Computer Science Standards Economic Impact Report

DRAFT SUMMARY

Montana
Office of Public Instruction
opi.mt.gov Elsie Arntzen, Superintendent

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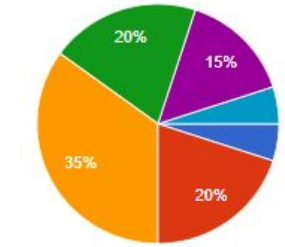
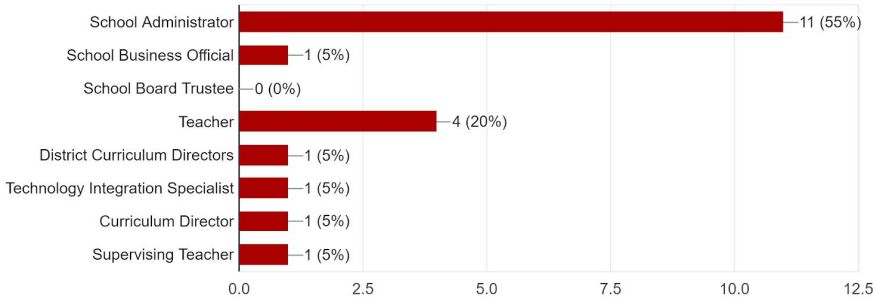
*Note:This is a summary of the Economic Impact Survey. Not all questions or written responses are included.

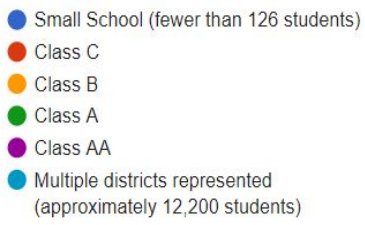
Computer Science Economic Impact Survey

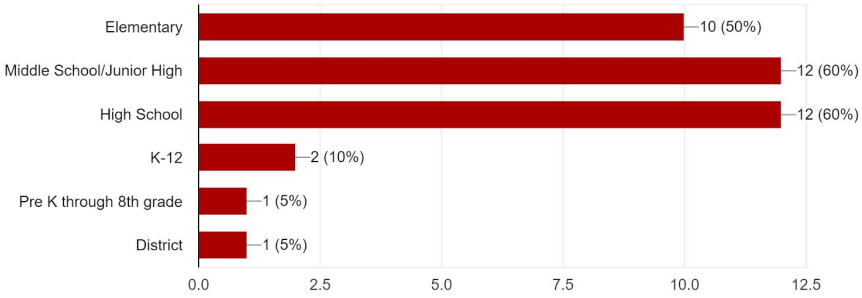
Survey Demographics (n=20*)

*many of the questions were optional



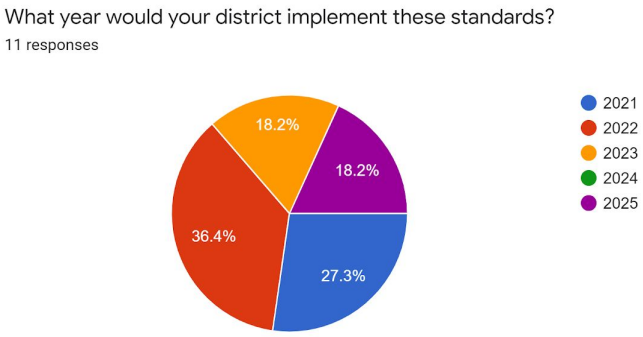






Content Standards Implementation

Question	Yes	No
Do you anticipate that your district will be able to implement the proposed standards with existing resources?	6 (30%)	14 (70%)
Will your district be able to implement the proposed program delivery standards for computer science?	8 (40%)	12 (60%)



Personnel was the most significant challenge to implementation with all 12 voting “no” to the program delivery standards selecting personnel as one of the most significant challenges to implementation. Additional concerns are:

“this does not fit into the school day for teachers or students”

"We have a small school with a small, unique populations, due to factors beyond student control, many are below grade level and much of our time as teachers is spent not only teaching current core standards, but attempting to fill gaps students have. I struggle with finding enough time in the day to teach the current standards, I will not be able to teach additional standards due to time and achievement gaps from my students previous years in education."

