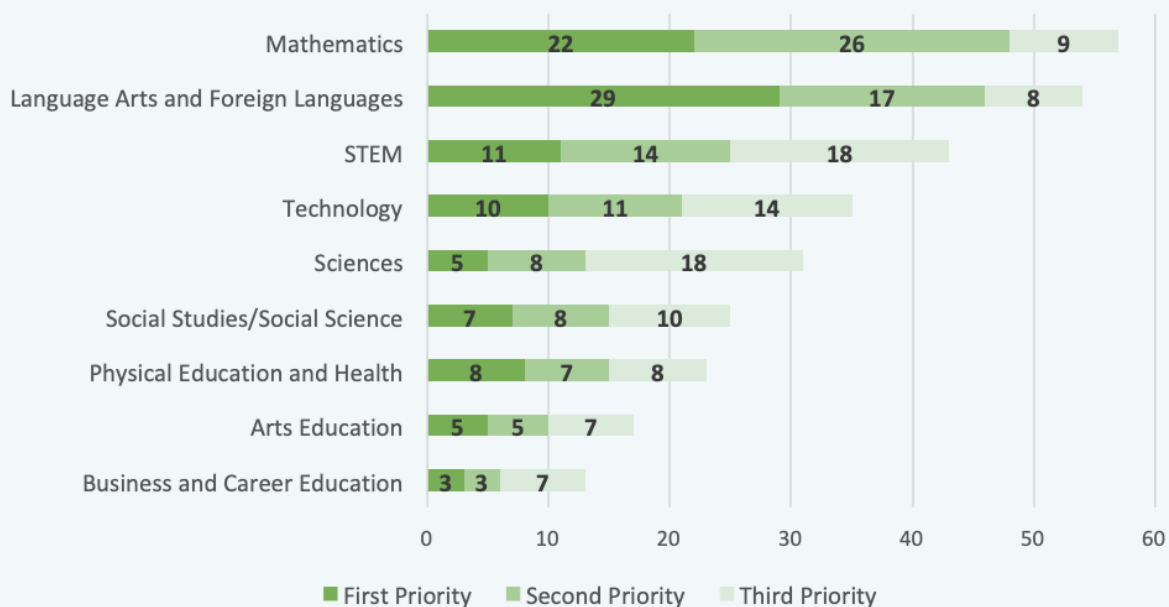| Barrier	Percent
Too few opportunities	50
Time	39
Cost	32
Other PD opportunities more pressing	25
Opportunities not available in my area	23
Poor quality of available opportunities	17
Not interested	6
Other	5
No barriers	7

TEACHERS WANT MORE STEM AND DIGITAL PROFESSIONAL DEVELOPMENT OPPORTUNITIES

Teachers' interest in professional development opportunities in STEM is high. When asked to choose their top three most important professional development opportunities, 43 percent of teachers selected STEM and 35 percent selected technology. 57 percent selected mathematics and 31 percent selected sciences more generally. Evidently, there is a large appetite among teachers for professional development focused on STEM, and specific components, including mathematics, technology and science.

Top Professional Development Opportunities for Teachers
(percent of teachers selecting subject as a top 3 priority)

Subject	First Priority	Second Priority	Third Priority
Mathematics	22	26	9
Language Arts and Foreign Languages	29	17	8
STEM	11	14	18
Technology	10	11	14
Sciences	5	8	18
Social Studies/Social Science	7	8	10
Physical Education and Health	8	7	8
Arts Education	5	5	7
Business and Career Education	3	3	7

■ First Priority   ■ Second Priority   ■ Third Priority

In terms of the STEM and digital skills professional development formats they would most prefer, teachers prioritize more structured formats (such as workshops, courses and conferences) over less structured formats (such as self-directed learning). For both STEM and digital skills professional development opportunities, teachers generally seem to prefer in-person activities over online activities, but this varies by format and subject matter. (Charts 9 and 10).

