Computer Science State Strategic Plan

Report to the Legislature

As required by Minnesota Statutes 2023, section 120B.241

For more information:

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Contents

Legislative Charge

During Minnesota's 2023 legislative session the Computer Science Education Advancement Program (120B.241) was established.

Subdivision 1. Definitions.

(a) "Computer science" means the study of computers and algorithmic processes, including their principles, their hardware and software designs, their implementation, and their impact on society.

(b) "Computer science courses and content" means courses at:

1. elementary and middle schools that teach computer science as standalone implementations or embedded in other subjects; and
2. high schools that teach computer science as standalone courses and focus on teaching students how to create new technologies.

(c) "High-quality computer science educator training" means activities that:

1. clarify the conceptual foundations of computer science;
2. teach research-based practices, including hands-on and inquiry-based learning;
3. are primarily intended for existing teachers with or without prior exposure to computer science with options for advanced training for teachers; and
4. align to existing integrated computer science standards in Minnesota or nationally recognized standards, including the Computer Science Teachers' Association's kindergarten through grade 12 computer science education standards.

(d) "High-quality computer science professional learning providers" means institutions of higher education, nonprofits, other state-funded entities, or private entities that have successfully designed, implemented, and scaled high-quality computer science professional learning for teachers as defined in paragraph (c).

(e) "STEAM" means science, technology, engineering, arts, and mathematics.

Subd. 2. Computer science education supervisor. The Department of Education must employ a computer science supervisor dedicated to:

(1) the implementation of this section and the implementation of the computer science education strategic plan developed by the working group under subdivision 3;

(2) outreach to districts that need additional supports to create or advance their computer science programs; and

(3) supporting districts in using existing and available resources for districts to create and advance their computer science programs.

Subd. 3. Computer science working group.

(a) The Department of Education shall establish a computer science education working group to develop a state strategic plan for long-term and sustained growth of computer science education in all kindergarten through grade 12 school districts and charter

schools. The commissioner of education must appoint members of the working group by October 1, 2023.

(b) Demographics of the working group must be inclusive and represent the diversity of the state, including but not limited to racial, ethnic, and geographic diversity, and diversity related to gender and sexual orientation.

(c) Meetings of the advisory committee are subject to the Open Meeting Law under Minnesota Statutes, chapter 13D.

(d) The computer science education advisory committee shall consist of the following members:

1. the commissioner of education or the commissioner's designee;
2. the commissioner of higher education or the commissioner's designee;
3. one representative of the Professional Educator Licensing and Standards Board;
4. one representative of the Computer Science Teachers Association of Minnesota;
5. one representative from the business community employing computer scientists or technologists;
6. one representative from the Minnesota Technology Association;
7. one representative from a nonprofit organization working with students and teachers in computer science;
8. one representative from the Minnesota Association of School Administrators;
9. one representative from Education Minnesota;
10. one representative from the Minnesota Association of Colleges for Teacher Education;
11. one representative from CSforAll Minnesota;
12. one licensed library media specialist;
13. one representative from the Minnesota School Boards Association;
14. one representative from SciMathMN;
15. one representative from the Tribal Nations Education Committee;
16. one high school student enrolled in a school with fewer than 1,000 students and one high school student enrolled in a school with more than 1,000 students; and
17. four computer science teachers that teach at schools of different sizes, including at least one teacher of students in kindergarten to grade 5, one teacher of students in grades 6 to 8, and one teacher of students in grades 9 to 12, and one career and technical education teacher.

(e) The computer science education working group shall develop a state strategic plan for a statewide computer science education program that includes but is not limited to:

1. a statement of purpose that describes the objectives or goals the Department of Education will accomplish by implementing a computer science education program, the strategies by which those goals will be achieved, and a timeline for achieving those goals;
2. a summary of the current state landscape for kindergarten through grade 12 computer science education, including diversity of students taking these courses;

3. the creation or expansion of flexible options to license computer science teachers, which may include approval codes, technical permits, ancillary licenses, and standard licenses;
4. a description of how the state will support the expansion of computer science education opportunities in every public school and public charter school in the state within five years, with a focus on ensuring equitable access;
5. identifying high-quality computer science professional learning providers for teachers;
6. an ongoing evaluation process that is overseen by the Department of Education;
7. proposed rules that incorporate the principles of the state strategic plan into the state's public education system as a whole;
8. recommendations for long-term expansion and sustainability of computer science education, including:
    i. implementation of a requirement that every kindergarten through grade 12 public school and public charter school employs at least one certified or endorsed computer science teacher, which may be met through multiple approved processes for certification and endorsement, including but not limited to endorsing a certified teacher as determined by the Professional Educator Licensing and Standards Board endorsed in another subject area;
    ii. expansion of a high school credit equivalency for computer science;
    iii. the development of standalone kindergarten through grade 12 standards for computer science; and
    iv. training preservice teachers in computer science education; and
9. a description of existing gaps in computer science education access, participation, and success by geography and subgroup of students and a description of how to equitably address these gaps.

(f) By February 29, 2024, the Department of Education shall publish the proposed state strategic plan for public feedback.

(g) By March 22, 2024, the Department of Education shall present the adopted state strategic plan described in paragraph (c) to the chairs of the legislative committees with jurisdiction over education.

(h) The commissioner of education, or the commissioner of education's designee, may approve updates and changes to the state strategic plan described in paragraph (c) as necessary for the successful implementation of kindergarten through grade 12 computer science education.

(i) The Department of Education shall update the legislative committees with jurisdiction over education on all changes to the strategic plan described in paragraph (c) approved by the commissioner of education's designee since the last presentation to each respective entity.

Subd. 4. Computer science educator training and capacity building.

(a) The Department of Education shall develop and implement, or award grants or subcontract with eligible entities, for the development and implementation of high-quality, coordinated teacher

recruitment and educator training programs for computer science courses and content as defined in subdivision 1 and aligned to the state strategic plan as developed under subdivision 3.

(b) For the purposes of this subdivision, eligible entities include:

1. a consortium of local educational agencies in the state; and
2. high-quality computer science professional learning providers, including institutions of higher education in the state that are reasonably accessible geographically to all Minnesota educators, nonprofits, other state-funded entities, or private entities working in partnership with a consortium of local educational agencies.

(c) For purposes of this subdivision, eligible uses of funding include:

1. high-quality professional learning opportunities for kindergarten through grade 12 computer science content that:
   i. are created and delivered in a consistent manner across the state;
   ii. are made available with no out-of-pocket expenses to educators, including teachers, counselors, administrators, and other district employees as approved by the Department of Education, schools, and school districts;
   iii. are made available asynchronously online, in person, and online or hybrid as determined appropriate by the Department of Education; and
   iv. include introductory, intermediate, and advanced trainings aligned to the kindergarten through grade 12 academic standards or, as necessary, other standards approved by the Department of Education, specified for each of the grade bands kindergarten through grade 2, grades 3 to 5, grades 6 to 8, and grades 9 to 12;
2. professional learning opportunities for educators of students in grades 9 to 12 that may include trainings for advanced placement, international baccalaureate, and concurrent enrollment credit computer science courses;
3. travel expenses for kindergarten through grade 12 computer science teachers:
   i. for attending training opportunities under clauses (1) and (2); and
   ii. deemed appropriate and approved by the commissioner of education, or the commissioner of education's designee;
4. any future credentialing for kindergarten through grade 12 computer science teachers, including Career and Technical Education and academic endorsements;
5. supports for kindergarten through grade 12 computer science professional learning, including mentoring and coaching;
6. creation and deployment of resources to promote training opportunities and recruitment of kindergarten through grade 12 computer science teachers;
7. creation or purchase of resources to support implementation approved by the commissioner of education, or the commissioner of education's designee;
8. creation and deployment of resources to promote learning opportunities or recruit students to engage in the learning opportunities;
9. development of teacher credentialing programs;

10. planning for districts to implement or expand computer science education opportunities; and
11. employment, or grant for employment, of personnel or contractors to oversee the statewide initiative, develop programs and trainings, and deliver training opportunities under clause (1).

(d) As a condition of receiving any funding through grants or subcontracts, eligible entities must submit an application to the Department of Education. The application must, at a minimum, address how the entity will:

1. reach new and existing teachers with little to no computer science background;
2. attract and support educators from schools that currently do not have established computer science education programs;
3. use research- or evidence-based practices for high-quality professional development;
4. focus the professional learning on the conceptual foundations of computer science;
5. reach and support subgroups underrepresented in computer science;
6. provide teachers with concrete experience through hands-on, inquiry-based practices;
7. accommodate the particular teacher and student needs in each district and school; and
8. ensure that participating districts begin offering courses or content within the same or subsequent school year after the teacher receives the professional learning.

(e) The Department of Education shall prioritize the following applications:

1. consortiums of local educational agencies that are working in partnership with providers of high-quality professional learning for kindergarten through grade 12 computer science;
2. proposals that describe strategies to increase enrollment overall, including but not limited to subgroups of students that are traditionally underrepresented in computer science; and
3. proposals from rural or urban areas with a low penetration of kindergarten through grade 12 computer science offerings, including local education consortiums within these areas.

(f) The award recipient shall report, for all funding received under this section annually, at a minimum:

1. the number of teachers:
   i. trained within each elementary, middle, and high school; and
   ii. trained within trainings offered as outlined in paragraph (c), clause (1), item (iv);
2. the number of trainings offered in advanced placement, international baccalaureate, and concurrent enrollment credit computer science courses; and
3. the number of teachers, and percentage of teachers trained, that started implementing computer science courses limited to middle and high school implementation.

(g) The Department of Education shall make these reports public. The publicly released data shall not include student-level personally identifiable information.

Subd. 5. Teacher preparation. On and after July 1, 2027, any program of teacher preparation leading to professional certification shall include, as part of the curriculum, instruction in computer science as applied to student learning and classroom instruction that are grade-level and subject-area appropriate.

Subd. 6. Computer science education data collection.

(a) The Department of Education shall require all high schools to report data and information about computer science course offerings and enrollment.

(b) The Department of Education shall develop a plan for the secure and regular reporting of computer science course offerings and enrollment data from schools with kindergarten to grade 8 bands within 90 days of enactment of this act.

(c) Data collected in processes described in paragraphs (a) and (b) should be disaggregated by gender, race, ethnicity, free and reduced-price lunch status, Individuals with Disabilities Education Act status, 504 status, and English language learner status.

Subd. 7. Adoption of rules. The Department of Education and Professional Educator Standards and Licensing Board may adopt rules under this section, including rules for flexible options to license computer science teachers, approval codes, technical permits, ancillary licenses, and standard licenses.

Executive Summary

Statement of Purpose

The purpose of this state plan is to provide strategic recommendations for the long-term, equitable, and sustainable growth of computer science education in all K–12 school districts and charter schools across Minnesota.

Addressing persistent disparities in capacity for, access to, participation in, and experience with computer science is a leading theme within this plan. As computer science, including artificial intelligence and cybersecurity, continues to expand and influence various sectors, bridging these gaps becomes increasingly important. Early introduction to Science, Technology, Engineering, Arts and Mathematics (STEAM) and computer science at the elementary level emerges as a pivotal strategy, particularly benefiting individuals who identify with a group historically excluded from computer science by fostering a sense of inclusion and belonging. Furthermore, providing students with early exposure and access to computer science not only instills confidence but also equips them with the necessary skills to navigate an ever-evolving, technology-driven landscape. Prioritizing diverse representation within computing holds transformative potential, offering a means to mitigate the negative impacts and biases inherent in technological innovations.

Computer science education is not solely for students who plan to work in computer science after high school; it is a vital tool in preparing *all* students for the future. Computer science is a foundational skill that teaches problem-solving, adaptability, and communication, and acquiring this knowledge is essential for all students to be successful in career and life.

Vision

Within the next five years, every school district and charter school in Minnesota will include computer science learning opportunities for students in K–12, with a focus on equitable access. More broadly, by receiving a quality and rigorous computer science education, the students of Minnesota will:

- increase their confidence and fluency in computational and critical thinking, problem solving, creativity and collaboration through early exposure to computer science;
- be prepared to compete in a global workforce; and
- understand, navigate, and innovate in response to the impacts of computing on the world.

Recommendations

The following are the key recommendations made by the Computer Science Working Group. All 10 recommendations are needed to set the foundation for a robust and sustainable approach to computer science education. The first five recommendations have been prioritized by the working group as important first steps in achieving this plan. An important component of every recommendation is building awareness in order to address the many misconceptions about computer science and who is able to acquire and harness these skills. Awareness of computer science needs to be introduced early and able to grow over time as access to computer science education increases.

1. **Computer Science Advisory Committee**: The working group recommends creating a Computer Science Advisory Committee to work with the Minnesota Department of Education to inform and support the implementation of the Minnesota Computer Science Education State Strategic Plan.
2. **Teacher Qualification and Licensure**: The working group recommends the creation of multiple qualification and licensure pathways for current and future computer science educators.
3. **Grants and Funding**: The working group recommends, with the goal of supporting equitable scaling of computer science education, funding grants through the Minnesota Department of Education to support technology infrastructure for Local Education Agencies (LEA) and the implementation of district computer science plans.
4. **K–12 Computer Science Pathway**: The working group recommends the authority and allocation of funds to develop K–8 computer science standards, followed by the implementation of those standards through integration into K–5 curriculum, a required middle school computer science course, and the offering of a computer science elective in high school.
5. **Continuous Improvement**: The working group recommends suggested timelines, enhanced data and reporting structures, and an evaluation process and revision cycle for the implementation and advancement of computer science in all K–12 school districts and charter schools.
6. **Awareness Building**: The working group recommends the Minnesota Department of Education and the Computer Science Advisory Committee work with Regional Computer Science Specialists and state partners to execute an awareness building plan to inform identified audiences across the state throughout the implementation of the Minnesota Computer Science Education Plan.
7. **Local Education Agency (LEA) Computer Science Education Plans**: The working group recommends each LEA in Minnesota create a computer science education plan based on the Computer Science Advisory Committee and the Minnesota Department of Education's computer science guidance documents, with the purpose of providing students with computational thinking and computer science learning in grades K–12.

8. **Outside Funding**: The working group recommends the Legislature and the Minnesota Department of Education consider the possibilities of outside funding, such as funding from local industry, to provide additional support for computer science education implementation.
9. **Regional Communities of Learning and Computer Science Specialists**: The working group recommends establishing region-based communities of learning to provide support to local LEAs and educators in learning about the needs and cultural assets of their communities in order to (1) cultivate an environment in which diverse approaches to computer science education are able to flourish, and (2) support LEAs in developing and implementing computer science education plans, including applying for funding/grants.
10. **Graduation Requirements Review Committee**: The working group recommends that the Legislature establish a committee to holistically review high school graduation requirements and make recommendations that are feasible for schools and students, yet still allow choice in electives. (Note: Although incorporating computer science into graduation requirements is not feasible at this time, this important step is a precursor to potentially adjusting the requirements to encompass computer science in the future.)

Introduction

Background

Computer science education in Minnesota is poised to grow. For the past three years, Minnesota has ranked lowest in the nation in terms of access to foundational computer science courses at the high school level (State of CS Report).

