2022 ACE Leadership

Final Group Project Recommendation

EXECUTIVE SUMMARY

The Minnesota Technology Association believes Minnesota's technology-driven companies achieve the greatest success when they have access to exceptional talent, dedicated public policy advocates, and are part of an innovative, inclusive technology community. For more than 30 years, the Minnesota Technology Association has helped nurture each of these attributes within our state, enabling Minnesota technology-driven businesses, professionals, and communities to thrive.

The problem: Minnesota is facing a technology talent crisis that requires an ecosystem wide response. Jobs are going unfilled. Schools are not producing the volume of technology talent needed to sustain our rate of employment. Our largest employers are looking to other metros and other countries in order to satisfy their talent needs. Meanwhile, Minnesota misses out on a unique opportunity to diversify its tech workforce, to grow its local economy and to improve its outlook. MnTech staff requested ACE Leaders that were a part of their 2022 cohort to research a response to this crisis.

ACE Leadership is an 8-month, cohort-based leadership development program designed to develop and connect our region's next generation technology leaders for the role they will play in our region's global competitiveness. There are 33 members of this year's cohort representing more than 25 organizations.

The Challenge: The boards of the Minnesota Technology Association and Minnesota Technology Foundation are requesting the catalytic investment of $1M in funds over the next two years to equitably rebuild Minnesota's technology talent pipeline. Seven teams of 5 ACE Leaders reviewed research, talked to leaders across many fields, and then collectively placed their investments on solutions they felt best reached the defined outcome.

Collective Investment Recommendation: Teams were challenged to place their two-year investments onto a visual frame. Below, you will see the collective $7M investment approach recommended.

Investment Grid	6-12 CS Education	Internships (HS or College)	2- and 4-Year Degrees	Apprenticeships or Bootcamps	Employee reskill or upskill
Policy	**$900k**				
Marketing and Awareness	**$1.50M**	**$83k**	**$83k**	**$83k**	
Partnerships with Companies	**$125k**				**$500k**
Partnerships with Service Providers	**$1.28M**				**$500k**
Funding Mechanisms or Incentives	**$1.95M**				

About the language: For clarity, the following acronyms are used throughout the document:

AP – Advanced Placement

CS – Computer Science

HS – High School

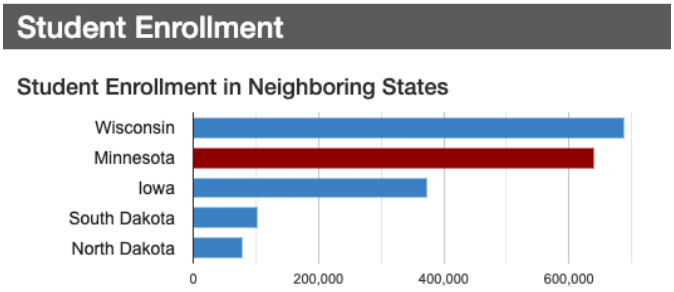
MnTech – Minnesota Technology Association

GROUP 1

Jen Bentrim, University of Minnesota; Anna Maxam, Target; Tyrel Dawson, Comcast

Evidence of Challenge

- MN does not have enough technologists to fill the positions available
  - 13,327 open computing jobs but only 1,533 CS college graduates in 2019[3]
  - Over 12,000 open computing jobs monthly in 2020 but only 1,502 CS college graduates from U of M in 2021 [16&17]
- MN lacks foundational computer science education in high school
  - Only 24% of Minnesota high schools offer a foundational CS course[9]
  - There are 540 CS courses offered among the 1200 MN high schools across 77 districts[8]
  - Of the 600K+ MN high school students, less than 20,000 took CS in 2018 – 5% students (Figure 1)
  - Minnesota has not yet created a state plan for K-12 CS and does not require high schools to offer CS[9]



  - Number of schools offering AP CS
    - 84 schools offer AP CS in 2020 (29% total MN schools offering AP classes)
    - 1806 students took AP CS exam in 2020 (1547 took in 2019)[3]
    - 21% taken by females in 2019 and 23% in 2020[3]
- MN does not currently have enough high school teachers qualified to teach CS
  - Minnesota does not yet have clear certification pathways for computer science teachers[9]
  - 70% of representatives surveyed from Minnesota Association of Colleges for Teacher Education indicated that all teacher education programs should include CT or CS (though they currently do not)[18]

Opportunity

Our investigation has found that students who have exposure to Computer Science courses in high school lead to increased interest in continuing their computer science learning through future educational pathways. For example, students who complete an AP CS exam are eight times more likely to major in computer science in college[14]. We also believe that students who have exposure to computer science education in high school will be more likely to pursue

computer science through alternative pathways such as bootcamps or associate degrees if they do not have direct access to a four-year degree.