Instructional Materials

Question	Yes	No	Maybe
Will your district have difficulty finding instructional materials to implement the proposed standards? n=19	8 (42.1%)	7 (36.8%)	4 (21.1%)

"There is plenty on the market available for CS both free and inexpensive. The question will be if those resources are ongoing digital subscriptions based on number of students or site licenses."

"Cost is the technology: code.org is free and meets all these but we don't have the time to add it to the day at the K-5 level, and 6-12 we can't afford FTE"

"We are using and will continue to use PLTW as a mechanism for computer science"

"Finding will not likely be a problem. Affording is very likely to be. Also, some of the standards appear to require hardware and programming tools and materials that no one on my team is prepared to use."

"It may be challenging to find materials that cover these standards specifically because they are so general and do not include a progression of skills such as keyboarding proficiency levels and being able to use specific programs at various grade levels."

What increase in total dollars would be required to cover the cost associated with Instructional Materials? (best estimate)

**"1500 per year Code HS" and "300,000 every three years to rotate out Chromebooks. We have 16,000 students and they would each need access to technology of some sort."*

Personnel

Question	Yes	No	Maybe (if option)
Does your district have a shortage of teachers endorsed in computer science?	15 (78.9%)	4 (21.1%)	

Summary of if answered “no” or “maybe” feedback:
“Computer Science is not currently an endorsement in MT. It is my understanding that all can teach it.”

“This is a difficult question that needs further clarifications at both K-8 and High School. High school we can use business and tech-ed teachers but we have shortages in both those areas as well. If we are adding a CS program of study in the K-8, what are the requirements?”

How many new hires would be needed? n=14	Count	What increase in total dollars would be required to cover the cost associated with Personnel?
0	3	none
1	8	$40,000-$75,000
2	1	$90,000
10	1	$500,000
32	1	$250,000

Professional Learning

Question	Yes	No	Maybe (if option)
Will your district have difficulty finding professional development opportunities for computer science educators?	6(35.3%)	11(64.7%)	

Summary if answered “yes”
“The UM/MSU summer CS PD will be ending this summer. No opportunities after that.”

“Rural location makes it difficult to receive professional development in this area.”

“We need to train teachers in computer science to deliver the content and assess learning”

“There are numerous professional development opportunities on the Learning Hub, Region III and Region I.”

“The problem wouldn't necessarily be finding PD for computer science educators, it would be finding computer science educators. My instinct is that people with CS degrees will not likely be in the education field.”

What professional development would be needed?

"code.org can provide the K-12 support. It will be up to the district to decide the system but it could be fulfilled with code.org"

"Train the trainer model through PLTW"

"There are a lot of options online for Professional Development. We currently use the online system."

"First, we would establish curriculum materials, hardware, and software, then there would be the task of teaching our current educators how to use it and how to instruct with it. Assessment would be very difficult because establishing a baseline for showing mastery of each individual standard would be difficult to pioneer."

"Level 1 Awareness on new standards and the pedagogy required to implement them. Level 2 Resources and implementation of new curriculum Level 3 Proficiency Based Assessments towards those standards."

Curriculum Development

Question	Yes	No	Maybe (if option)
Would the proposed standards, if adopted, require your district to substantially revise its current curriculum?	9(47.4%)	4(21.1%)	6(31.6%)

Summary if answered "yes"

"This would require a great deal of time. Time would need to come from within the school year with PIR time allowed to work on this."

"At the K-5 level we do not have time or money to implement. 6-8 this is doable."

"Because it has been a long time since many of our districts worked on computer science curriculum, it is possible that these standards would cause substantial revisions. Some districts I represent would likely not have to make changes, while others would."

"We are a small school. We do not have Computer Science as a part of our curriculum at this time, nor do we foresee adding this course to our course offering here at the school."

"Regardless of how we integrate the standard, time will be a major fact. If we had a devoted computer science teacher it would mean sacrificing another elective (music, art, etc.) . If we taught it with our current staff, it would steal minutes from core classes."

"The area of greatest impact will be the K-5 level, but even middle and high school teachers will need to meet and revise what we are currently doing for computer programming. These new standards go above and beyond that."