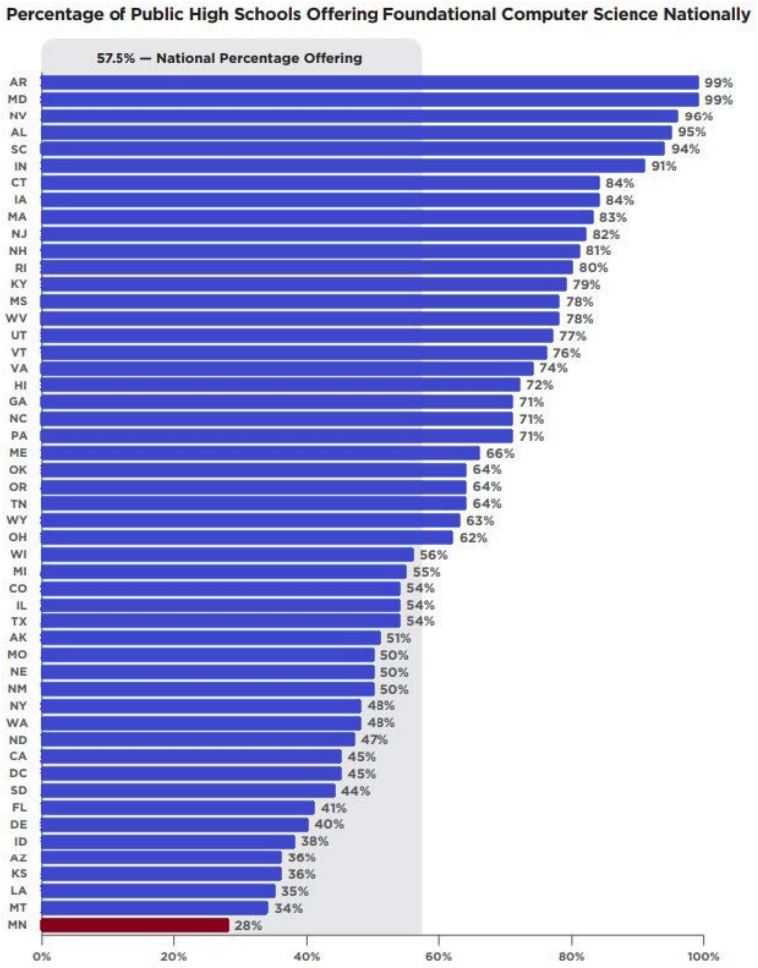


Figure 1 Minnesota's National Ranking in High School Foundational Computer Science Offerings (Source: Code.org)

Although the important work and impacts of individual educators and organizations in expanding access to computer science education is notable, as a state, there is a lack of larger structures and supports such as teacher licensure, funding for professional development, guidance from standards, and consistent data and reporting. The aim of this state strategic plan and its recommendations are to provide a roadmap for establishing long-term, equitable and sustainable growth of computer science education in all K–12 school districts and charter schools across Minnesota.

Code.org's *Ten Policies to Make Computer Science Foundational* outlines 10 policies that are important components in establishing a system for computer science education at the state level (Code.org). These policies provide helpful milestones for educational leaders and policymakers who aim to make computer science education a priority in the state.

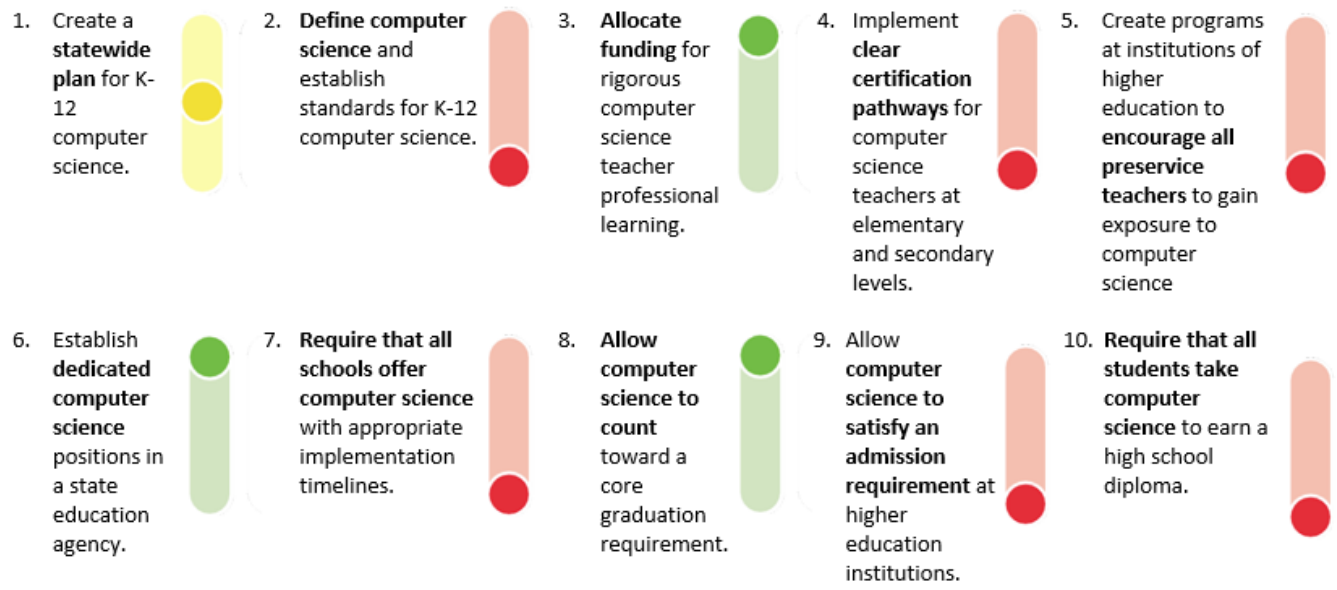


Figure 2 Minnesota Computer Science Policies (Source: Code.org)

As indicated by the green and yellow sliders in Figure 2, out of the 10 policies outlined by Code.org, Minnesota currently has three policies in place (allow computer science to count toward a graduation requirement, dedicated state computer science roles, and funding available for computer science professional development) with a fourth policy in progress (create a state plan). This newly-created state strategic plan offers a path for Minnesota to achieve all 10 policies by outlining recommendations for sustainable growth of K–12 computer science education.

The Minnesota Department of Education's efforts to increase access to computer science started in 2018 by integrating it into required academic standards. Connecting computer science to other content areas helps students explore a variety of ways that computer science impacts the world. Then, on July 14, 2022, the National Governors Association announced that 50 U.S. governors signed the Compact To Expand K–12 Computer Science Education, committing to (1) increase the number of schools offering computer science, (2) allocate funding for computer science, (3) create post-secondary career pathways in computer science, and (4) increase participation in computer science from traditionally underserved populations. Governor Tim Walz showed his support by signing the compact.

Computer Science Working Group

In May 2023, Governor Walz signed the Computer Science Education Advancement Act into law, which included funding for convening a statewide Computer Science Working Group composed of 22 individuals, including educators, industry and nonprofit representatives, community leaders, and high school students. The working group was charged with developing a state strategic plan for long-term and sustained growth of computer science education in all Minnesota K–12 school districts and charter schools. This working group and the department's computer science specialist will help the legislation take shape.

The Minnesota Department of Education convened this working group and facilitated the group's five meetings, held in October and November 2023 and in January, February, and March 2024. The state strategic plan was open for public comment on the Minnesota Department of Education website in February 2024. The request for public comment elicited over 200 comments. This feedback was received via an online survey as well as by way of five virtual feedback Zoom sessions.

The following is a summary of the demographics of the public feedback survey respondents (based on 138 survey responses):

83% educators
6% parents/guardians
0% students
3% residents of Minnesota
9% business/industry

Ethnicity of Respondents

Answer Choice for Ethnicity	Response %
American Indian	2.2
Black or African American	0.7
Hispanic or Latino	1.4
Prefer not to answer	12.3
Two or more races	1.4
White	42.8

Gender of Respondents

Answer Choice for Gender	Response %
Man	18.1
Non-binary	1.4
Prefer not to say	9.4
Woman	28.3

Geography of Respondents

Answer Choice for Geography	Response %
Rural	21.0
Suburban	18.8
Urban	15.2

Regional Location of Respondents

Answer Choice for Regional Location	Response %
Central Minnesota	12.3
North Central Minnesota	0.7
Northeast Minnesota	8.0
Northwest Minnesota	0.0
Southeast Minnesota	5.8
Southwest Minnesota	2.9
Twin Cities Metro	23.9
West Central Minnesota	0.0

Type of Educator (from Educator Demographic Group)

Answer Choice for Type of Educator	Response %
Administration (District and/or School Leadership team)	37.45
Teacher	24.1
Computer science teacher	16.9
Other (please describe)	16.9
STEM teacher	15.7
Library media specialist	13.3
Career and Technical Education (CTE) teacher	12.1
Science teacher	10.8
Mathematics teacher	9.6
Technology integrationist	8.4
Elementary school teacher	8.4
Social studies teacher	3.6
Community youth organization	2.4
Teacher of English learners	2.4
Pre-kindergarten/Early childhood educator	1.2
Special education teacher	1.2
Arts (visual, music, media, theater, and dance) teacher	1.2
Non-Licensed/Non-Instructional staff	1.2

The survey gathered feedback related to participants' support of computer science education in general, support of the recommendations in the plan, and potential barriers to successful implementation as well as ways to mitigate those barriers. Overall, the recommendations were supported across all groups (no student responses were received) with some exceptions (see information below). Participants identified that the biggest barriers to successful implementation were "too many conflicting priorities" and "lack of time/resources."

The following is a summary of survey participants' responses, relative to key questions and recommendations:

Agreement that it is important for all students to have the opportunity to learn computer science

- Educators – 94%
- Parents/guardians – 87.5%
- Residents of Minnesota – 100%
- Business/industry – 100%

Educators' Survey Responses to Each Key Recommendation (Total respondents: 114)

Educator Survey Recommendations	Response
Data and Reporting	Support
Teacher Licensure	Support, except sunsetting mathematics licensure permission and adding computer science to licensure renewal requirements
High Quality Professional Development (PD) (all areas)	Support
Standards (all areas)	Support

Parents'/Guardians' Responses to Each Key Recommendation (Total respondents: 8)

Parent/Guardian's Recommendations	Response
Data and Reporting	Support, except data collection plan
Teacher Licensure	Support, except split on micro-credentials, updating Career and Technical Education (CTE) license pathways, and staffing recommendations
High Quality PD	Split, except do not support computer science advisory committee and do not support shifting grant cycle from two to three years
Standards	Do not support, except split on awareness building

Residents' Responses to Each Key Recommendation (Total respondents: 4)

Residents' Recommendations	Response
Data and Reporting	Support
Teacher Licensure	Support, except do not support micro-credentialing or sunsetting of mathematics license permission
High Quality PD	Support
Standards	Support, except middle school requirement and high school elective

Industry Responses to Each Key Recommendation (Total respondents: 12)

Industry Recommendations	Response
Data and Reporting	Support
Teacher Licensure	Support
High Quality PD	Support
Standards	Support

The working group organized, discussed, and incorporated this public feedback into the state strategic plan. When reviewing the feedback and making decisions about revisions to recommendations, the working group considered the number of respondents who did or did not support a recommendation, the reasons given for supporting or not supporting, and any possible unintended consequences that were suggested.

The only recommendations that were not supported by more than one respondent group were the sunsetting of mathematics licensure permission to teach computer science and the establishment of a micro-credentialing system as a pathway to computer science licensure. In response to the feedback on sunsetting mathematics licensure permissions, the working group modified the recommendation to include a longer timeline and a review process once new computer science licenses are established. In regards to the feedback on micro-credentialing, the working group continues to recommend that exploring micro-credentialing is an important effort in the state's goal to reduce barriers to computer science licensure and to keep pace with other states who have successfully implemented these programs. Full details on both of these recommendations can be found in the licensure section of this report.

The feedback indicated that clarification of the key recommendations was needed. A subgroup of the working group revised and consolidated the recommendations to address this request, and the recommendations were prioritized and organized to reflect the work's important first steps. Additionally, the awareness building and funding recommendations were added as a component of each recommendation. Finally, the standards recommendation was revised to incorporate the full K–12 sequence and is now titled *K–12 Computer Science Pathway*.

The finalized version of the Computer Science State Strategic Plan will be presented to the Minnesota legislature in March 2024.

Strategic Priorities of Minnesota's Computer Science Education State Plan

In order to ensure successful implementation of the plan's recommendations, the working group has aligned the recommendations to the Capacity, Access, Participation and Experience (CAPE) Framework (Figure 3), which outlines essential components in establishing equitable computer science education ecosystems (Fletcher).

The Capacity component within the CAPE Framework includes who is teaching, what professional development they receive, what preparation they have had, what resources they have access to, and the policies that are in place at the school or district level. The Access component refers to where, when, and how computer science courses are offered. The Participation component refers to student enrollment and ensuring equitable representation based on school population. The Experience component refers to a sense of belonging, identity,

and success in computer science learning experiences. The Access, Participation, and Experience components are measured by looking at local disaggregated data by student groups. Consideration of this framework is important in order to ensure equitable and sustainable growth of computer science education.

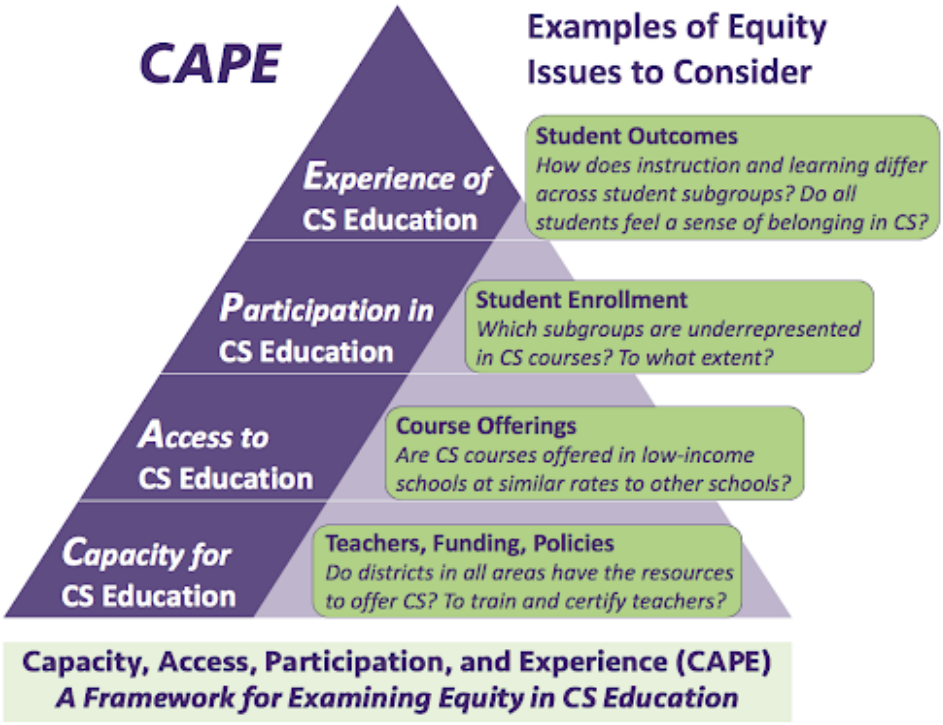


Figure 3 CAPE Framework (Source: Association for Computing Machinery (ACM))

To cultivate an inclusive and empowered generation of learners prepared for the digital world, the working group developed 10 key recommendations aligned with each component of the CAPE Framework. These comprehensive recommendations are considered essential to establish a robust and sustainable approach to computer science education.

The strategies and timeline to accomplish the recommendations are described in detail in the Analysis section of this report. An overview of the recommendations can also be found in Appendix 1.

Analysis

Data and Reporting Summary

Purpose

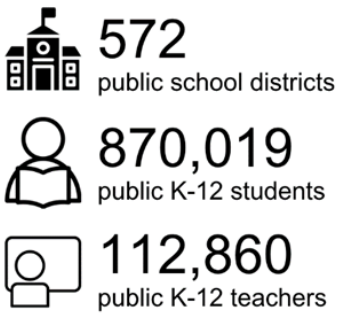
The 2023 Computer Science Education Advancement Act requested a summary of the current state landscape for K–12 computer science education. The legislation specifically outlined requests for information on the diversity of students taking computer science courses and a description of existing gaps in computer science education access, participation and experience by geography and subgroups of students. The legislation also requested a description of how to equitably address these gaps.

Data in landscape reports provide a snapshot of the current context, including gaps in access, participation and success, all of which inform policy and decision-making. By understanding Minnesota's current landscape for computer science education, it is possible to benchmark the current state of computer science education, identify existing gaps, and track progress towards closing those gaps. The data can help us understand how to broaden participation in computer science, particularly for groups historically marginalized in the subject.

The Minnesota Department of Education requires school districts to report data on teachers, courses and students each year. The data used in this report is primarily from the department and the Professional Educator Licensing and Standards Board (PELSB), but some data is from the College Board. Therefore, this data snapshot, while providing the best available data currently, will also illustrate existing gaps and suggest more robust data collection, which is imperative to launching a new computer science program and understanding whether it is successful or not for all students in Minnesota.

State Profile

The following information provides a statewide snapshot of Minnesota K–12 student and teacher demographics; this data encompasses all Minnesota students and teachers and is not restricted to participation in computer science education. Data specific to computer science are provided in the following sections.



Overall Minnesota Student and Teacher Data

- There are 572 LEAs (including school districts and charter schools) in Minnesota.
- There are 870,019 public K–12 students.
- There are 112,860 public K–12 teachers.