To achieve the goal of increasing the number of technologists in the state of MN, we must increase both the number of CS courses taught in high school and the number of educators who are qualified to teach those courses. Currently only 24% of high schools in MN offer computer science. We would like to double that number to 50%. To support the increased number of CS classes taught, we also must have teachers who are capable of teaching computer science.

Investment Strategy

Investment Grid	6-12 CS Education	Internships (HS or College)	2- and 4-Year Degrees	Apprenticeships or Bootcamps	Employee reskill or upskill
Policy	**$250k**				
Marketing and Awareness	**$50k**				
Partnerships with Companies					
Partnerships with Service Providers	**$400k**				
Funding Mechanisms or Incentives	**$300k**				

Our main goal is to have more high schools offer Computer Science courses.

There is an existing organization, CS for All MN, which currently drives policy to increase Computer Science education throughout the state, including high school. MnTech could support their initiatives as they have done vast amounts of research and are the most knowledgeable organization in the state to provide a clear pathway forward for policy initiatives to increase Computer Science education. Once policies are passed by the legislature, schools will need funding to implement the policy initiatives. This could include funding for additional teachers, developing curriculum, and equipment and resources to aid computer science classes. Along with funding for the implementation of the new high school CS programs, schools could also be offered a stipend for enrolling a certain number of students in CS classes to ensure the policies do increase the number students. This type of benefit has worked well in other states to increase the CS student population[7].

To support the greater number of classes offered, we need to have teachers qualified to teach computer science. Currently there is no clear or accredited pathway for teachers in MN to become licensed as CS high school teachers. Only six schools offer Computer Technology /Computer Science experiences within teacher education with only two requiring students to create CT/CS lessons within the courses[18]. Having a direct pathway for teachers to become licensed would help increase the number of and speed up the process to produce qualified teachers. Including teach-back internships for those enrolled in CS courses could also contribute to the pathways for more education for students and teachers. Targeting students majoring in CS to engage in experiences such as high school teaching internships, or tutoring opportunities will bolster their skills and bring more awareness of computer science to high school students.

Additionally, for current teachers, there are existing opportunities, which could be utilized to provide them with the education they need to teach these courses. A couple of such programs and resources are **TEALS** – a computer science teach-back program through Microsoft, and CSTA-MN – an organization built to give teachers the resources they need to introduce computer science into classrooms and bolster CS courses. Many other programs exist as well (exemplified by Figure 2). Part of our funding would go towards supporting the partnerships between schools and these existing programs to make it more accessible for schools and teachers alike to offer the additional computer science courses for which we are striving.

Curriculum & Professional Learning Providers

Many organizations in Minnesota have developed CS curricula and/or provide professional learning opportunities for educators. The following table is not meant to be comprehensive, but rather focuses on high-quality opportunities available in Minnesota. The national directories offer more complete listings of opportunities. In addition, these institutions of higher education offer graduate courses in CS education: 1) College of St. Scholastica, 2) St. Catherine's University, and 3) University of Minnesota-Twin Cities.

Minnesota: CS Professional Learning Providers

Grade Level	Approach	Curriculum	Organization
K-12	Integrated	Computational Thinking & CS	Code Savvy
6-12	Standalone	CS Discoveries & CS Principles	Twin Cities Public Television & Code.org
9-12	Standalone	Mobile CS Principles & CSAwesome (Jave)	National Center for CS Education at the College of St. Scholastica
6-12	Standalone	IT Explorations	Minnesota State IT Center of Excellence
6-8	Out of School	SciGirls	Twin Cities Public Television
3-12	Out of School	Girls Who Code	Individual School Districts
K-12	School Teams	SCRIPT Workshops	CSforAll-MN
K-12	Counselors	Counselors for Computing (C4C)	NCWIT / Hermantown Schools
3-12	Standalone	CoderZ	High Tech Kids

Finally, for schools and teachers to know that the above education and funding opportunities are available we have allocated 50K towards marketing and awareness to get the word out about the resources available to continue bolstering CS high school education in MN. Many of the factors guiding our strategy come from seeing other states (such as Arkansas) who were able to improve the state of their computer science education by implementing similar initiatives as we have mentioned above –

- AR – In 2014-15 there were **60** computer science classes offered in all of Arkansas. In the 2015-16 school year that number went up to **345** (ADE Data Center)[7] (475% increase)
- AR – level of student participation in computer science courses increases dramatically after the "initiative," jumping up to 2.5% in 2015-16 and then to 3.6% in 2016-17[7]

Our strategies outlined – policies requiring schools to teach CS, support to implement the courses, and clear pathways for teachers to become qualified in CS – will help us achieve our goal of doubling the CS courses offered in MN high schools and produce more qualified technologists to strengthen the state's workforce.