CHART 9

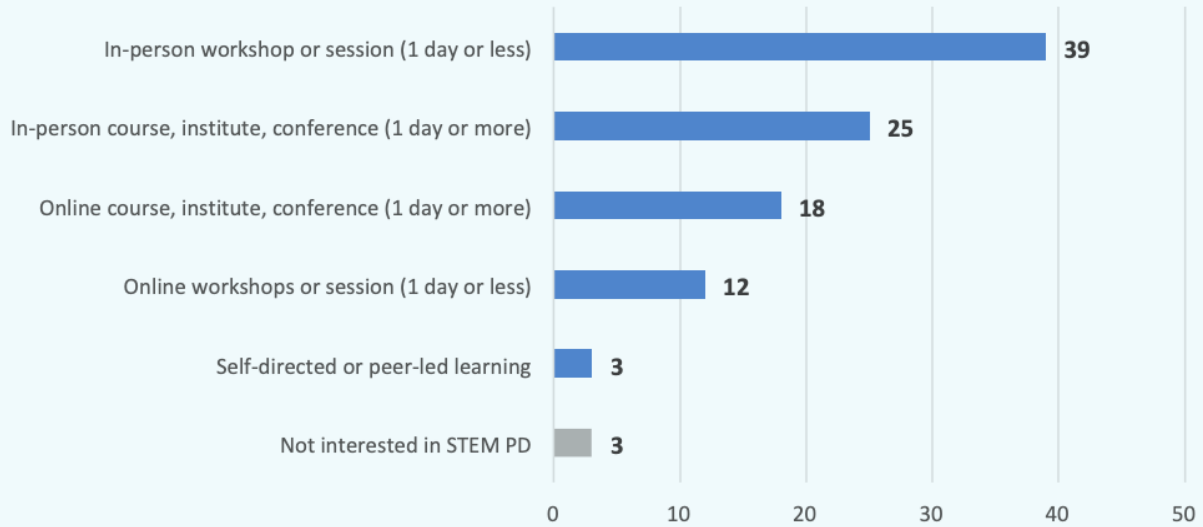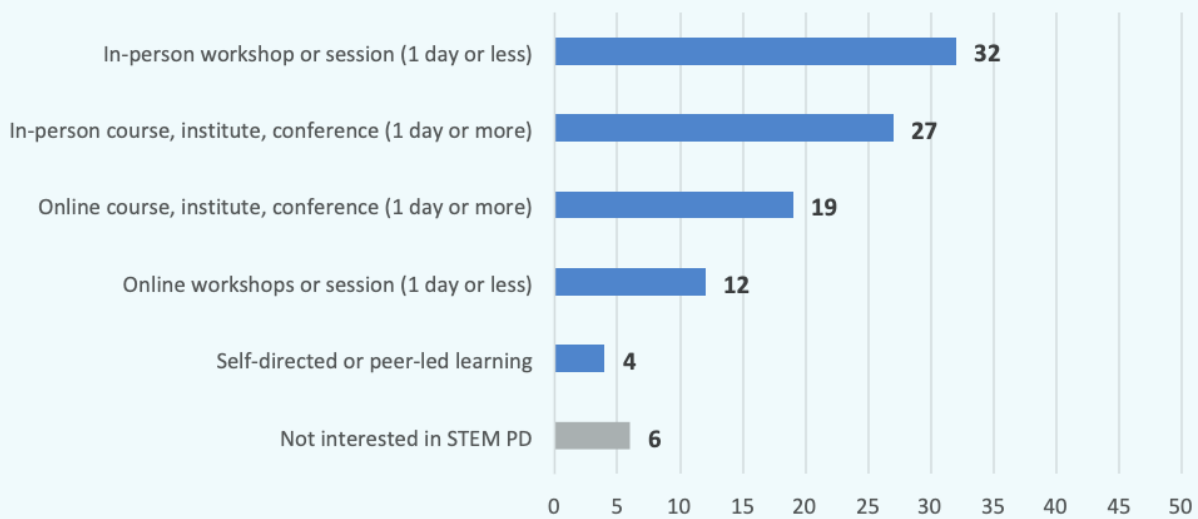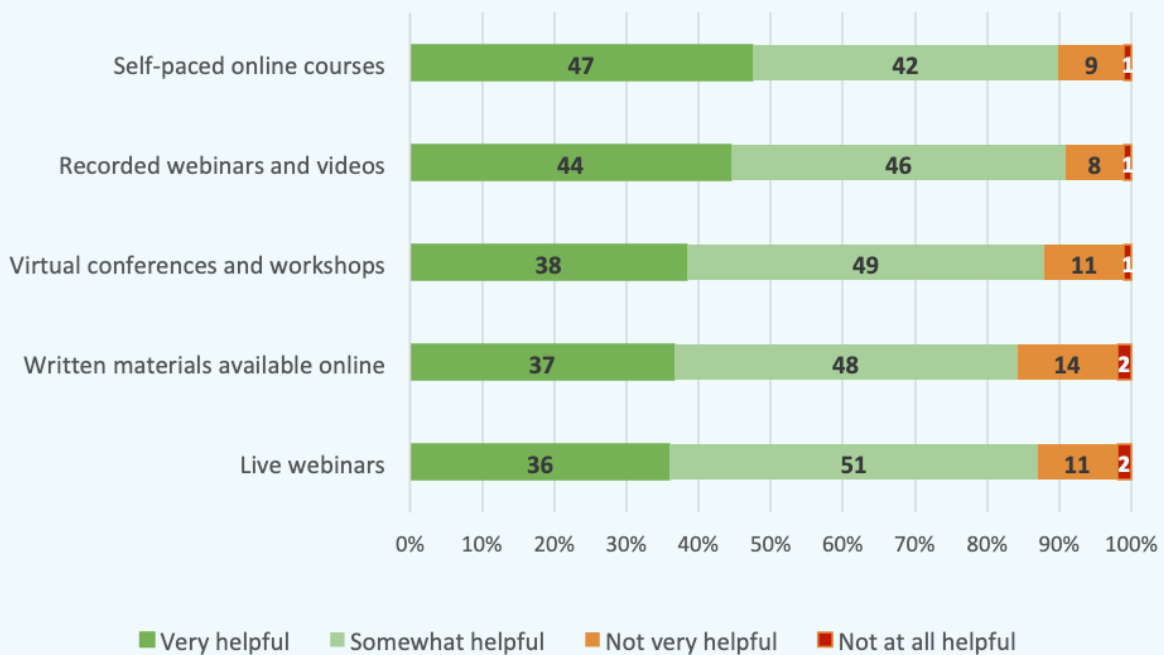## STEM Professional Development Format Preferences (percent)