Figure 4 Minnesota K–12 School Demographics (Source: Minnesota Department of Education Data Reports and Analytics)

Student Gender Demographics

- 49% of K–12 students identify as female, and 51% identify as male. *Note: Other student gender identities are not collected.*
- **Note:** 64% of all Minnesota public teachers are female, and 53% of Minnesota computer science teachers are female.

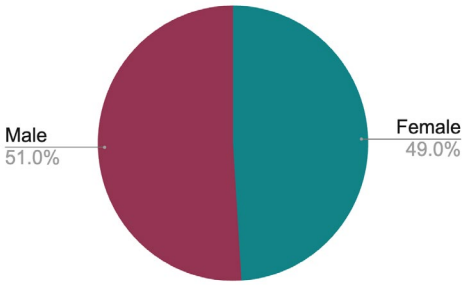


Figure 5 Student Gender Demographics (Source: Minnesota Department of Education, Data Reports and Analytics)

Student Racial and Ethnic Demographics

- 62.33% of White students
- 10.55% of Hispanic or Latino students
- 11.71% of Black or African American students
- 6.99% of Asian students
- 4.99% of students who are two or more races
- 3.22% of American Indian students
- 0.11 % of Native Hawaiian/Pacific Islander students
- 0.09% of Other Indigenous students
- **Note:** 84% of all Minnesota teachers are white, and 79% of Minnesota computer science teachers are white.

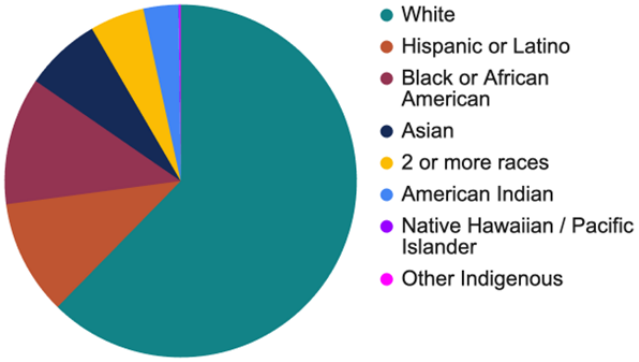


Figure 6 Student Racial and Ethnic Demographics (Source: Minnesota Department of Education Data Reports and Analytics)

Other Student Demographic Categories

- 43% Free or Reduced Price Meals
- 18% Special Education Services
- 9% English Learners
- 1% Homeless

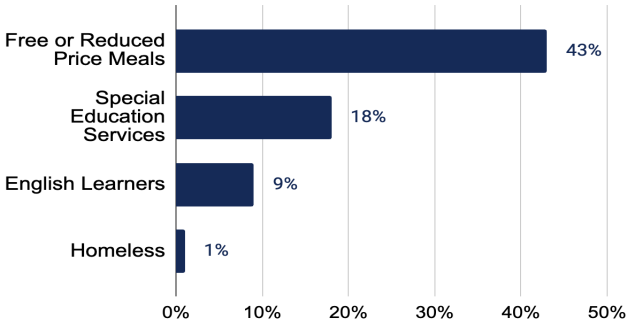


Figure 7 Other Student Demographics (Source: Minnesota Department of Education Data Reports and Analytics)

Computer Science Data

Significant disparities exist for Minnesota's students in both access to computer science teachers and courses. Teachers need professional learning that leads to licensure or qualifications in computer science. Students from historically marginalized backgrounds in computer science (female, students of color, rural communities, students with disabilities, and English learners) have less access to computer science and participate in computer science courses at lower rates.

Teachers

In 2022–23, only 209 teachers in the state were assigned to teach computer science for at least a portion of their day. For many reasons, access to teachers who are able to teach computer science is currently a significant constraint to advancing the expansion of computer science curriculum in Minnesota.

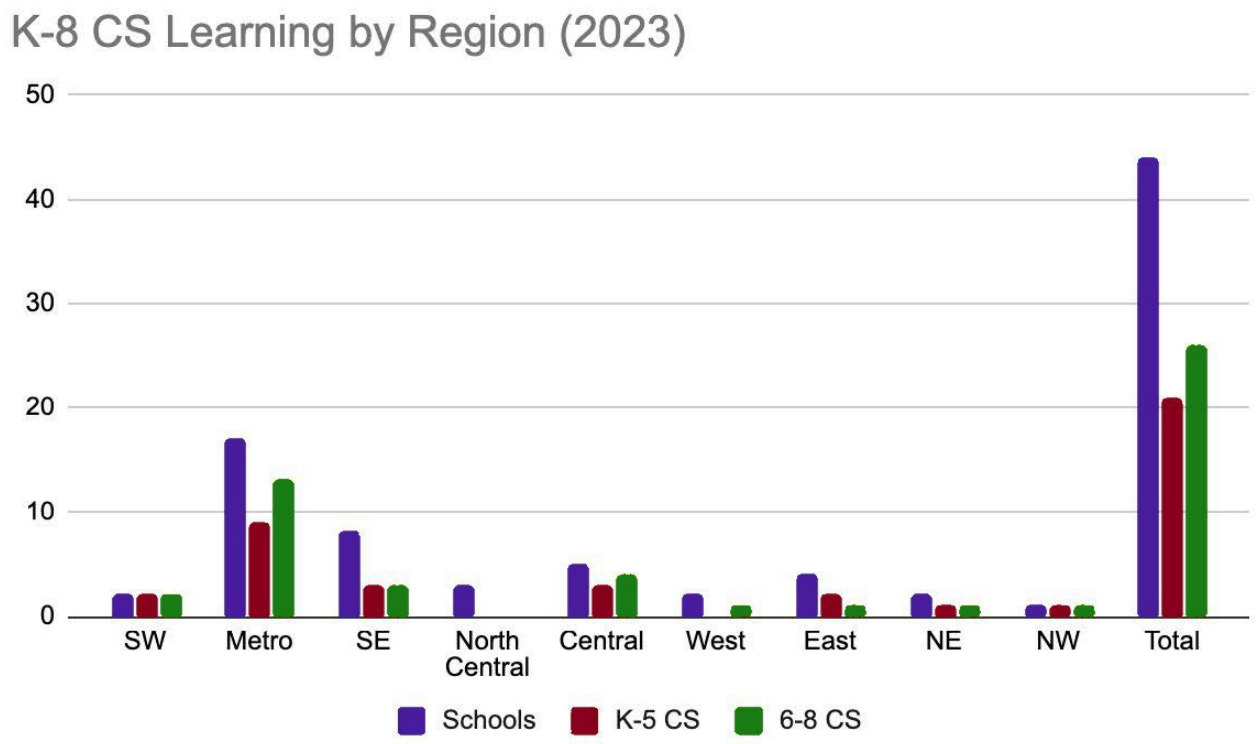
- Although secondary computer science can be taught by teachers with a library media specialist, mathematics, business, or communication and technology careers license, no current license exists specifically for computer science.
- There is a lack of opportunities for computer science training and a lack of funding for those trainings.
- Teacher education programs do not yet include computer science; barriers include funding to develop programs, faculty expertise and a lack of state guidance.
- Overall, teacher shortages are a significant concern for most districts in the state, especially for rural Minnesota, and this shortage impacts choices about offering elective courses such as computer science.

K–8 Students

MDE began initial collection of K–8 computer science data in the fall of 2023 via a survey shared widely across the state. Forty-four schools or districts responded. Currently, this survey's limited results are the only available data about student access to and participation in K–8 computer science education.

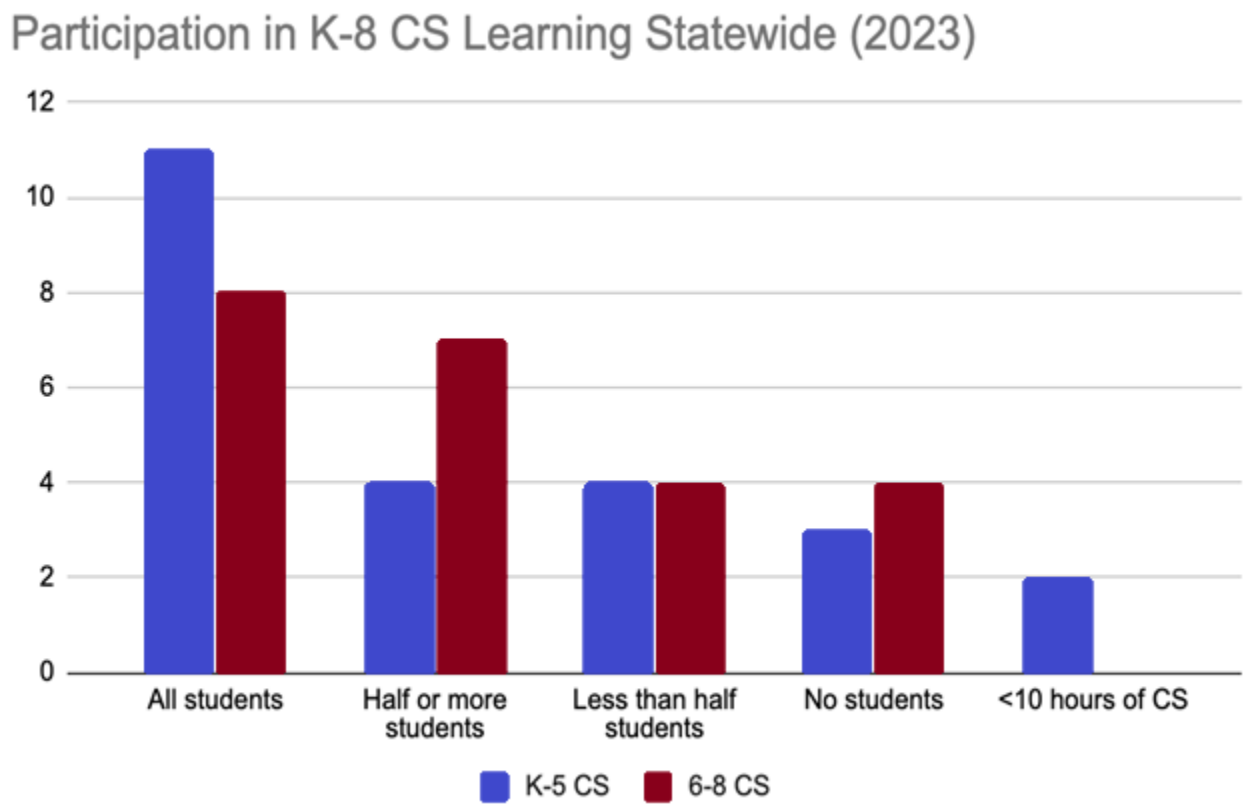
- Access:
    - About half of respondents offer elementary computer science, and 60% offer computer science in grades 6–8.
    - Three out of four responding elementary schools teach computer science as a standalone subject using a specialist.
    - Two out of three responding middle schools teach computer science as a standalone course.

Region	Number of Schools	Grades K–5	Grades 6–8
Southwest (SW)	2	2	2
Metro	17	9	13
Southeast (SE)	8	3	3
North Central	3	0	0
Central	5	3	4
West	2	0	1
East	4	2	1
Northeast (NE)	2	1	1
Northwest (NW)	1	1	1
Total	44	21	26



- Participation: In the survey, respondents indicated how many students participated in at least 10 hours of computer science learning each year.

Participation	Grades K–5	Grades 6–8
All students	11	8
Half or more students	4	7
Less than half students	4	4
No students	3	4
Less than 10 hours of Computer Science	2	-



- Experience: Currently, no data has been collected statewide about the learning experiences of K–8 students taking computer science courses.
- Identified needs include administrative support, professional development, curriculum and funding.
- K–8 computer science course description was added to the Minnesota Common Course Catalogue (MCCC) in 2023.

9–12 Students

In 2021–22, over half of the state's 816 public high schools did **not** report course data to the MCCC. Therefore, the data provided below and in Figure 8 is not a complete picture of Minnesota high school computer science education. The analysis draws from the computer science courses listed in the MCCC, which include programming, robotics, data science, databases, information systems, cybersecurity, artificial intelligence (AI) and machine learning, networking, and information technology. Additionally, because data on Advanced Placement (AP) computer science is available for all students who took either the AP Computer Science Principles or AP Computer Science A exam, this data is also included. Not all student demographic groups are available for all data sets shown below, and some data is suppressed due to student privacy policies.

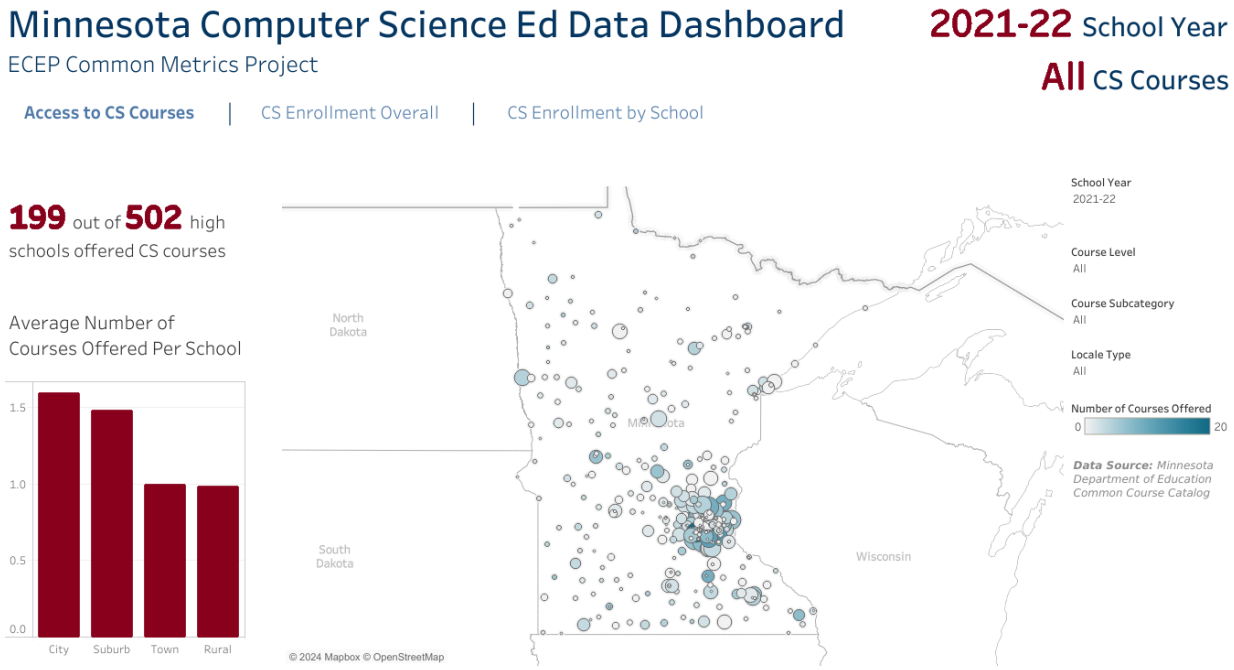


Figure 8 Minnesota Computer Science Education Data Dashboard (Source: Tableau Public)

Access:

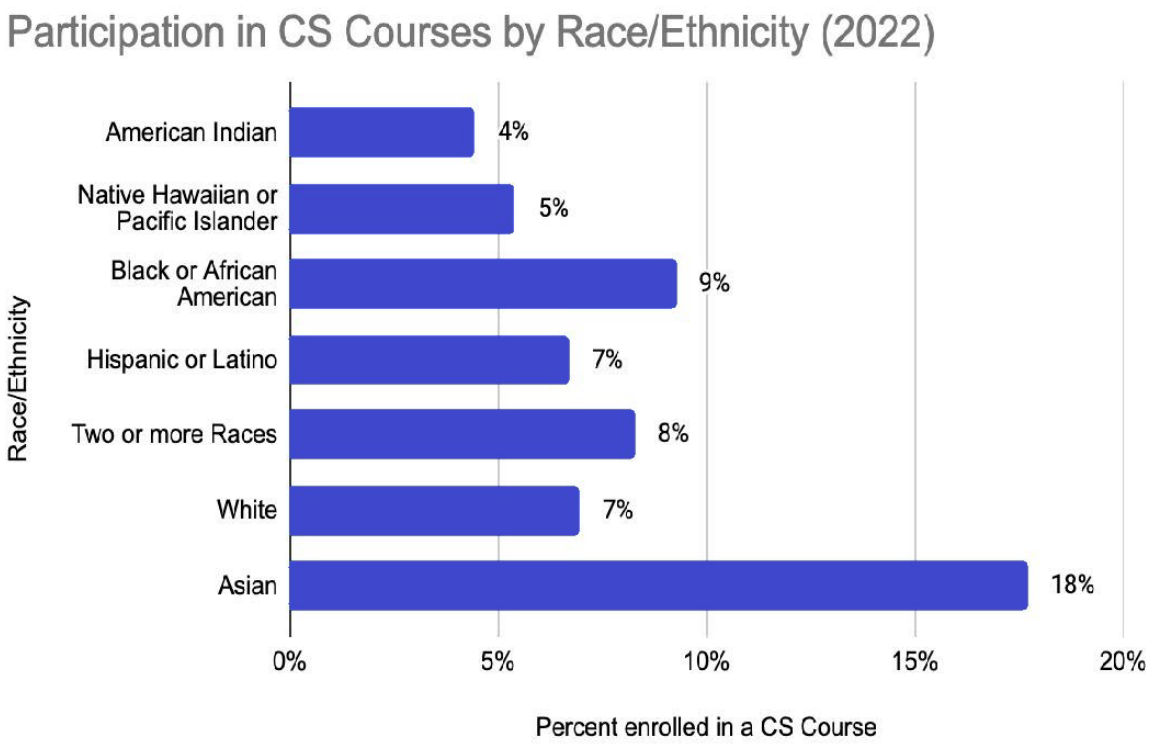
- 199 out of 502 high schools offered any type of computer science course (basic or advanced, core computer science, computer science-related) in 2021–22.
    - Advanced courses are more likely to be offered in schools located in cities versus schools in suburbs, towns or rural areas.
    - Core computer science courses, which include more programming-focused courses, are more likely to be offered in cities whereas computer science-related courses are more likely to be offered in schools in suburbs, towns or rural areas.
    - Schools in cities or suburbs were more likely to offer computer science courses than those in towns or rural areas.