Key Recommended Measurements

- Double the number of high schools offering CS courses
- Increase the number of high school CS educators in the state through in-service and pre-service teacher training to support the additional CS being offered

Constraints and Risks

The ROI period can be longer when focusing on high school education. However, based on what we have seen from other states, this strategy may offer the largest return on investment overall as it should reach the greatest number of individuals providing the most surefire way to increase the number of technologists in the state.

Relying on policy measures leaves some pieces for moving forward out of our control. Regardless of how quickly the policy initiatives pass, we believe that portions of our strategy (such as teacher training) can continue to be implemented even while policy adoption is in progress.

Sources

	Name	URL
1	Support K-12 Computer Science Education in Minnesota	https://code.org/advocacy/state-facts/MN.pdf
2	Council on Integrity in Results Reporting	https://cirr.org/standards
3	Code HS	https://codehs.com/states/MN
4	2021 State of Computer Science Education	https://advocacy.code.org/state_handouts/Minnesota.pdf
5	CODE Advocacy Coalition	https://advocacy.code.org/
6	2021 State of Science Education	chrome-extension://efaidnbmnnnibpcajpcglclefindmkaj/https://www.house.leg.state.mn.us/comm/docs/TC9PYMIqjEOGY8-627d6Sw.pdf
7	Arkansas Coding for All	Arkansas' Coding for All - Is it Really Reaching All Students?
8	Increasing Access to Computer Science in Minnesota Schools	Increasing Access to Computer Science in Minnesota Schools PowerPoint December with edits 2021.pdf
9	CS for all MN	https://csforallmn.org/
10	Minnesota K-12 Integrated Computer Science Benchmarks	https://education.mn.gov/MDE/dse/stds/ComputerScience/
11	2018 AP Scores by State and Ethnicity	highereddatastories.com/2018/11/2018-ap-scores-by-state-and-ethnicity.html
12	Microsoft TEALS Program	https://www.microsoft.com/en-us/teals

13	Computer Science Teachers Association of Minnesota	https://minnesota.csteachers.org/400396/Page/Show?ClassCode=Page&Slug=resources
14	Study: Computer science students much more likely to enroll in college	https://codeorg.medium.com/study-computer-science-students-much-more-likely-to-enroll-in-college-faca65b1476d
15	Minnesota High Schools	https://high-schools.com/directory/mn/
16	CSE by the numbers	https://cse.umn.edu/college/cse-numbers
17	CS For All Brief #1	https://csforallmn.files.wordpress.com/2021/01/csforall-mn-brief-1-12-7-20.pdf
18	CS For All Brief #4	https://csforallmn.files.wordpress.com/2021/01/csforall-mn-brief-4-updated-12-10-2020.pdf
19	CS For all Brief #5	https://csforallmn.files.wordpress.com/2021/06/csforall-mn-brief-5-2021-06-14.pdf

GROUP 2

Arun Purushothaman, Land O'Lakes; Scott Brons, SPS Commerce; Kathryn Wolfram, Target; Andy Lind, Surescripts

Evidence of Challenge

The gap between job openings and local MN company needs for technologists and the number of students going through the pipeline to fill these roles after post-secondary education are not enough to meet this demand.

- There is an average of 13,000 open jobs in computing/month in MN, but only ~1,500 graduates in CS, local talent unable to fill the open positions needed for local companies.
- Twenty-four percent of public schools teach a CS class in MN
- Teacher preparation programs in Minnesota only graduated three new teachers prepared to teach computer science in 2018.
- Based on the MN employment and economic outlook, by 2030 Software Developers and Software Quality Assurance job roles will increase by 23%, a net job increase of about 7,700 roles, and a need to replace 8,600 existing roles

Opportunity

Primary opportunities:

- MN has the population to support filling these roles with the right level of education
- More well-rounded STEM learning opportunities across public schools in MN

Additional opportunities:

- Increase diversity of talent as well as boost earning potential for under-represented
- Boost overall earning potential for local-Minnesota families
- Blueprint for education to fill needed skills beyond tech (like nursing)

Investment Strategy

Investment Grid	6-12 CS Education	Internships (HS or College)	2- and 4-Year Degrees	Apprenticeships or Bootcamps	Employee reskill or upskill
Policy					
Marketing and Awareness		**$83k**	**$83k**	**$83k**	
Partnerships with Companies					
Partnerships with Service Providers					
Funding Mechanisms or Incentives	**$750k**				

Hook, line, and hire! Right now, we do not have the hook or the line with the qualified teacher gap. If we want to double the number of technologists in MN in 10 years, we need to lengthen & widen the funnel at the start of the talent pipeline. Giving students exposure to Computer Science Education from early grade school up to graduation is a key to opening those pathways for future talent. We also want to increase awareness for all the options for post-secondary tech education and opportunities.