General Feedback

"The addition of these new CS standards will help to delineate the grade-level requirements, but the overlap to the forthcoming Technology and Media Literacy standards revisions need to be looked over as a whole."

I am unable to answer many of the questions as we do not have computer science as a course and do not plan on adding in the near future. If students are interested in this topic area, we offer MDA Computer Science online.

There are no teachers endorsed in this area, nor is there room in the master schedule for adding another course. We are struggling with maintaining our core courses, electives (to include CTE varieties).

"These standards do not address a progression of skills at developmental age levels (with a few exceptions); therefore, districts will have a greater economic impact in developing and implementing local curriculum guides than they would if these provided more specific guidance. It would be better if these standards more closely aligned with national level expectations for things such as keyboarding proficiency and working knowledge of word processing programs, etc. "

"This is going to be a difficult position for any smaller Class C school to fill. We do the best we can with other subjects and including aspects where applicable and we readily use MTDA and Odysseyware whenever possible to help our students with this area of study. "

"I love computer science and hope all children are computer literate but an ***unfunded mandate*** *will be nearly impossible to fulfill. Additionally, at the K-5 level our kids and teachers have very limited time to add anything to the day with testing and behavior issues eating up the majority of extra time. "*

"Teachers have limited ***time*** *available to work on this. Districts are hesitant to give time for this to happen, which means that teachers either have to use their personal time or choose not to complete the work. Time must be allocated during the school year."*

"Teaching CS is not a PD thing, no more that the training to be a math or science teacher can be done with PD. There needs to be content courses and methods courses offered at the universities. It cannot be a point at a willing teacher and say "your it". Course work needs to be developed to train CS teachers. None of the universities in Montana seem inclined to do so. No teachers qualified to teach CS means this whole curriculum is sort of a dead end. Qualified teachers cannot be made with just PD."

Montana Computer Science Cost Estimate from Code.org

This spreadsheet below approximates the one-time cost of expanding access to computer science to offer a basic K-12 pathway in every school in a state. This does not model teacher attrition or long-term costs. Once teachers are established, existing state/federal funding streams should address this issue.

Assumptions/limitations:
-- The cost to establish a computer science program is based on preparing an in-service teacher, NOT hiring a new teacher.
-- The major grade bands where teachers will be established are K-6 (elementary), 7-8 (middle school), 9-12 (high school) and uses NCES data (school year '14/'15, which is the most recent year) to determine how many unique schools each state has in these grade bands
-- This model assumes establishing one teacher per grade major grade band at a school using NCES data for number of unique schools at each grade band. For example, if a school has both K-6 grades and middle school grades, then the model will assume establishing two teachers. It also assumes that one K-6 teacher (such as technology teacher that reaches all students or a librarian) will be established per school. This figure may need to be adjusted (which is supported below) if states/districts want to establish more than one elementary school teacher per school.
-- Only Public and Public Charter School Districts would be eligible for this funding.
-- The model assumes some cost overhead compared to the work of private organizations such as Code.org

Approximate number of public/charter elementary schools	449
Approximate number of public/charter middle/high schools	503
Approximate % of schools that don't teach CS	55%
Assumption of number of teachers/elementary school	1
Assumption of number of teachers/middle/high school school	1
Number of new elementary school CS teachers needed	247
Number of new middle/high school CS teachers needed	277
Cost to an elementary school to establish a CS teacher	$500
Cost to establish a middle or high school CS teacher	$6,000
Total cost: elementary school	$123,475
Total cost: middle/high school	$1,659,900
TOTAL COST	$1,783,375
Total new CS classrooms	524

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Montana

1 State Plan	2 Standards	3 Funding
No	In Progress	No

4 Certification	5 Preservice Teacher Prep	6 State Supervisor
Yes	Yes	No

7 Require HS to Offer	8 Core Grad Credit	9 Higher Ed Admission
No	District Decision	No

Refer to **advocacy.code.org** for additional up-to-date information.