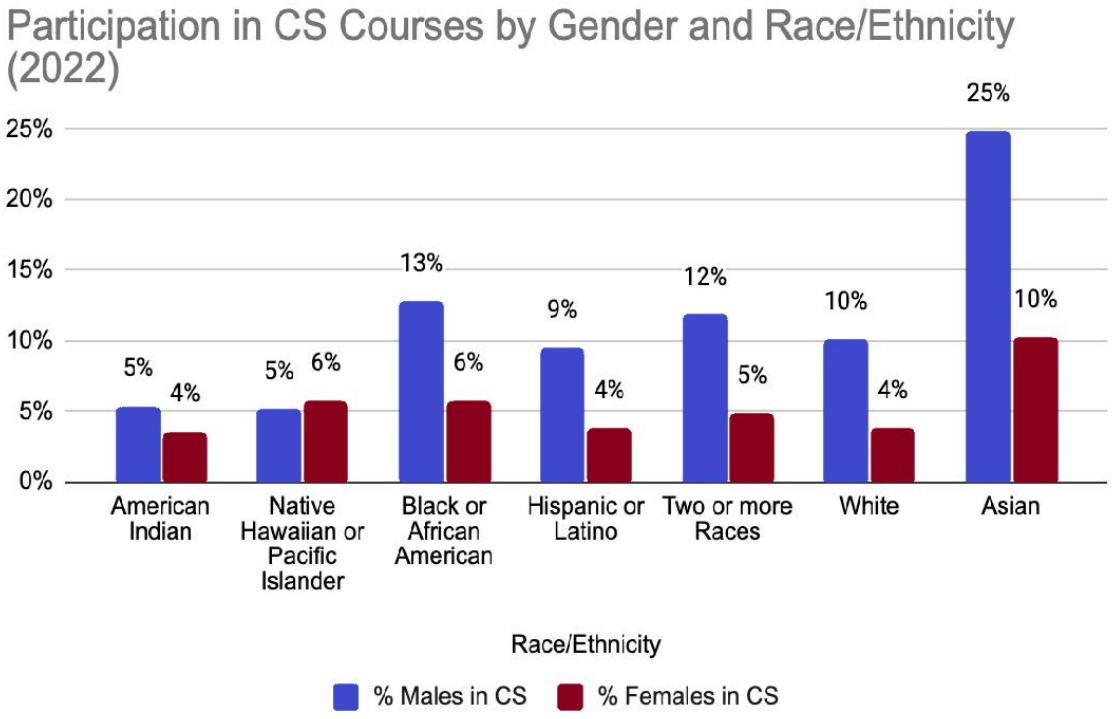
- Additional data can be explored online using the Minnesota Computer Science Ed Data Dashboard.
- 68 of 85 schools offering AP computer science courses in 2023 are in the Twin Cities metro region.

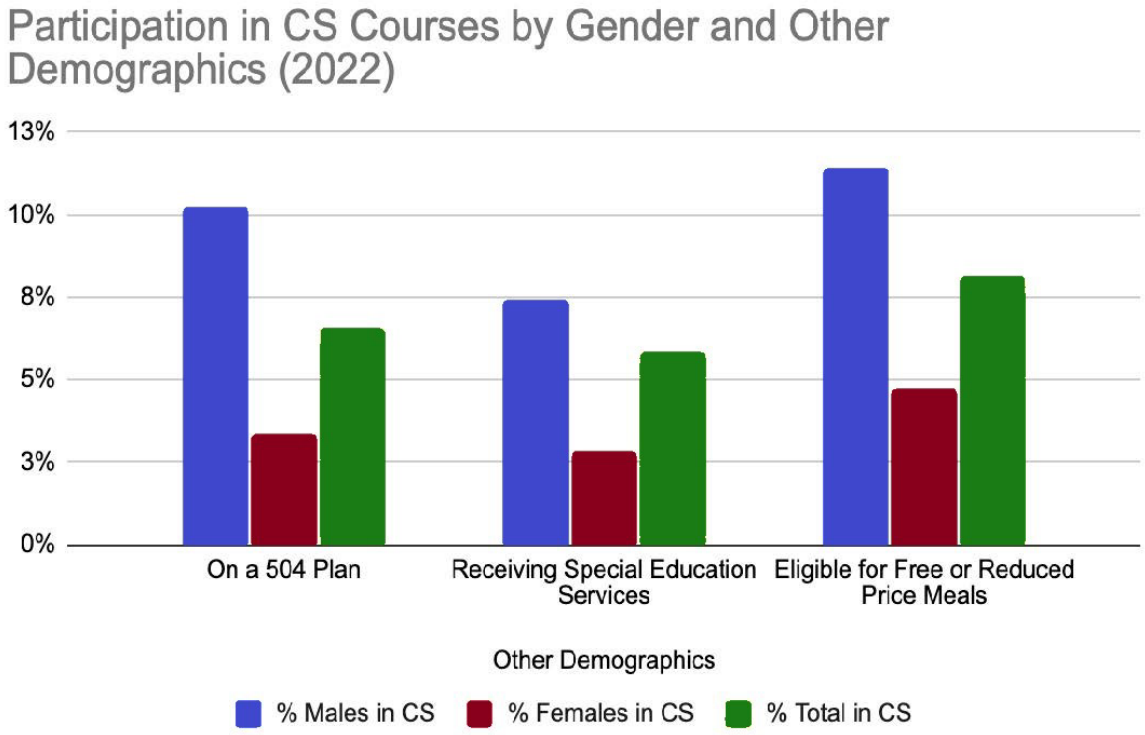
Region	Number of Schools w/AP Computer Science Principles and/or AP Computer Science A
Northwest (Regions 1 and 2)	0
Northeast (Region 3)	1
West (Region 4)	1
North Central (Region 5)	0
Southwest (Regions 6E, 6W, 8, 9)	4
Central (Region 7E and 7W)	5
Southeast (Region 10)	6
Metro (Region 11)	68

Participation:

- Percentage of high school students enrolled in a computer science course in 2021–22
  - 8% of all high school students
  - 4% of high school females; 11% of high school males
  - 4% of American Indian or Alaska Native high school students
  - 5% of Native Hawaiian or Pacific Islander students
  - 7% of Hispanic or Latino students
  - 7% of White students
  - 8% of students who are more than two races
  - 9% of Black students
  - 18% of Asian students
  - 7% of students on a 504 plan
  - 6% of students receiving special education services
  - 8% of students eligible for free or reduced price meals


Participation in CS Courses by Race/Ethnicity (2022)
American Indian
Native Hawaiian or Pacific Islander
Black or African American
Hispanic or Latino
Two or more Races
White
Asian
4%
5%
9%
7%
8%
7%
18%
Race/Ethnicity
0%
5%
10%
15%
20%
Percent enrolled in a CS Course


Participation in CS Courses by Gender and Race/Ethnicity (2022)
25%
20%
15%
10%
5%
0%
5%
4%
5%
6%
13%
6%
9%
4%
12%
5%
10%
4%
25%
10%
American Indian
Native Hawaiian or Pacific Islander
Black or African American
Hispanic or Latino
Two or more Races
White
Asian
Race/Ethnicity
% Males in CS
% Females in CS



- Percentage of high school students taking an AP computer science exam in 2022
    - 0.65% (1,811) of all high school students
    - 0.95% (1,353) of high school males
    - 0.32% (441) of high school females
    - 0.53% (954) of White high school students
    - 2.43% (443) of Asian high school students
    - 0.35% (110) of Black high school students
    - 0.70% (100) of Two or more high school students
    - 0.33% (97) of Hispanic or Latino students
    - 0.23% (11) of American Indian or Alaska Native high school students
    - 0.76% (1) of Native Hawaiian or Pacific Islander high school students

Experience:

In their article *CAPE: A Framework for Assessing Equity throughout the Computer Science Education Ecosystem*, Carol L. Fletcher and Jayce R. Warner state, "Experience of CS education encompasses the various outcomes of participating in CS. The overarching questions here are: When students participate in CS, do they have equitable learning experiences? What have they learned? Are their experiences culturally and personally relevant? Are students successful academically? Do all students feel welcome in the class?"

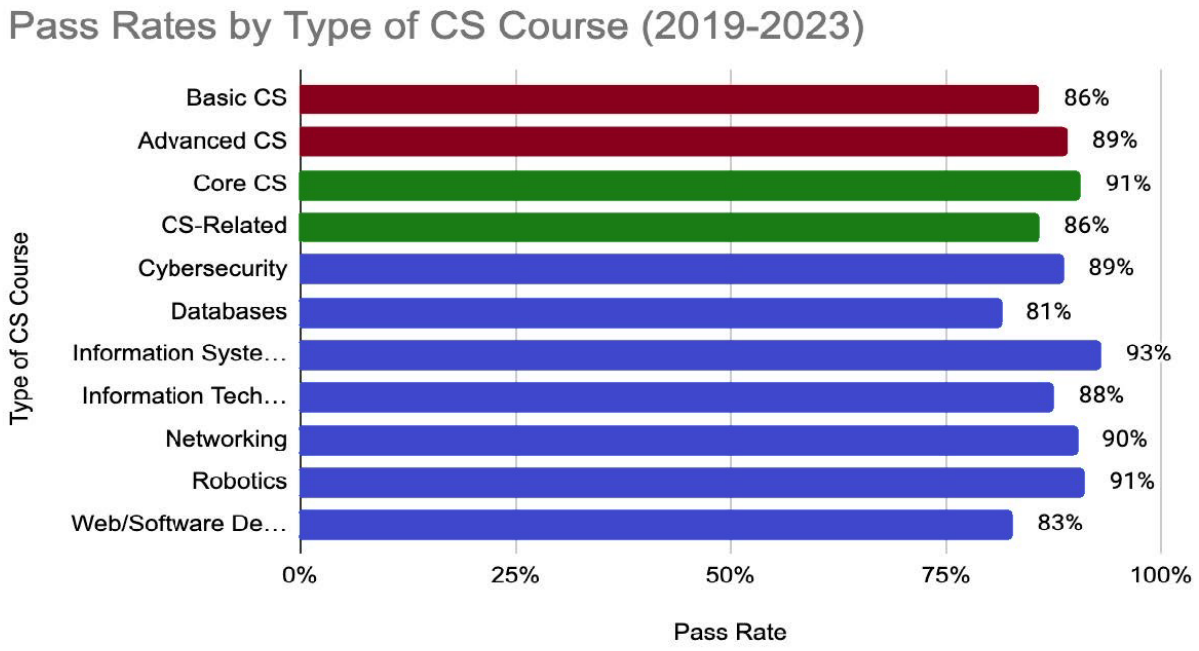
Students' experience of computer science education encompasses not only their success in the course (i.e., passing the course), but also the outcomes related to their sense of belonging, confidence, personal and cultural

relevance, and other attitudinal outcomes (Fletcher and Warner 2021). Currently, however, Minnesota collects only computer science success data in regards to student learning outcomes, or, in other words, whether or not a student passes a course.

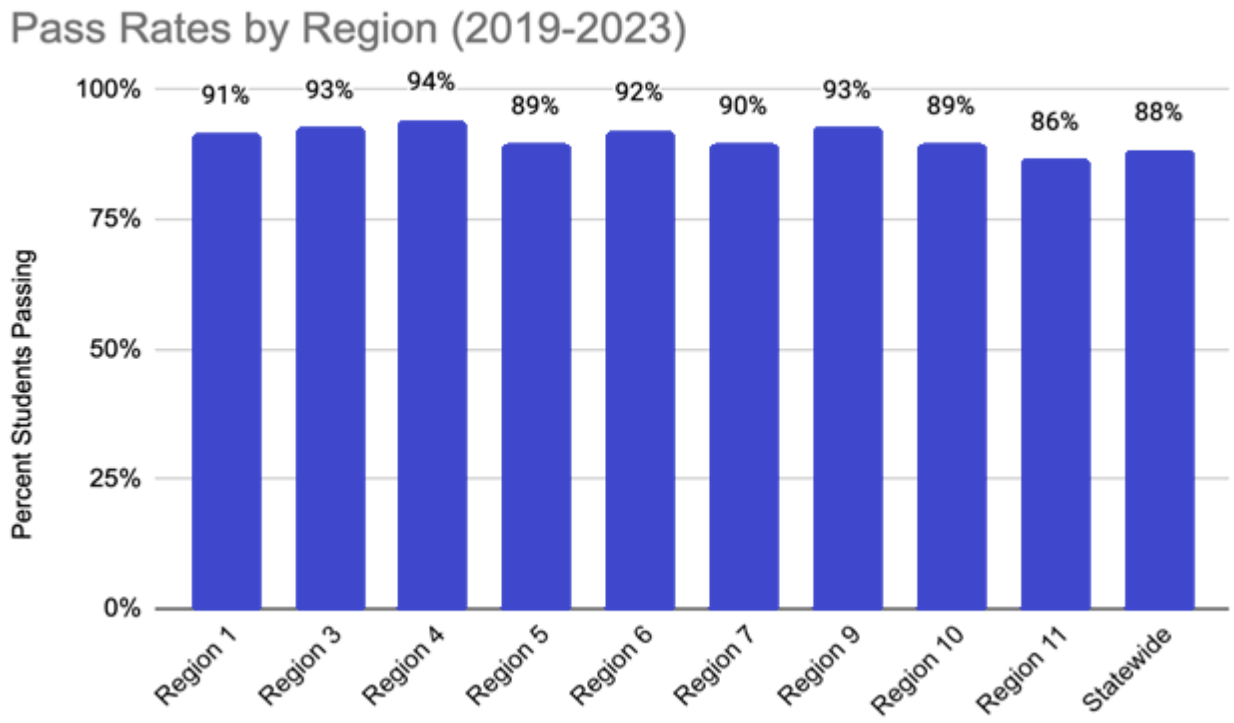
Minnesota Common Course Catalogue (MCCC) Computer Science:

- 88% pass rate average for all students in all computer science courses from 2018–19 to 2022–23
- Student pass rates for basic and advanced computer science courses are similar (86% basic and 89% advanced)
- Student pass rates for Databases and Web/Software Development are slightly lower (81% and 83% respectively) than other areas of computer science, including core computer science classes (91%)