Format	Percent
In-person workshop or session (1 day or less)	39
In-person course, institute, conference (1 day or more)	25
Online course, institute, conference (1 day or more)	18
Online workshops or session (1 day or less)	12
Self-directed or peer-led learning	3
Not interested in STEM PD	3

CHART 10

Coding & Digital Skills Professional Development Format Preferences (percent)

Format	Percent
In-person workshop or session (1 day or less)	32
In-person course, institute, conference (1 day or more)	27
Online course, institute, conference (1 day or more)	19
Online workshops or session (1 day or less)	12
Self-directed or peer-led learning	4
Not interested in STEM PD	6

While teachers tend to prefer in-person over online formats, the appetite for online formats for STEM and digital skills development is substantial (Chart 11). Approximately 9 in 10 say that online professional development formats would be very or somewhat helpful in the development of STEM and digital skills and knowledge for teaching. Self-paced online courses are viewed as the most helpful, with 47 percent saying they are very helpful (and 42 percent viewing them as somewhat helpful), while 36 percent of teachers say live webinars would be very helpful (and 51 percent regarding them as somewhat helpful).

CHART 11

Helpfulness of Online STEM Professional Development Formats (percent)

	Very helpful	Somewhat helpful	Not very helpful	Not at all helpful
Self-paced online courses	47	42	9	1
Recorded webinars and videos	44	46	8	1
Virtual conferences and workshops	38	49	11	1
Written materials available online	37	48	14	2
Live webinars	36	51	11	2

Given that the top barriers teachers face to professional development are few opportunities (50 percent), time (39 percent) and cost (32 percent) – and in light of ongoing uncertainty about in-person activities and travel due to COVID-19 – the availability of high-quality online options is welcome.

CONCLUSION

Teachers across Canada believe that STEM skills and knowledge will be important to their students' future education, careers and citizenship and say that it is important for teachers to develop these skills. Most teachers are confident that they can deliver STEM and digital skills instruction to their students, but only if they have adequate preparation and resources. Teachers with pre-service education in a STEM field and male teachers tend to be more confident than teachers without a STEM background and female teachers. This suggests that there may be opportunities to customize professional development programs to the needs and preferences of certain cohorts of teachers.

Almost all teachers agree that there is room to improve their own STEM, digital and technology skills and knowledge for teaching, regardless of their previous experience and knowledge. This is consistent with educators' general interest in self-improvement for the benefit of their students. Yet, many face barriers and limited options to pursue professional development in STEM, coding and digital skills and knowledge.

Although more teachers prefer in-person over online professional development formats, almost all agree that online formats would be helpful in developing their skills. Given the time, cost and availability barriers teachers face to professional development – and in light of ongoing uncertainty about in-person activities and travel due to COVID-19 – there is a strong case for developing and widely distributing high-quality online STEM and digital skills development opportunities for teachers across Canada.

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