Updates

- The state began development of K–12 computer science standards in July 2018.
- The state passed a permissive and encouraging policy to allow computer science to count as a science, mathematics, elective, or CTE graduation requirement. Alternatively, a district may increase the local requirements in math, science, or career and technical education and allow a computer science course to fulfill one of the required credits, or require all students to complete a computer science credit.
- Governor Steve Bullock is a member of the Governors' Partnership for K–12 Computer Science.

Data

- In the 2018–2019 school year, 45% of high schools taught at least one computer science course, compared to 40% in 2017–2018.
- 6 schools (6% of schools with AP programs) offered an audited AP computer science course in 2017–2018, which is 4 more schools than the previous year.
- 7 female students (18%) took an AP CS exam in 2018, compared to 2 (15%) in 2017.
- 1 underrepresented minority student (3%) took an AP CS exam in 2018, compared to 2 (15%) in 2017.
- 99 bachelor's degrees in computer science were earned in 2017; 11% were female.

2019 State of Computer Science Education Equity and Diversity, advocacy.code.org

Montana Computer Science Coding Endorsement and Core Graduation

Frequently Asked Questions: Computer Science in High School Graduation Requirements- March 5, 2019
Computer Science Opportunities to Satisfy a Core Graduation Requirement- March 5, 2019

Question: What are the teacher licensure requirements for a student to fulfill a credit requirement in another subject area through a computer science course? Must the teacher hold a licensure or endorsement in the subject area AND computer science?

Answer: If a district chooses to allow a computer science course to fulfill a mathematics, science, CTE or technology credit, the district must ensure the course is taught by an appropriately licensed teacher. For example, if a computer science course is assigned a mathematics course code, the teacher must hold current grade-level and subject area licensure in mathematics.
The Montana Board of Public Education recently created a high-quality pathway to certification in teaching computer science content. Specifically, ARM 10.57.421, as amended by 2018 rulemaking, permits an individual to obtain an endorsement on the Class 4 license to teach the following courses if s/he holds the qualifications below:

10.57.421 CLASS 4 ENDORSEMENTS
For health science education, engineering, computer information systems, computer coding, teacher education, EMT, or fire and disaster services, an alternative to the above requirement of 10,000 hours of work experience may be substituted as recognized by the Office of Public Instruction and the Board of Public Education as follows:
(c) For computer information systems an individual may provide verification of completion of an approved technical program in a recognized training institution and hold a professional license or industry standard certificate recognized by the Office of Public Instruction and the Board of Public Education.
(d) For computer coding:
(i) hold a Class 1 or 2 license; and
(ii) provide verification of successful completion of a blended learning professional development course of at least 80 hours by a provider recognized by the Office of Public Instruction and the Board of Public Education.

Question: What credit requirement(s) may a local board of trustees allow a computer science course to fulfill?

Answer: A computer science course that is assigned the appropriate course code and taught by an appropriately credentialed instructor may fulfill any of the following:

1. *A credit requirement in mathematics*
2. *A credit requirement in science*
3. *A local elective requirement*
4. *A local career and technical education (or technology) requirement*
5. *A stand-alone computer science credit requirement.*

Question: What are the teacher licensure requirements for a student to fulfill a credit requirement in another subject area through a computer science course? Must the teacher hold a licensure or endorsement in the subject area AND computer science?