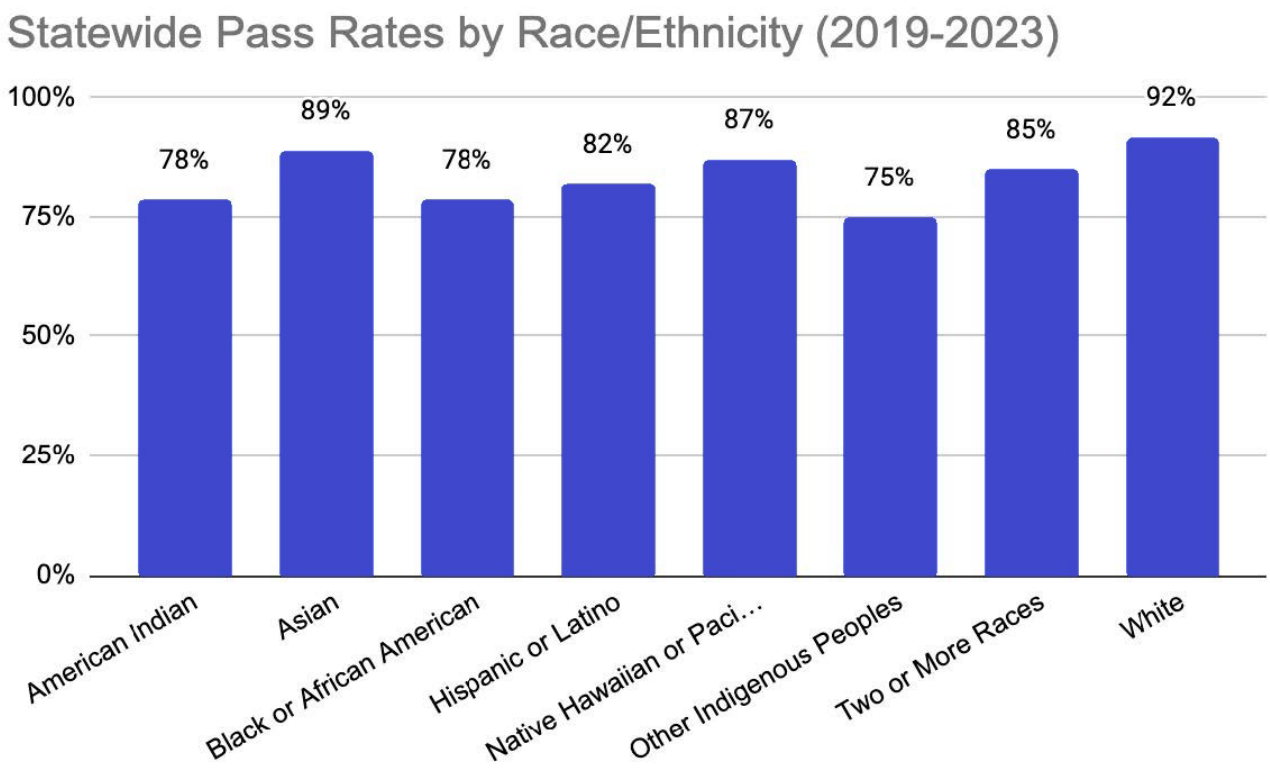
Type of Computer Science (CS) Course	Pass Rate for Type of CS Course
Basic CS	86%
Advanced CS	89%
Core CS	91%
CS-Related	86%
Cybersecurity	89%
Databases	81%
Information Systems	93%
Information Technology	88%
Networking	90%
Robotics	91%
Web/Software Development	83%



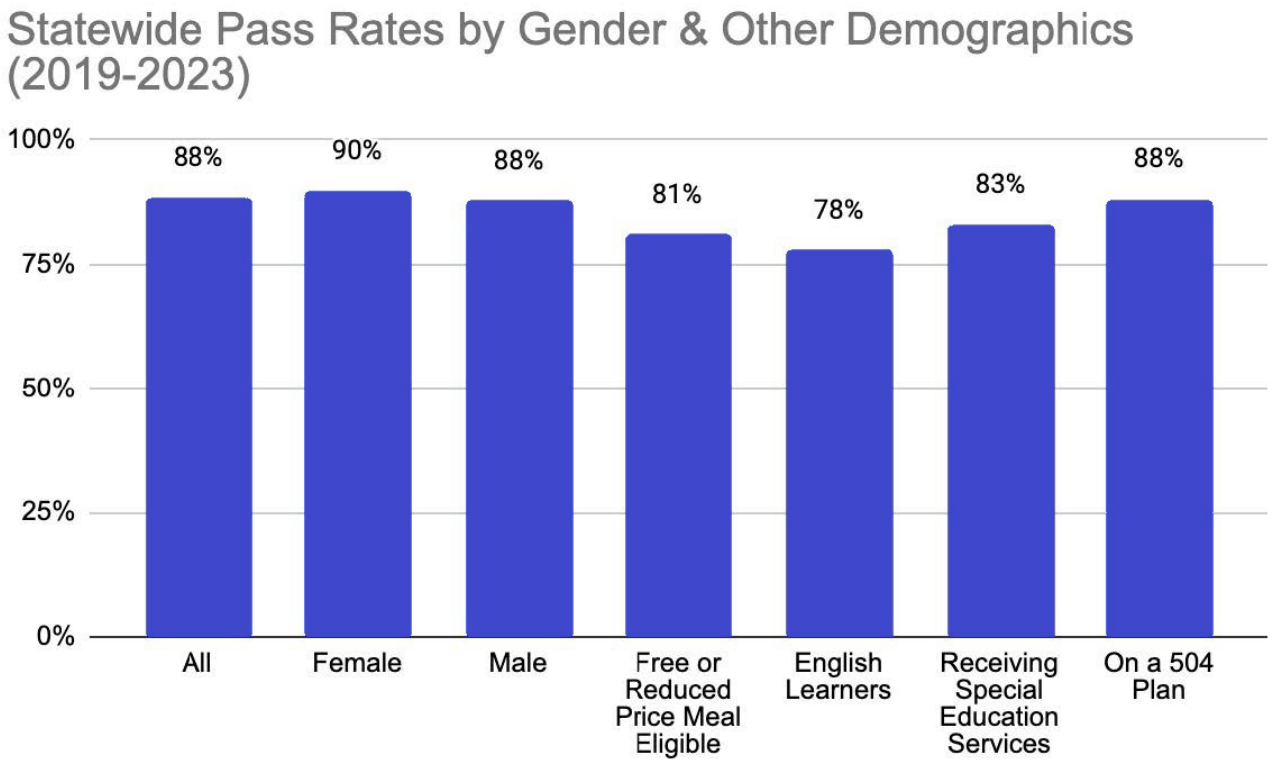
Region	Pass Rate for Region
Region 1	91%
Region 3	93%
Region 4	94%
Region 5	89%
Region 6	92%
Region 7	90%
Region 9	93%
Region 10	89%
Region 11	86%
Statewide	88%



Race/Ethnicity	Statewide Pass Rate for Race/Ethnicity
American Indian	78%
Asian	89%
Black or African American	78%
Hispanic or Latino	82%
Native Hawaiian or Pacific Islander	87%
Other Indigenous Peoples	75%
Two or More Races	85%
White	92%



Gender and Other Demographics	Statewide Pass Rate for Gender/Other Demographics
All	88%
Female	90%
Male	88%
Free or Reduced Price Meal Eligible	81%
English Learners	78%
Receiving Specical Eduation Services	83%
On a 504 Plan	88%



Advanced Placement Computer Science (2022):

- 74% of students taking an AP computer science exam passed the exam (earned a score of 3, 4 or 5)
- 77% of male students passed the AP Computer Science Principles (CSP) exam and 68% passed the AP Computer Science A (CSA) exam
- 84% of female students passed the AP CSP exam and 71% passed the AP CSA exam
- 85% of White students passed the AP CSP exam and 72% passed the AP CSA exam
- 47% of Black students passed the AP CSP exam and 39% passed the AP CSA exam

Technology Infrastructure

Technology infrastructure—both at school and home—is integral to computer science learning. While the use of unplugged computer science activities (activities that do not require a computer) is valuable in teaching computer science, a computer and internet access is essential for learning programming and other concepts beginning in upper elementary. Large gaps in access to broadband and computers exist across the state, mainly in rural areas and for marginalized and under-resourced populations. These gaps will affect equitable access to existing and new computer science education.

Access to Broadband Internet

- 21% of Minnesota residents do not have access
- 44% of households below the poverty line do not have access
- 30% of households with limited English Proficiency lack access to broadband
- 43% of rural residents do not have access
- 43% of racial/ethnic minorities do not have access

Access to a Computer, Laptop or Tablet

- 11% of students do not have access to a digital device (personal or school)
- 65% of students receive their primary learning device from their school
- 14% of students share their primary learning device

Summary of Gaps

- Teacher gaps
    - The absence of certification in computer science makes it difficult to track who is qualified to teach it.
    - Teacher shortages in rural and other areas make it difficult to offer computer science courses and to assign teachers with in-demand licenses, such as mathematics, to teach computer science.
- K–8 gaps
    - There is a lack of data on Minnesota K–8 computer science offerings; out of Minnesota's 572 LEAs, only 44 responded to a survey to report offering computer science in K–8.
    - The limited number of survey responses makes it difficult to draw conclusions and highlight gaps about K–8 computer science.
- 9–12 gaps
    - Access: There are gaps in access to computer science, specifically looking at AP course data, based on geography— more districts in the Twin Cities/Metro offer AP courses than in greater Minnesota. Schools in cities/suburbs across the state were more likely to offer computer science than those in rural areas or towns.

    - Participation: Gaps in computer science participation show that the following student demographic groups are underrepresented: female students, American Indian and Native Hawaiian/Pacific Islander.
    - Experience: According to the MCCC, there is an 88% average pass rate in computer science courses for all students. The following student demographic subgroups have pass rates that are more than 10% below the average: English learners, American Indian, Black/African American, and Other Indigenous.
- Tech Infrastructure gaps
    - Broadband internet access is limited in marginalized communities: below the poverty line, rural, limited English proficiency, racial/ethnic minorities.
    - Many students do not have a permanent primary learning device, instead they may receive one from school, or share one with another person.

Recommendations

The following are the key recommendations made by the Computer Science Working Group. All 10 recommendations are needed to set the foundation for a robust and sustainable approach to computer science education. The first five recommendations have been prioritized by the working group as important first steps in achieving this plan. An important component of every recommendation is building awareness in order to address the many misconceptions about computer science and who is able to acquire and harness these skills. Awareness of computer science needs to be introduced early and able to grow over time as access to computer science education increases.

1. Computer Science Advisory Committee

Recommendation: The working group recommends creating a Computer Science Advisory Committee to work with the Minnesota Department of Education to inform and support the implementation of the Minnesota Computer Science Education State Strategic Plan.

Rationale: A Computer Science Advisory Committee is necessary because the expedited timeline provided for the development of the Computer Science State Strategic Plan didn't allow enough time to fully research or define some of the specific strategies required to equitably provide access to K–12 computer science. Recommendations identified in the Computer Science State Strategic Plan are dynamic and include actions that will be prioritized according to their importance and timelines associated with legislative support. Because computer science is new in Minnesota, it will be important to bring together collective expertise to help guide next steps and implementation.

Sub-Recommendations:

1.1. The scope of the Computer Science Working Group, as defined in the 2023 Computer Science Education Advancement Act (Minn. Stat. 120B.241, subd. 3), is expanded to include the sub-recommendations below, and will function as the Computer Science Advisory Committee.

1.2. The Minnesota Department of Education and the Computer Science Advisory Committee will develop a data collection plan for school districts to retrieve an accurate count of access, participation, and success in computer science education across grades K–12.

1.2.1. Review and evaluate how data is currently being collected to understand what existing data tools can be used and if additional tools are needed.

1.3. The Minnesota Department of Education and the Computer Science Advisory Committee will define key performance indicators and success measures of computer science education in Minnesota.

1.3.1. Some examples could include:

a. Number of schools offering courses—breakdown by type of course, K–5, 5–8 and 9–12
b. Participation by key student demographics
c. Student success data
d. Number of qualified teachers

1.4. The Minnesota Department of Education and the Computer Science Advisory Committee will create K–12 computer science guidance documents for schools and districts.

1.4.1. This document should define what computer science is and outline what computer science skills instruction would look like at various grade levels (for example, a list of possible grade-level benchmark skills, computer science courses, adopting Computer Science Teachers Associations [CSTA] K–12 Computer Science Standards, etc.).

1.4.2. This document should address equity in computer science, including equitable teaching practices and how to break down barriers to access, participation, and experience in computer science classes for historically excluded student groups. Once launched, this is an ongoing process to maintain.

1.4.2.1. Expand computer science access to schools that serve rural populations and low-income populations.

1.4.2.2. Use data to identify strategies to recruit underrepresented populations into computer science programs.

1.4.2.3. Develop a plan to increase diversity: Increase the number of female and racial and ethnic minority students. Reference CSTA *Standards for CS Teachers*: Standard 2 as a base plan to address equity.

1.4.2.4. Ensure that all curriculum and course content is accessible to people with disabilities.

1.4.2.5. Ensure access for the Tribal Nations and Indigenous communities of Minnesota.

1.4.3. This document will outline key components of LEA computer science plans, providing students with computational thinking and computer science learning in grades K–12.

1.4.4. Provide guidance and facilitate access to elective computer science certifications for high school students that are industry-recognized and vendor-neutral.

1.4.5. Alignment of career-ready standards between the Minnesota computer science guidance documents and secondary education and/or a career in the computer science field.

1.5. The working group recommends the Minnesota Department of Education and the Computer Science Advisory Committee work with Regional Computer Science Specialists and state partners to execute an awareness building plan to inform identified audiences across the state throughout the implementation of the Computer Science State Strategic Plan.

1.6. The Minnesota Department of Education and the Computer Science Advisory Committee will plan and support the creation of region-based communities of learning to provide support to local LEAs and educators in learning about the needs and cultural assets of their communities in order to (a) cultivate an environment in which diverse approaches to computer science education are able to flourish, and (b) support LEAs in developing and implementing computer science education plans, including applying for funding/grants.

1.7. The Legislature should empower the Minnesota Department of Education to convene a Computer Science Advisory Committee with the goal of determining the criteria for what constitutes a high-quality, culturally responsive program of professional learning. There currently exist many guideline documents and evaluative tools which can serve as a basis for this delineation. These include:

1.7.1. The Computer Science Teachers Association PD Alignment Rubrics

1.7.2. The Teacher Accessibility, Equity, and Content Rubric for Evaluating Computing Curricula developed by the University of Chicago and University of Maryland's Canon Lab

1.7.3. The Kapor Center's Culturally Responsive-Sustaining Computer Science Framework

1.8. Ensure that educator professional learning supports both standalone computer science course development and integrated approaches to computer science education. It is understood that in some contexts, it is preferable for a teacher to teach a standalone computer science course, and in other contexts it is preferable to integrate computer science into another content area such as mathematics or social science. The programs of professional learning that are offered to teachers and therefore should support both approaches.

1.8.1. Elementary and middle schools should not be limited to integrating computer science into another content area, and high schools should not be limited to standalone courses. In the context of an elementary or middle school, standalone computer science

courses are helpful in establishing computer science pathways for students within a school district. In the context of a high school, integrated computer science courses are helpful in terms of providing opportunities for students to explore computer science within a content area of their comfort and interest. An example might be a course which combines computer science and art through web design and app development.

1.8.2. Educators can engage in professional learning across the skill levels and grade bands in order to determine what will meet their students' needs

1.9. The Minnesota Department of Education and the Computer Science Advisory Committee should be tasked with the creation of an evaluative tool or series of rubrics that LEAs and school districts can use to vet and recommend computer science professional learning programs.

1.9.1. The working group recommends that this advisory board also document the process through which they developed this evaluative tool so that this process of creation is repeatable. Such a tool can also be used by the department to provide school districts with a list of computer science professional learning programs that meet the criteria of high-quality learning experience. This tool or series of rubrics should strive to capture the multifaceted nature of teacher professional learning and highlight aspects, including, but not limited to:

1.9.1.1. Foundational computer science content according to grade band

1.9.1.2. Practices in culturally relevant and culturally responsive pedagogy

1.9.1.3. Methods to engage students with varying needs, including, but not limited to, English learners, diverse learners, twice exceptional students and students with disabilities

1.10. Expand the scope of which adults in a school community should receive professional development in foundational computer science concepts. Classroom teachers will largely be the school staff members tasked with computer science pedagogy, but they are not the only school staff members who would both benefit from foundational training in computer science and enrich the professional learning programs in which they participate.

1.10.1. The working group recommends that high-quality computer science training be offered not only to K–12 teachers, but also to school counselors, paraprofessionals, special education specialists and other education support personnel. Each staff member with their particular expertise will bring an invaluable asset to Minnesota's programs of professional learning.

1.10.2. Additionally, the working group recommends two kinds of professional learning opportunities oriented toward school administrators.

1.10.2.1. First, the working group recommends that administrators have access to professional development identifying best practices in developing and sustaining computer science education opportunities within their schools and districts.

1.10.2.2. Second, the working group recommends that administrators have access to professional training oriented toward best practices in evaluating effective computer science education pedagogy. While, in many ways, good computer science teaching is just good teaching, there are particularities in computer science pedagogical strategies that are less common in current core content areas.

1.11. Expand the scope of what learning experiences are considered "professional development." There exist many forms through which teachers can experience high-quality programs of professional learning. While this may include more traditional approaches such as workshops or seminars, the working group encourages the Minnesota Department of Education and the Legislature to embrace the multitude of ways that teachers can learn from one another, as well as the multitude of partners who can aid in bringing such meetings to fruition, including the Minnesota Computer Science Teachers Association, local industry and nonprofit organizations, and Institutes of Higher Education (IHE). This may include annual opportunities for educators to meet with one another and attend local conferences and/or "unconferences" either at the state level or at a more regional level.

1.12. The working group encourages the Minnesota Department of Education and the Legislature to adopt a vision of professional learning as one that is not discrete from community education. While community education efforts do not always meet the same needs as teacher professional development, ensuring that the adults who interact with and influence the students of Minnesota feel a sense of comfort and ownership in computer science will be crucial to highlighting these efforts as truly worthwhile community-oriented endeavors.

1.13. The Legislature will allocate funds for the Minnesota Department of Education and the Computer Science Advisory Committee to create an online computer science resource hub that includes, but is not limited to, resources for teaching (lesson plans), curriculum and learning communities.

1.14. Once standards are implemented, the Minnesota Department of Education and the Computer Science Advisory Committee will revisit the effort to create strategies to expand high school equivalency.

1.15. The working group recommends funding for the Computer Science Advisory Committee as described in the budget.

2. Teacher Qualification and Licensure

Recommendation: The working group recommends the creation of multiple qualification and licensure pathways for current and future computer science educators.

Rationale: One essential component of a computer science education ecosystem is ensuring a steady supply of qualified teachers to support all students learning computer science in Minnesota. Some teachers are teaching computer science in Minnesota despite an absence of state standards and computer science licensure. Currently, teachers who are licensed in secondary mathematics, business, and communication and technology can teach computer science. Library media specialists, grades 5–12 technology teachers (legacy name: Industrial Arts), and teachers with a keyboarding endorsement are also authorized to teach computer science. Licensed elementary teachers can teach computer science up to one-third of their time. Some teachers in the state have other licenses and teach computer science on a variance. The lack of a clear licensure criteria for computer science results in confusion as to who can and cannot teach computer science.

The existing Minnesota legislation (Minn. Stat. 120B.241, subd. 5 [2023]) directs teacher preparation programs to teach computer science at grade-level and subject-area appropriate levels starting July 1, 2027. In Minnesota, there are multiple types of teacher preparation programs: 30+ universities/colleges, Minnesota Association of Colleges of Teacher Education, Minnesota Service Cooperatives (MSC), K–12 school districts, and others.

Teacher education programs will need multiple supports to create computer science licensure and qualification pathways. There are significant barriers to creating high-quality computer science teacher preparation programs, such as buy-in from peer faculty and leaders, limited space within programs, and a lack of guidance about what to include in computer science education programs (CSforAll-MN 2021). Teacher educators will also need guidance on how to integrate computer science into content areas and funding to redesign their programs. This support should initially focus on the current integration of computer science and computational thinking concepts as they have been integrated in the recently revised arts, English language arts, science, and mathematics standards. In addition, programs that license elementary teachers will need to be supported in integrating foundational computer science.

Teaching licensure and endorsement programs are extraordinarily expensive to operate. Coupled with many factors including declining enrollments in licensure programs, high teacher turnover, and teacher shortages (National Academies of Sciences, Engineering, and Medicine, 2020; Partelow, 2019; PELSB, 2023), the working group advises preparation organizations to strategize the development of teacher education programs around the state. Currently, there are 15 states that have computer teacher education programs, which are “typically limited to one or two programs in each state, often at larger universities or colleges” (Ottenbreit-Leftwich et al., 2022, p. 3). In a state like Minnesota, which has over 500 districts that are located primarily in rural settings, strategic planning is necessary in order to best serve students, educators and schools. Computer science education teacher preparation needs to be strategically holistic with multiple access points and programs (including online) that are not solely based in higher education settings.

Classroom teachers are only one part of the K–12 education ecosystem. For change to be effective, other school staff will also need to understand the need for computer science and how to support teachers and students. For example, administrators determine budgets, decide who teaches courses, influence class schedules, evaluate teachers and perform many other tasks. Counselors help determine student schedules, discuss career pathways

with students and families, and help students select courses that align with their career goals. Special education professionals, including both specialists and paraprofessionals, support students in their learning and collaborate closely with classroom teachers. Existing professional learning opportunities (Counselors for Computing, Administrators for Computing, and UDL4CS) target these educators and help them understand how to best support computer science with an equity lens in their schools.

Sub-Recommendations:

2.1. Create new teaching licenses specific to computer science. In FY2025, PELSB and/or the Computer Science Advisory Committee should create the teacher standards needed for each new license using the current CSTA K–12 Computer Science Standards until Minnesota has established state-specific computer science standards. Library media specialists, mathematics, business, communication and technology, technology teachers (legacy name: Industrial Arts), and teachers with a keyboarding endorsement will remain authorized to teach computer science.

2.1.1. Create a Foundational Computer Science Endorsement (K–12) that will provide currently licensed educators with the training and skills necessary to teach computer science based on the Level 1 and 2 of the CSTA standards. The endorsement will focus on providing an understanding of core computer science concepts and practices and also focus on the integration of computer science with other subject areas.

2.1.2. Create a Secondary Computer Science License (5–12) that will allow for teaching in grades 5–12 with the understanding of Levels 2 and 3 of the CSTA standards. Focusing on the advanced concepts and applications of computer science will allow for an educator with this license to teach middle school and high school computer science courses.

2.2. Use multiple and flexible options for computer science teacher qualification and licensure, which allow for immediate, multiple, diverse, flexible pathways for existing teachers to demonstrate competency in order to teach computer science. Multiple pathways will effectively, quickly and affordably address the need for qualified computer science educators. These pathways should be reviewed and refined by the Computer Science Advisory Committee as needed.

2.2.1. Use micro-credentialing platforms and courses as pathways for computer science teacher qualification and licensure. Micro-credentials are “digital certifications that verify an individual’s competence in a specific skill or set of skills” (Digital Promise, December 2023). It is possible to immediately use existing micro-credential courses for teachers to demonstrate competency while state-level computer science standards are being developed. Micro-credentials can be embedded within existing qualification coursework as teacher preparation programs develop the computer science content knowledge of their teacher educators. When the Minnesota computer science licensure

standards are in effect, approved micro-credentials should be included as pathways for teachers to demonstrate qualification for the Foundational Computer Science Endorsement and Secondary Computer Science License.

2.2.1.1. Develop a list of approved state-level micro-credential pathways for teacher qualification.

2.2.1.2. Fund a needs assessment and exploration of systems that support micro-credential pathways to computer science licensure.

2.2.1.3. Micro-credentials could be used to support the Licensure via Portfolio option for an educator earning a Tier 3 teaching license or adding an additional computer science license.

2.2.1.4. Use approved professional learning as pathways for computer science teacher qualification and licensure via micro-credentials. PELSB will determine, and regularly update, approved professional learning offerings in alignment with the recommendations of the Computer Science Advisory Committee. For example, professional learning endorsed by the College Board can be used as a pathway to teach the relevant AP computer science course (CSP or CSA).

2.2.2. Use national tests as pathways for computer science teacher qualification and licensure. For example, teachers can take national tests such as Praxis 5652 to demonstrate computer science competency. Many states currently require this pathway; however, there are multiple equity issues associated with this exam including potential racial and income biases (ECEP, 2022).

2.2.3. Use the existing Licensure via Portfolio pathway for computer science teacher qualification. The Licensure via Portfolio option in Minnesota, which awards a Tier 3 teaching license, can be used by professionals in computer science areas to demonstrate their qualifications to teach specialized computer science courses without going through a formal licensure or endorsement process.

2.3. Develop teacher qualification and licensure programs specific to computer science.

2.4. Develop an expedited approval process with PELSB for programs leading to computer science licensure or endorsement. It will take at least two or more years for universities and other providers to complete internal and external approvals and begin building computer science qualification and licensure programs. PELSB should provide an expedited approval process for initial approval of these programs.

2.5. Update the existing library media specialist license to include the teaching of foundational computer science. Library media specialists should be able to be teachers of record for

foundational computer science classes. A list of these specific computer science courses should be identified in Staff Automated Reporting (STAR).

2.6. Review and update the existing CTE license pathways to provide updated options for computer science qualification in collaboration with the Minnesota Association for Career and Technical Education (MnACTE).

2.7. The Computer Science Advisory Committee should determine when to sunset the existing pathway for mathematics teachers to teach computer science. This sunset should not occur before other pathways are created and mathematics teachers are provided an opportunity to transition to a computer science qualification pathway.

2.8. Recommend, but not require, that each district has at least one qualified/licensed computer science educator.

2.9. Add foundational computer science to teacher licensure renewal requirements.

2.10. The Minnesota Department of Education should intentionally and clearly align professional learning to the requirements for computer science teacher qualification and licensure. Particularly in the initial years of this plan, the working group recommends that the department align specific benchmarks of computer science competency with the to-be-established benchmarks for licensure, endorsement, micro-credentialing and licensure through the Licensure via Portfolio option. Once these alignments are established, they will be highlighted and communicated to teachers to increase their awareness of the expanded capabilities of these qualification options.

2.11. The Legislature will provide PELSB with funding and support for licensure and qualification programs to plan and develop pathways and content expertise.

2.11.1. Starting in 2024, integrate computer science in grade level and subject areas aligned to new standards in science, mathematics and other areas.

2.11.2. In 2028–2030, create programs that lead to computer science endorsement or licensure.

2.11.3. Include teacher educators and teacher candidates in computer science professional learning opportunities for computer science teachers.

2.12. The Legislature will provide PELSB with funding to incentivize participation in all computer science qualification pathways, including, but not limited to:

2.12.1. Years 2024–2027

2.12.1.1. Support for computer science education teachers in the portfolio pathway who already hold a Tier 3 or 4 license; cohorts will complete a portfolio over a six-

month program (waivers for all portfolio, testing fees, stipends for substitute teacher costs, dedicated PELSB support)

2.12.1.2. Support for industry professionals to complete qualification pathways for Tier 3 license (testing, micro-credentials, portfolio)

2.12.1.3. Fund micro-credentialing fees for current computer science teachers

2.12.2. Years 2028–2030

2.12.2.1. Current and new teachers and professionals to complete any computer science education qualification pathway (initial endorsement, portfolio, testing, micro-credentials, etc.)

2.12.2.2. Teacher candidates enrolled in secondary initial computer science education licensure programs.

2.12.2.3. Fund micro-credentialing fees for current computer science teachers

2.13. The working group recommends funding for teacher qualifications and licensure as described in the budget.

3. Grants and Funding

Recommendation: The working group recommends, with the goal of supporting equitable scaling of computer science education, funding grants through the Minnesota Department of Education to support technology infrastructure for Local Education Agencies (LEA) and the implementation of district computer science plans.

Rationale: To ensure equity in computer science education across the state, it is important that the Legislature support the Computer Science State Strategic Plan with funding that will reinforce state, regional and local supports for computer science education. The Computer Science Advisory Committee will work with the Minnesota Department of Education to identify and deploy grant programs to fund initiatives including, but not limited to, district computer science education implementation and computer science education infrastructure development. They will also establish ongoing data and grant support for Minnesota districts.

Sub-Recommendations:

3.1. The Minnesota Department of Education should provide the supports necessary in the application and reporting processes to ensure that all school districts are able to pursue grant funds related to computer science.

3.1.1. The working group also recommends that the department produce a template to guide grant applicants through the reporting process that will be required at the end of the grant cycle.

3.1.2. The working group further advocates for the creation of a centralized location through which grant applicants can request additional support for their grant applications and reports.

3.2. The standard two-year cycle for grant funding should be expanded to a three-year cycle for the purposes of establishing computer science professional learning. The current Minnesota Department of Education standard grant period is a two-year cycle. The working group recommends that, for the purposes of establishing computer science plans and computer science professional learning, this grant period be extended to a three-year cycle, after which applicants can pursue another grant to enhance their computer science programming. The financial consistency afforded by this additional grant cycle time will allow grant applicants to focus more attentively on the process of forming a plan, implementing the plan, assessing its outcomes, and reporting results than if reapplication for funding was required every other year.

3.3. The Minnesota Department of Education will evaluate and report annually on the success of each grant program based on the relevant focus areas, including, but not limited to: capacity, access, participation and experience. The department will use LEA grant reports to inform focus areas for each grant cycle.

3.4. The Minnesota Department of Education will develop a grant program to support LEAs in their computer science education implementation efforts to provide students with computational thinking and computer science courses in K–12. In order to access implementation funding, districts must have a computer education plan that has been reviewed by the department. Funding could also be used to ensure that all curriculum and course content is accessible to all students, with emphasis on student subgroups historically underrepresented in computer science.

3.4.1. Implementation grants can provide funding for administrators, counselors and other staff to attend computer science professional development specific to their school role, which will help inform their decisions and evaluations.

3.4.2. Implementation grants can include funds for industry certifications in computer science for high school students. Minnesota will allocate funding to support computer science industry certifications for students. The Computer Science Advisory Committee will assess the required funding, distribute it to schools and districts, and collaborate with testing centers to provide a resource for students to take the certification tests.

3.5. The Minnesota Department of Education will develop a grant program that concentrates on the unique challenges that small schools, as well as some rural and urban districts, face in rolling out computer science education from an infrastructure access perspective. This grant will provide funding and resources for access to broadband, technology equipment and other infrastructure.

3.5.1. Infrastructure grants will ask LEAs to identify existing technology infrastructure and identify future needs to support computer science learning. Technology infrastructure

might include the district's vision for technology, access and use of devices, building-level and student-level connectivity, the software ecosystem and the IT support ecosystem.

3.6. The Minnesota Department of Education will develop a grant program for professional development providers to support the establishment of high-quality professional development that is aligned with computer science guidance documents and the Computer Science Advisory Committee's criteria for high-quality, culturally-responsive programs of professional learning.

3.7. The working group recommends funding for grants as described in the budget.

4. K–12 Computer Science Pathway

Recommendation: The working group recommends the authority and allocation of funds to develop K–8 computer science standards, followed by the implementation of those standards through integration into K–5 curriculum, a required middle school computer science course, and the offering of a computer science elective in high school.

Rationale: The 2023 Computer Science Education Advancement Act (Minn. Stat. 120B.241) underscores the need for the creation of comprehensive computer science standards aimed at enhancing K–12 education in Minnesota. Computer science standards will serve as a crucial component in the K–12 computer science pathway in Minnesota and should be designed to help close the technology education gaps that exist across the state's schools. This section of the plan outlines a blueprint for a K–12 computer science pathway in Minnesota to foster sustained and long-term growth in computer science education across all K–12 school districts and charter schools in the state. By implementing a cohesive K–12 computer science education pathway, the state can equip its students with the skills they need to succeed in the digital age, ensure a future-ready workforce and drive economic growth.

The proposed phased approach, starting with K–8 computer science standards development and curriculum integration, followed by a required middle school course and a high school elective course, allows for gradual accumulation of student knowledge and skills. This approach plays a pivotal role in providing every student with the opportunity to acquire essential computer science skills necessary for navigating our increasingly digital world. By extending support to schools, teachers and administrative staff, the K–12 computer science education pathway facilitates the seamless integration of computer science education from elementary to high school levels.