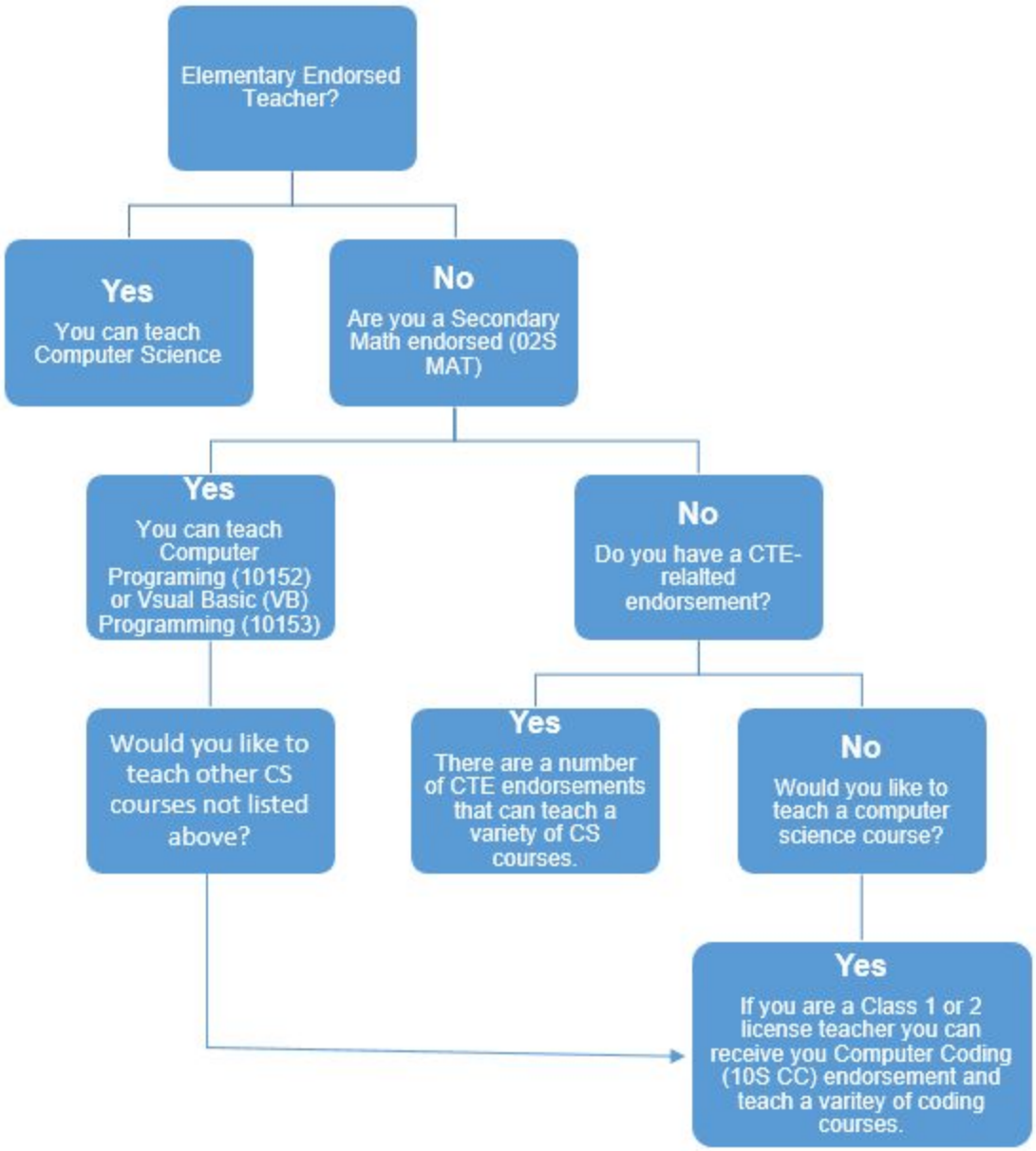
Answer: If a district chooses to allow a computer science course to fulfill a mathematics, science, CTE or technology credit, the district must ensure the course is taught by an appropriately licensed teacher. For example, if a computer science course is assigned a mathematics course code, the teacher must hold current grade-level and subject area licensure in mathematics.

Question: What course code requirements apply if a computer science course fulfills a local credit requirement in another subject, such as mathematics, science, or career and technical education?

Answer: Per ARM 10.55.911, a student's high school transcript must include the course code and credits earned for each course taken. This means that if a district chooses to allow a computer science course to fulfill a mathematics, science, CTE or technology credit, the school or district must:

- *Assign an appropriate course code for the subject area to which graduation credit will be applied (i.e., assign a math course code if the computer science course will be allowed to fulfill a math credit requirement).*
- *Denote on the student transcript that the student has met the applicable subject area requirement by completing a computer science course.*

Who Can Teach Computer Science Courses in Montana



CTE endorsements
Variety of CS courses (p.42)
Computer Coding section 4d

2018-2019 Computer Science Course Data (TEAMS)

Prior to Secondary (PTS)