- **What are standards?**
    - An academic standard is a summary description of student learning in a content area (from the Minnesota Department of Education's definition).
    - Standards outline a fundamental set of educational objectives intended to serve as the basis for a comprehensive computer science curriculum in K–12 education (from CSTA standards overview).
- **Why are standards important?**

    - Standards can help teachers, administrators and policymakers align other components of an education plan, such as curriculum, instruction and assessment, to prepare students for college and the workplace.
    - Standards set a benchmark for the academic content and skills that all students should learn and have access to.
- **What currently exists related to computer science standards in Minnesota?**
    - Integrated computer science benchmarks
    - Nationally, access to the K–12 CSTA standards is available

A cohesive K–12 computer science education pathway that begins with the development of K–8 standards offers significant benefits for students, the state's workforce, and the quality of our educational offerings in the state.

Benefits for Students:

- **Develops critical skills:** Computer science education fosters the development of computational thinking, a problem-solving approach that emphasizes decomposition, pattern recognition, abstraction and algorithmic design. These skills are applicable across all disciplines and crucial for success in any career path (K–12 CS Framework).
- **Improves creativity and innovation:** Computer science empowers students to become not just consumers of technology, but creators. Learning to code allows them to express themselves creatively, build new tools and solve problems in innovative ways.
- **Increases engagement and participation**: Studies show that computer science education can increase student engagement and motivation in school. Students often find computer science concepts interesting and challenging (K–12 CS Framework).
- **Prepares students for future careers:** The demand for workers with computer science skills is rapidly growing across all industries. For students who are interested in pursuing a career in computer science, a strong computer science foundation can prepare them for high-paying, high-demand jobs in fields such as software development, artificial intelligence, cybersecurity and data science.

Benefits for the State:

- **Strengthens workforce competitiveness**: By fostering a pipeline of computer science-educated graduates, the state can attract and retain businesses in the technology sector. This not only creates jobs but also boosts the state's economy.
- **Promotes innovation and entrepreneurship**: A workforce skilled in computer science fuels innovation and entrepreneurship, leading to the development of new technologies and businesses within the state.
- **Increases equity and access:** A comprehensive computer science education program ensures all students, regardless of background, have the opportunity to develop the skills needed to thrive in our increasingly technology-focused world.

Sub-Recommendations:

4.1. Grant rulemaking authority to the Minnesota Department of Education for K–8 computer science standards.

4.2. Establish a computer science standards review committee.

4.2.1. Computer science standards review committee will write Minnesota K–8 computer science standards, including computational thinking and digital citizenship standards, through middle school. If new CSTA standards don't address digital citizenship, the working group recommends looking at the International Society of Technology in Education (ISTE) standards for digital citizenship.

4.3. Complete the rulemaking process with a recommendation to implement the K–8 state standards in the 2030–31 school year.

4.4. Update the K–8 computer science standards on a 10-year cycle.

4.5. Require implementation of the K–8 Minnesota Academic Standards for Computer Science.

4.6. The Legislature approves a required K–12 computer science education pathway. Timeline: 2031. Responsible parties: Legislature, MDE, LEAs.

4.6.1. Legislature requires all schools to integrate K–5 Minnesota computer science standards at elementary level.

4.6.2. Legislature requires every student to take a foundational computer science class while in middle school, aligned to middle school Minnesota computer science standards.

4.6.3. Legislature requires LEAs to offer at least one computer science course at the high school level.

4.6.3.1. LEAs must use the current CSTA standards or CTE info-tech and/or communication tech frameworks for their 9–12 computer science elective courses.

4.7. The working group recommends funding for a K–12 computer science pathway as described in the budget.

4.7.1. The working group recommends funding for LEA staffing as described in the budget.

5. Continuous Improvement

Recommendation: The working group recommends enhanced data and reporting structures, suggested timelines, and an evaluation process and revision cycle for the implementation and advancement of computer science in all K–12 school districts and charter schools.

Rationale: In order to ensure the successful implementation of the goals and strategies for computer science education outlined in the Computer Science State Strategic Plan, there is a need for a continuous improvement process that includes robust state data collection, progress tracking, and reporting and evaluation expectations.

Sub-Recommendations:

5.1. The Minnesota Department of Education will support school districts and Student Information Systems (SIS) vendors in using the Ed-Fi system to report grades 9–12 computer science course information.

5.1.1. This support should include raising awareness about updated course classifications for computer science in grades 9–12, providing training on reporting through Ed-Fi, and communicating reporting requirements.

5.2. In 2024–25, implement the Plan for Secure and Regular Reporting for K–8 Computer Science, including, but not limited to, defining course classifications for computer science in grades K–8, communicating new reporting requirements, implementing new reporting requirements, and providing reports on progress via public and legislative updates.

5.3. Create a data dashboard that is accessible and displays data in a user-friendly, actionable way. The data should be used to update the Legislature and the public on key success metrics.

5.3.1. Include wider categories for students' gender and race/ethnicity identities in student demographics.

5.4. The Minnesota Department of Education and the Computer Science Advisory Committee should identify milestones, timelines and reporting structures for the implementation of the recommendations in the state strategic plan.

5.5. Develop a revision cycle for the state strategic plan.

5.6. Create a process for continuous feedback from various invested groups related to implementation milestones that inform the revision cycle.

5.7. Develop and share annual progress via public and legislative updates related to implementation milestones through 2030 and then as needed.

5.8. The working group recommends funding for continuous improvement as described in the budget.

6. Awareness Building

Recommendation: The working group recommends the Minnesota Department of Education and the Computer Science Advisory Committee work with Regional Computer Science Specialists and state partners to execute an awareness building plan to inform identified audiences across the state throughout the implementation of the Minnesota Computer Science Education Plan.

Rationale: Computer science is a field that contains persistent and pervasive misconceptions about what the discipline is and who should participate in it. Impacts of these misconceptions include the lowest participation by girls in high school AP courses, similar to physics courses (Ericson, 2023), and significantly lower participation by women, Black, and Hispanic/Latinx employees in the Minnesota tech workforce than in any other occupation (MnTech). The landscape of computer science education included in this legislative report identifies additional gaps in capacity, access, participation and student success in computer science. However, early exposure to computer science can change these misconceptions and increase a sense of belonging and confidence in computer science for historically marginalized populations. The teaching of computer science is not just important to prepare certain students for an occupation; it is a skill all students need to successfully engage and thrive in a technology-driven world.

Sub-Recommendations:

6.1. Create materials that target a broad audience including LEAs, school counselors, students, parents, industry partners, higher education institutions and other relevant partners.

6.2. Create a promotional campaign team that includes students and a plan that encompasses a variety of media channels, including, but not limited to, radio advertisements, poster and flyer distribution, and virtual and/or in-person webinars.

6.3. Conduct outreach at regional and state conferences for all subject areas and educator audiences, led by the Minnesota Department of Education, the Computer Science Advisory Committee, and Regional Computer Science Specialists.

6.4. Create materials with messages designed to close equity gaps in computer science:

- Why computer science is important for everyone to learn
- Who belongs in computer science
- Impact of historically marginalized populations on computer science
- What types of computer science opportunities exist in Minnesota, connecting to regional industries
- Diverse computer science career pathways and higher education opportunities

6.5. The working group recommends funding for awareness building as described in the budget.

7. Local Education Agency (LEA) Computer Science Education Plans

Recommendation: The working group recommends each LEA in Minnesota create a computer science education plan based on the Computer Science Advisory Committee and the Minnesota Department of Education's computer science guidance documents, with the purpose of providing students with computational thinking and computer science learning in grades K–12.

Rationale: Most schools and districts in Minnesota do not currently teach computer science or have educators with computer science expertise on staff. To support schools and districts in developing plans to introduce a new subject area, providing funding and structured support will be crucial to building the capacity of districts to

offer computer science education. LEA plans should be comprehensive and begin by documenting their current capacity for computer science education (any computer science taught, teacher capacity, tech infrastructure, etc.), identifying gaps and needs, and devising a plan for closing the gaps in order to ensure equitable access, participation and success for all students in the LEA to a high quality computer science education.

Sub-Recommendations:

7.1. One-time funding should be allocated to LEAs for planning grants.

7.2. The working group recommends specific criteria and data points be included in each LEA plan.

7.2.1. Identify existing computer science learning opportunities within the LEA, identify any gaps in access and participation for all students, and identify gaps in success of students in grades 9–12, including by school, gender, race/ethnicity, disability status, English learner status, and eligibility for free or reduced price meals.

7.2.2. Identify existing teacher qualifications and skills and needs for future professional development, including for district and school leadership, classroom teachers, counselors, specialists, paraprofessionals and other relevant educators.

7.2.2.1. Schools and districts needing instructional support in their plans should look to the Minnesota Department of Education's guidance documents and to PELSB (computer science teacher incentive) to identify teachers currently licensed/coded to teach computer science skills and courses.

7.2.3. Identify existing technology infrastructure and identify future needs to support computer science learning. Technology infrastructure might include the district's vision for technology, access to and use of devices, building-level and student-level connectivity, the software ecosystem and the IT support ecosystem.

7.2.4. Identify existing curriculum and materials for computer science learning, and identify future needs to support computer science learning. Considerations for curriculum and materials might include a selection process, K–12 alignment and progression, ancillary materials, assessment, support for lesson development, and integrated or multidisciplinary activities.

7.2.5. How districts will teach and support computer science standards for all students in grades K–8 and offer computer science electives in high school by the end of 2030–31 school year.

7.2.6. How pedagogy, curriculum, course content and technology infrastructure will be accessible to all students, including students with disabilities, English learners, etc.

7.2.7. How the computer science strategic plan is informed by and meets community needs, including collaborations with local industry and workforce organizations, informal

learning organizations, local diversity efforts, local higher education institutions and families.

7.3. The working group recommends funding for the LEA computer science plans as described in the budget.

8. Outside Funding

Recommendation: The working group recommends the Legislature and the Minnesota Department of Education consider the possibilities of outside funding, such as funding from local industry to provide additional support for computer science education implementation.

Rationale: Despite an infusion of funding in the 2023 legislative session, many schools in Minnesota struggle to provide a quality education within budget constraints. While the state and local government play a crucial role in funding education, to introduce an entirely new subject into the school system will require significant changes and investment. Computer science is a crucial subject that impacts the current and future workforce. Minnesota companies rely heavily on a well-qualified workforce and have a history in funding education projects at local schools. Establishing a matching fund to which business and industry can contribute would bolster the department's available funding to support implementation of computer science education across the state.

Sub-Recommendations:

8.1. Funding should be organized at the state level to ensure equitable distribution across communities based on needs and not based solely on proximity to tech-enabled companies.

8.2. Funding priorities should be determined by identifying barriers that exist to computer science education. For example, teachers may be unable to participate in summer computer science professional development without adequate childcare.

9. Regional Communities of Learning and Computer Science Specialists

Recommendation: The working group recommends establishing region-based communities of learning to provide support to local LEAs and educators in learning about the needs and cultural assets of their communities in order to (1) cultivate an environment in which diverse approaches to computer science education are able to flourish, and (2) support LEAs in developing and implementing computer science education plans, including applying for funding/grants.

Rationale: The people of Minnesota represent a rich variety of local cultures, values, needs and cultural assets. In order to support and uplift these local communities of Minnesota, it is vital to recognize that an approach to computer science education that may work well in one environment may not work as well in another. At the same time, due to both the ubiquity of computing and the ever-shifting nature of computer science, computer science education offers a multitude of points of entry. In the context of the diverse needs of Minnesota students, a truly sustainable statewide approach to computer science education will not be one that prescribes a specific pathway to integrating computer science into the school day. Rather, Minnesota's approach should build upon already-existing regional partnerships and relationships in a way that affords the flexibility to

embrace what resonates with each community while maintaining a central and unified set of standards and expectations.

Sub-Recommendations:

9.1. The working group recommends that the Minnesota Department of Education establish region-based Communities of Learning (CoL) by identifying geographical regions and hubs within Minnesota that would develop cohorts of practitioners and constituents, communicate Minnesota computer science guidance documents and standards, and survey schools and school-districts to learn the needs and cultural assets of those LEAs.

9.1.1. The formation of these regional hubs may consider already-existing regional partnerships, such as the Minnesota Perkins Consortia, the Minnesota Education Service Cooperatives, the Tribal Nations Education Committee, and non-education-oriented regional affiliations such as the Minnesota Association of Development Organizations.

9.1.2. The role and goals of these CoL can include:

9.1.2.1. Awareness building and broader communication—sharing and marketing Minnesota computer science guidance, marketing licensure, micro-credentialing, and portfolio pathway opportunities to educators.

9.1.2.2. Assessing regional needs and cultural assets—surveying schools and school districts to help generate computer science goals that are (a) aligned to any state guidance while also being (b) tied to the needs and assets of the local communities.

9.1.2.3. Assisting educators in the design and development of approaches to computer science education that engage students who are often minoritized and underrepresented in computer science.

9.1.2.4. Professional development and training coordination—planning and coordinating K–12 professional learning opportunities for teachers within their regions and hosting series of workshops and planning events to aid LEAs in developing their own computer science plans, including applying for MDE grants and receiving allocated funding

9.2. The working group recommends that the Legislature create positions for Regional Computer Science Specialists to ensure that the work of the CoL is ongoing and that educators continue to be supported after the initial work has begun. The primary goal of these Regional Computer Science Specialists should be to collaborate with the Minnesota Department of Education along with other local, state or national organizations to provide comprehensive support and communication to Minnesota educators and leaders. This supportive work may include:

9.2.1. Coordinating or facilitating workshops to assist LEAs in developing computer science plans, accessing allocated funding, and applying for and reporting on state grants

9.2.2. Facilitating communication among LEAs as well as between LEAs and the Minnesota Department of Education

9.2.3. Broader sharing of educational materials and pedagogical resources within the geographic region

9.2.4. Further, the working group recommends that the Minnesota Department of Education generate guidance for any regional cohorts in order to maintain a cohesive vision for Regional Computer Science Specialists to follow.

9.3. The working group recommends that following the creation of statewide computer science guidance, the Minnesota Department allows regional computer science cohorts and Regional Computer Science Specialists to assist LEAs in creating computer science education plans that are responsive to the needs and cultural assets of their regions.

9.3.1. To meet the needs of a given region, the regional computer science CoL and regional specialists may engage with their local communities by surveying schools, school districts, educational institutions including Institutions of Higher Education, and informal education organizations to identify their region's needs and cultural assets.

9.3.2. To ensure a consistent and equitable system of computer science education for all students in the state, the Minnesota Department of Education should establish a mechanism to provide feedback to these region-specific computer science plans. This feedback should particularly focus on ensuring that all students—regardless of the lens through which they are exposed to computer science education—are receiving the same baseline and foundational learning in computer science in accordance with state frameworks and guidance.

9.4. The working group recommends that the Minnesota Department of Education develop avenues of communication to allow these regions to communicate their developments with one another to ensure that the learning that occurs in one region is not limited to that single region. Avenues through which the various regions can communicate their work with one another may include, but are not limited to:

9.4.1. Sharing the created curricular resources and training models to the resource hub recommended in the section on establishing K–12 computer science pathways

9.4.2. Introducing virtual bulletin boards on which teachers can leave feedback, engage in discussion and evaluate the efficacy of lessons

9.4.3. Hosting computer science professional development weeks for Minnesota educators to take place in multiple parts of the state

9.5. The working group recommends funding for these regional CoLs and specialists, as described in the budget.

10. Graduation Requirements Review Committee

Recommendation: The working group recommends that the Legislature establish a committee to holistically review high school graduation requirements and make recommendations that are feasible for schools and students, yet still allow choice in electives. (Note: Although incorporating computer science into graduation requirements is not feasible at this time, this important step is a precursor to potentially adjusting the requirements to encompass computer science in the future.)

Rationale: Minnesota has extensive graduation requirements, with more being added in the 2023 legislative session. The working group recognizes the importance of computer science education for all students; however, adding another graduation requirement for computer science would be problematic in the current context. Instead, the working group is recommending that computer science as a graduation requirement be revisited after a holistic review of all K–12 graduation requirements for Minnesota students. While the working group was not specifically charged with examining graduation requirements, this is a new policy added the past year to Code.org's computer education policy recommendations. Requiring a course for students increases access and participation; however, it does not necessarily increase success or other outcomes in an equitable manner without careful attention to curriculum and pedagogy to provide an engaging learning experience for all students. In fact, after Chicago Public Schools instituted a computer science graduation requirement, it reinforced equity gaps in advanced computer science courses (McGee, 2022).