Prior to Secondary (PTS) Category	Number
Number of PTS Computer Science Courses	771
Total Enrollment of PTS Computer Science Courses	13,170
School Systems with PTS Computer Science Courses	105
Schools with PTS Computer Science Courses	134
Number of PTS Computer Science Teachers/Facilitators	139
PTS Computer Science Course Codes Available	7
PTS Computer Science Course Codes Used	7

Course Code	Prior to Secondary Computer Science Courses	Courses	Enrollment
60001	Introduction to Computer Technology	186	2872
60002	Computing Systems	9	73
60003	Computer and Information Technology	97	1702
60004	Computer Applications	366	6478
60010	Computer Literacy	83	1457
60201	Web Page Design	1	2
60202	Computer Graphics	29	586
	Total	**771**	**13,170**

Secondary Category

Secondary Category	Number
Number of Secondary Computer Science Courses	772
Total Enrollment of Secondary Computer Science Courses	8,022
School Systems with Secondary Computer Science Courses	131
Schools with Secondary Computer Science Courses	139
Number of Secondary Computer Science Teachers/Facilitators	198
Secondary Computer Science Course Codes Available	39
Secondary Computer Science Course Codes Used	25

Course Code	Secondary Computer Science Courses	Courses	Enrollment
10001	Introduction to Computer Technology	24	342
10002	Computing Systems	10	44
10003	Computer and Information Technology	44	447
10004	Computer Applications	292	4130
10005	Business Computer Applications	71	859
10006	Telecommunications	0	0

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10007	IB Information Technology in a Global Society	1	12
10019	AP Computer Science Principles	2	16
10051	Information Management	4	30
10052	Database Management and Data Warehousing	2	2
10053	Database Applications	2	0
10054	Data Systems/Processing	1	11
10101	Network Technology	0	0
10102	Networking Systems	0	0
10103	Area Network Design and Protocols	0	0
10104	Router Basics	0	0
10105	NetWare Routing	0	0
10106	Wide Area Telecommunications and Networking	0	0
10107	Wireless Networks	0	0
10108	Network Security	4	13
10109	Essentials of Network Operating Systems	0	0
10110	Microsoft Certified Professional (MCP)	5	37
10151	Business Programming	0	0
10152	Computer Programming	134	720
10153	Visual Basic (VB) Programming	2	13
10154	C++ Programming	1	1
10155	Java Programming	12	125
10156	Computer Programming—Other Language	5	66
10157	AP Computer Science A	18	124
10159	IB Computer Science	8	24
10201	Web Page Design	60	382
10202	Computer Graphics	47	443
10251	Computer Technology	16	149
10252	Computer Maintenance	0	0
10253	Information Support and Services	0	0
10254	IT Essentials: PC Hardware and Software	0	0
10255	CISCO—The Panduit Network Infrastructure Essentials (PNIE)	6	24
10995	Information Technology—Aide**	0	0
10998	Information Technology—Workplace Experience	1	8
	Total	**772**	**8,022**

Montana course codes are a subset of the NCES (National Center for Education Statistics) Standard Codes. Along with the course code, a content description for each course is provided.

*Highlighted Green are courses that can be taught by Computer Coding endorsed teachers (10S CC)

*Highlighted Blue are courses that can be taught, right now, by Mathematics endorses teachers (02S MAT).

* As of 19-20 New course code: 71009 (PTS)/21009 (Secondary) Robotics, this is an open endorsement course so it can be taught be any grade-level appropriately endorsed teacher

**No longer available for Montana Schools as of 19-20.

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AP Computer Science Course

During the 2018- 2019 school year two AP Computer Science courses were offered in Montana, AP Computer Science A and AP Computer Science Principles. 140 students from 16 high schools comprised of 15 school districts, including one Catholic school, offered an AP Computer Science course. Of those 16 high schools, 7 schools offered the course through Montana Digital Academy (MTDA).

Costs for offering the MTDA AP Computer Science course for 25 students is $15,000 ($7,500 per semester). Historically this course has not been full with only 10 students enrolled during the 2018-2019 school year.

This summer there is one, four day, AP Computer Science professional development training occuring in Montana hosted by School Services of Montana. The cost for this professional development is $775.

Additional funds would need to be allocated in promotion to students and training for teachers to increase the number of students enrolled in AP Computer Science courses.