Sub-Recommendations:

10.1. The working group recommends funding for the Graduation Requirement Review Committee as described in the budget.

Conclusion

In summary, the Computer Science State Strategic Plan outlines a comprehensive strategy to achieve equitable and sustainable growth of computer science education across all Minnesota K–12 LEAs. By prioritizing building capacity, expanding access to, broadening participation in, and ensuring equitable experiences in K–12 computer science education, the plan strives to mitigate existing barriers to computer science education and prepare all students for a technology-driven future. The Computer Science Working Group's 10 recommendations—with a focus on creating a Computer Science Advisory Committee, establishing multiple teacher licensure pathways, providing grants and funding, developing a K–12 computer science pathway, and continuously improving the implementation of computer science education for all—provide a clear roadmap for achieving the vision of the state strategic plan. Implementing these recommendations necessitates ongoing awareness building, collaboration among educators, LEAs and regional communities, and exploring external funding opportunities. Public feedback on the 10 recommendations was overwhelmingly positive, with strong support contingent upon securing the necessary funding for successful implementation. The successful implementation of the Computer Science State Strategic Plan has the potential to transform computer science

education in Minnesota, fostering a generation of future-ready students equipped with the critical thinking, problem-solving and collaborative skills necessary to thrive in an ever-evolving world.

Appendix 1 – Table of Recommendations

Recommendation 1: Computer Science Advisory Committee

The working group recommends creating a Computer Science Advisory Committee to work with the Minnesota Department of Education to inform and support the implementation of the Minnesota Computer Science State Strategic Plan.

Strategy / Sub-Recommendation	Timeline
1.1 The scope of the Computer Science Working Group, as defined in the 2023 Computer Science Education Advancement Act (Minn. Stat. 120B.241, subd. 3), is expanded to include the sub-recommendations below, and will function as the Computer Science Advisory Committee.	2024–2031
1.2 The Minnesota Department of Education and the Computer Science Advisory Committee will develop a data collection plan for school districts to retrieve an accurate count of access, participation and success in computer science education across grades K–12.	2024–2025
1.3 The Minnesota Department of Education and the Computer Science Advisory Committee will define key performance indicators and success measures of computer science education in Minnesota.	2024–2025
1.4 The Minnesota Department of Education and the Computer Science Advisory Committee will create K–12 computer science guidance documents for schools and districts.	2024–2026
1.5 The working group recommends the Minnesota Department of Education and the Computer Science Advisory Committee work with Regional Computer Science Specialists and state partners to execute an awareness building plan to inform identified audiences across the state throughout the implementation of the Computer Science State Strategic Plan.	2024–2031
1.6 The Minnesota Department of Education and the Computer Science Advisory Committee will plan and support the creation of region-based communities of learning to provide support to local LEAs and educators in learning about the needs and cultural assets of their communities.	2024–2031
1.7 The Legislature should empower the Minnesota Department of Education to convene a Computer Science Advisory Committee with the goal of determining the criteria for what constitutes a high-quality, culturally responsive program of professional learning.	2024–2025
1.8 Ensure that educator professional learning supports both standalone computer science course development and integrated approaches to computer science education.	2024–2031

Strategy / Sub-Recommendation	Timeline
1.9 The Minnesota Department of Education and the Computer Science Advisory Committee should be tasked with the creation of an evaluative tool or series of rubrics that LEAs and school districts can use to vet and recommend computer science professional learning programs.	2024–2025
1.10 Expand the scope of which adults in a school community should receive professional development in foundational computer science concepts.	2024–2031
1.11 Expand the scope of what learning experiences are considered "professional development."	2024–2031
1.12 The working group encourages the Minnesota Department of Education and the Legislature to adopt a vision of professional learning as one that is not discrete from community education.	2024–2031
1.13 The Legislature will allocate funds for the Minnesota Department of Education and the Computer Science Advisory Committee to create an online computer science resource hub that includes, but is not limited to, resources for teaching (lesson plans), curriculum and learning communities.	2026–2029
1.14 Once standards are implemented, the Minnesota Department of Education and the Computer Science Advisory Committee will revisit the effort to create strategies to expand high school equivalency.	2031
1.15 The working group recommends funding for the Computer Science Advisory Committee as described in the budget.	2024–2031

Recommendation 2: Teacher Qualifications and Licensure

The working group recommends the creation of multiple qualification and licensure pathways for current and future computer science educators.

Strategy	Timeline
2.1 Create new teaching licenses specific to computer science. In FY2025 PELSB and/or the Computer Science Advisory Committee should create the teacher standards needed for each new license using the current CSTA K–12 Computer Science Standards until Minnesota has established state-specific computer science standards. Library media specialists and CTE teachers will remain authorized to teach computer science.	2024–2027

Strategy	Timeline
2.2 Use multiple and flexible options for computer science teacher qualification and licensure, which allow for immediate, multiple, diverse, flexible pathways for existing teachers to demonstrate competency in order to teach computer science. Multiple pathways will effectively, quickly and affordably address the need for qualified computer science educators. These pathways should be reviewed and refined by the Computer Science Advisory Committee as needed.	2024–2031
2.3 Develop teacher qualification and licensure programs specific to computer science.	2024–2027
2.4 Develop an expedited approval process with PELSB for programs leading to computer science licensure or endorsement. It will take at least two or more years for universities and other providers to complete internal and external approvals and begin building computer science qualification and licensure programs. PELSB should provide an expedited approval process for initial approval of these programs.	2028–2031
2.5 Update the existing library media specialist license to include the teaching of foundational computer science. Library media specialists should be able to be teachers of record for foundational computer science classes. A list of these specific computer science courses should be identified in Staff Automated Reporting (STAR).	2024–2025
2.6 Review and update the existing CTE license pathways to provide updated options for computer science qualification in collaboration with the Minnesota Association for Career and Technical Education (MnACTE).	2024–2025
2.7 The Computer Science Advisory Committee should determine when to sunset the existing pathway for math teachers to teach computer science. This should not be before other pathways are created and mathematics teachers are provided an opportunity to transition to a computer science qualification pathway.	2028–2031
2.8 Recommend, but not require, that each district has at least one qualified/licensed computer science educator.	2028–2031
2.9 Add foundational computer science to teacher licensure renewal requirements.	2028–2031

Strategy	Timeline
2.10 The Minnesota Department of Education should intentionally and clearly align professional learning to the requirements for computer science teacher qualification and licensure. Particularly in the initial years of this plan, the working group recommends that the department align specific benchmarks of computer science competency with the to-be-established benchmarks for licensure, endorsement, micro-credentialing and licensure through the Licensure via Portfolio option. Once these alignments are established, they will be highlighted and communicated to teachers to increase their awareness of the expanded capabilities of these qualification options.	2024–2031
2.11 The Legislature will provide PELSB with funding and support for licensure and qualification programs to plan and develop pathways and content expertise.	2024–2027
2.12 The Legislature will provide PELSB with funding to incentivize participation in all computer science qualification pathways.	2028–2031
2.13 The working group recommends funding for teacher qualifications and licensure as described in the budget.	2024–2031

Recommendation 3: Grants and Funding

The working group recommends, with the goal of supporting equitable scaling of computer science education, funding grants through the Minnesota Department of Education to support technology infrastructure for Local Education Agencies (LEA) and the implementation of district computer science plans.

Strategy	Timeline
3.1 The Minnesota Department of Education should provide the supports necessary in the application and reporting processes to ensure that all school districts are able to pursue grant funds related to computer science.	2024–2031
3.2 The standard two-year cycle for grant funding should be expanded to a three-year cycle for the purposes of establishing computer science professional learning.	2024–2031
3.3 The Minnesota Department of Education will evaluate and report annually on the success of each grant program based on the relevant focus areas, including, but not limited to: capacity, access, participation and experience. The department will use LEA grant reports to inform focus areas for each grant cycle.	2025–2031

Strategy	Timeline
3.4 The Minnesota Department of Education will develop a grant program to support LEAs in their computer science education implementation efforts to provide students with computational thinking and computer science courses in K–12. In order to access implementation funding, districts must have a computer science education plan that has been reviewed by the department.	2024–2031
3.5 The Minnesota Department of Education will develop a grant program that concentrates on the unique challenges that small schools, as well as some rural and urban districts, face in rolling out computer science education from an infrastructure access perspective. This grant will provide funding and resources for access to broadband, technology equipment and other infrastructure.	2024–2031
3.6 The Minnesota Department of Education will develop a grant program for professional development providers to support the establishment of high-quality professional development that is aligned with computer science guidance documents and the Computer Science Advisory Committee's criteria for high-quality, culturally-responsive programs of professional learning.	2024–2031
3.7 The working group recommends funding for grants as described in the budget.	2024–2031

Recommendation 4: K–12 Computer Science Pathway

The working group recommends the authority and allocation of funds to develop K–8 computer science standards, followed by the implementation of those standards through integration into K–5 curriculum, a required middle school computer science course, and the offering of a computer science elective in high school.

Strategy	Timeline
4.1 Grant rulemaking authority to the Minnesota Department of Education for K–8 computer science standards.	2024–2031
4.2 Establish a computer science standards review committee.	2025–2026
4.3 Complete the rulemaking process with a recommendation to implement the K–8 state standards in the 2030–31 school year.	2026–2031
4.4 Update the K–8 computer science standards on a 10-year cycle.	2031 and beyond
4.5 LEAs implement K–8 Minnesota Academic Standards for Computer Science.	2031
4.6 The Legislature approves a required K–12 computer science education pathway.	2031
4.7 The working group recommends funding for a K–12 computer science pathway as described in the budget.	2024–2031

Recommendation 5: Continuous Improvement

The working group recommends enhanced data and reporting structures, suggested timelines, and an evaluation process and revision cycle for the implementation and advancement of computer science in all K–12 school districts and charter schools.

Strategy	Timeline
5.1 The Minnesota Department of Education will support school districts and Student Information Systems (SIS) vendors in using the Ed-Fi system to report grades 9–12 computer science course information.	2024–2031
5.2 In 2024–25, implement the Plan for Secure and Regular Reporting for K–8 Computer Science, including, but not limited to, defining course classifications for computer science in grades K–8, communicating new reporting requirements, implementing new reporting requirements, and providing reports on progress via public and legislative updates.	2024–2025
5.3 Create a data dashboard that is accessible and displays data in a user-friendly, actionable way. The data should be used to update the Legislature and the public on key success metrics.	2024–2031
5.4 The Minnesota Department of Education and the Computer Science Advisory Committee should identify milestones, timelines and reporting structures for the implementation of the recommendations in the state strategic plan.	2024–2025
5.5 Develop a revision cycle for the state strategic plan.	2024–2025
5.6 Create a process for continuous feedback from various invested groups related to implementation milestones that inform the revision cycle.	2024–2026
5.7 Develop and share annual progress via public and legislative updates related to implementation milestones through 2030 and then as needed.	2024–2031
5.8 The working group recommends funding for continuous improvement as described in the budget	2024–2031

Recommendation 6: Awareness Building

The working group recommends the Minnesota Department of Education and the Computer Science Advisory Committee work with Regional Computer Science Specialists and state partners to execute an awareness building plan to inform identified audiences across the state throughout the implementation of the Minnesota Computer Science Education Plan.

Strategy	Timeline
6.1 Create materials that target a broad audience including LEAs, school counselors, students, parents, industry partners, higher education institutions and other relevant partners.	2024–2031

Strategy	Timeline
6.2 Create a promotional campaign team that includes students and a plan that encompasses a variety of media channels, including, but not limited to, radio advertisements, poster and flyer distribution, and virtual and/or in-person webinars.	2024–2031
6.3 Conduct outreach at regional and state conferences for all subject areas and educator audiences, led by the Minnesota Department of Education, the Computer Science Advisory Committee, and Regional Computer Science Specialists.	2024–2031
6.4 Create materials with messages designed to close equity gaps in computer science.	2024–2031
6.5 The working group recommends funding for awareness building as described in the budget.	2024–2031

Recommendation 7: Local Education Agency (LEA) Computer Science Education Plans

The working group recommends each LEA in Minnesota create a computer science education plan based on the Computer Science Advisory Committee and the Minnesota Department of Education's computer science guidance documents, with the purpose of providing students with computational thinking and computer science learning in grades K–12.

Strategy	Timeline
7.1 One-time funding should be allocated to LEAs for planning grants.	2025–2031
7.2 The working group recommends specific criteria and data points be included in each LEA plan.	2025–2031
7.3 The working group recommends funding for the LEA computer science plans as described in the budget.	2024–2031

Recommendation 8: Outside Funding

The working group recommends the Legislature and the Minnesota Department of Education consider the possibilities of outside funding, such as funding from local industry to provide additional support for computer science education implementation.

Strategy	Timeline
8.1 Funding should be organized at the state level to ensure equitable distribution across communities based on needs and not based solely on proximity to tech-enabled companies.	2024–2031
8.2 Funding priorities should be determined by identifying barriers that exist to computer science education. For example, teachers may be unable to participate in summer computer science professional development without adequate childcare.	2024–2031

Recommendation 9: Regional Communities of Learning and Computer Science Specialists

The working group recommends establishing region-based communities of learning to provide support to local LEAs and educators in learning about the needs and cultural assets of their communities in order to (1) cultivate an environment in which diverse approaches to computer science education are able to flourish, and (2) support LEAs in developing and implementing computer science education plans, including applying for funding/grants.

Strategy	Timeline
9.1 The working group recommends that the Minnesota Department of Education establish region-based Communities of Learning (CoL) by identifying geographical regions and hubs within Minnesota that would develop cohorts of practitioners and constituents, communicate Minnesota computer science guidance documents and standards, and survey schools and school-districts to learn the needs and cultural assets of those LEAs.	2024–2031
9.2 The working group recommends that the Legislature create positions for regional Computer Science Specialists to ensure that the work of the CoL is ongoing and that educators continue to be supported after the initial work has begun. The primary goal of these regional specialists should be to collaborate with the Minnesota Department of Education along with other local, state or national organizations to provide comprehensive support and communication to Minnesota educators and leaders.	2024–2031
9.3 The working group recommends that following the creation of statewide computer science guidance, the Minnesota Department of Education allows regional computer science cohorts and regional specialists to assist LEAs in creating computer science education plans that are responsive to the needs and cultural assets of their regions.	2025–2031
9.4 The working group recommends that the Minnesota Department of Education develop avenues of communication to allow these regions to communicate their developments with one another to ensure that the learning that occurs in one region is not limited to that single region.	2025–2031
9.5 The working group recommends funding for these regional CoLs and specialists, as described in the budget.	2024–2031

Recommendation 10: Graduation Requirements Review Committee

The working group recommends that the Legislature establish a committee to holistically review high school graduation requirements and make recommendations that are feasible for schools and students, yet still allow choice in electives. (Note: Although incorporating computer science into graduation requirements is not feasible at this time, this important step is a precursor to potentially adjusting the requirements to encompass computer science in the future.)

Strategy	Timeline
10.1 The working group recommends funding for the Graduation Requirement Review Committee as described in the budget.	2024–2031

Appendix 2 – Budget

Recommendation	Responsible Party	FY25	FY26	FY27
Computer Science Advisory Committee	MDE, CS Advisory Committee	$366,000	$366,000	$366,000
Teacher Licensure	PELSB	$1,940,000	$1,940,000	$1,940,000
Grants and Funding	MDE	$4,153,458	$4,153,458	$4,153,458
K-12 Computer Science Pathway	MDE	No data	No data	$116,000
LEA Staffing	LEAs, MDE	$69,685,000	$69,685,000	$69,685,000
Continuous Improvement	MDE	$403,242	$403,242	$403,242
Awareness Building	MDE, CS Advisory Committee, Regional Communities of Learning	$150,000	$150,000	$150,000
LEA Computer Science Plans	MDE, CS Advisory Committee, LEAs	$2,082,000	$2,082,000	$2,082,000
Outside Funding	N/A	N/A	N/A	N/A
Regional Communities of Learning	MDE, CS Advisory Committee, Minnesota Education Service Coops	$990,350	$940,350	$940,350
Graduation Requirements Review Committee	Graduation Requirements Committee	$366,000	$366,000	N/A
Total		$80,136,050	$80,086,050	$79,836,050

Appendix 3 – Acknowledgements

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- MnTech
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- SciMath Minnesota

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