$750k (75%) - Public middle & high school pillars: Increase the availability of middle and high school Computer Science education in MN. Pilot grants for computer science educators and counselors in BIPOC/more predominately diverse schools like north Minneapolis district.

Pilot: five school districts with the least amount of either offerings or students taking advantage of the offerings in more diverse districts. *Assumption is legislature is coming soon to cover this area for schooling requirements – we will not do that piece.*

- We would utilize key metrics identified below to track the success of the pilot, then determine the plan to scale. Depending on success would plan to market & request more funds to scale.
- We need more info around attracting/training BIPOC teachers/counselors, and would use that to plan how to market within the schools that graduate teachers in Minnesota. Would explore: training program for the teachers leading into the pilot, incentives for existing teachers – what capabilities for teachers currently exist?

$250k (25%) - Marketing pillar: Support students through the funnel with marketing and program efforts that hand-hold beyond graduating high school and promote education in additional computer science programs, bootcamps, apprenticeships, or other post-secondary training. This would include marketing to improve awareness of pathways for non-4-year degrees. Two areas – program management and community engagement.

- Coordinator to lead with "marketing" (curated list of options, ideally take work away from teachers) materials for the five pilot schools, partnering with teachers and counselors to drive awareness and guide students & would track students involved in programs through post-secondary school.
- Could lead to opportunities beyond school – internships, AP School programs, etc.
- If successful, scale by leveraging additional programs similar in other states to grow beyond the five pilot schools.

Key Recommended Measurements

Overall metrics:

- Overall rates of opens in the tech industry, change year over year of available talent

Public middle & high school Pillar:

- **Top metric:** Amount of middle/high school students participating in class offerings and diversity rates
- **Top metric:** MN teachers' college - middle school and high school STEM teacher CS requirements/capabilities
- Tracking middle school students through high-school to see rates of continued tech education
- Time spent by counselors/teachers on directly supporting post-high school opportunities
- Tracking those students to see rate of retention/hiring in the tech field
- CS AP test scores (quality of education)
- Counts of:
    - graduates in computer science/tech focused major
    - Internships/apprenticeships and participation
    - Bootcamp participation

Marketing Pillar

- **Top metric:** Survey of students to track interest in continuation of tech post high-school graduation

- Highschool to post-secondary continuation (college degree, apprenticeship, bootcamp...)
- Post-secondary to receive an offer within the tech field for job placement

Constraints and Risks

- General shortages of teachers across the country and additional pressures within the school system
- Potential shift away from classic 4-year college degrees with loan and cost pressures
- Inability to get quality measurements post-high school to understand success of programs *(there could be more available with data tracked if partnering with organizations impacting policy/legislation)*

Sources

	Name	URL
1	2021 State of Computer Science Education	https://advocacy.code.org/state_handouts/Minnesota.pdf
2	Minnesota education stats	https://csforallmn.org/
3	Teacher Shortage Reports	https://www.mreavoice.org/category/quality-teachers/teacher-shortages/
4	Grants for MN Schools	https://education.mn.gov/MDE/DSE/PROD046915
5	occupations in demand in MN	https://mn.gov/deed/data/data-tools/oid/
6	Cyber States - in partnership with CompTIA	https://www.cyberstates.org/

GROUP 3

Kendra (Lettau) Apelt, AVI Systems; Marcel Holste, Carl Zeiss Industrial Metrology, LLC; Cristina Lalley, Thomson Reuters; Dao Lee, Land O'Lakes; Aim Notthakun, Winnebago Industries

Evidence of Challenge

There is a saturated market of pathways to technology learning and employer partnerships available in Minnesota that are seeking interested candidates. These pathways can include (but are not limited to): internships, registered apprenticeships, apprenticeships, on-the-job training, corporate work study, and boot camps. Challenges are present on either side of the pathways. Companies struggle to find suitable talents, especially technologists, resulting in a more than 5% job vacancy rate (as a comparison, <3% is considered healthy), but not enough are investing into e.g., internal training programs to grow their own talent.

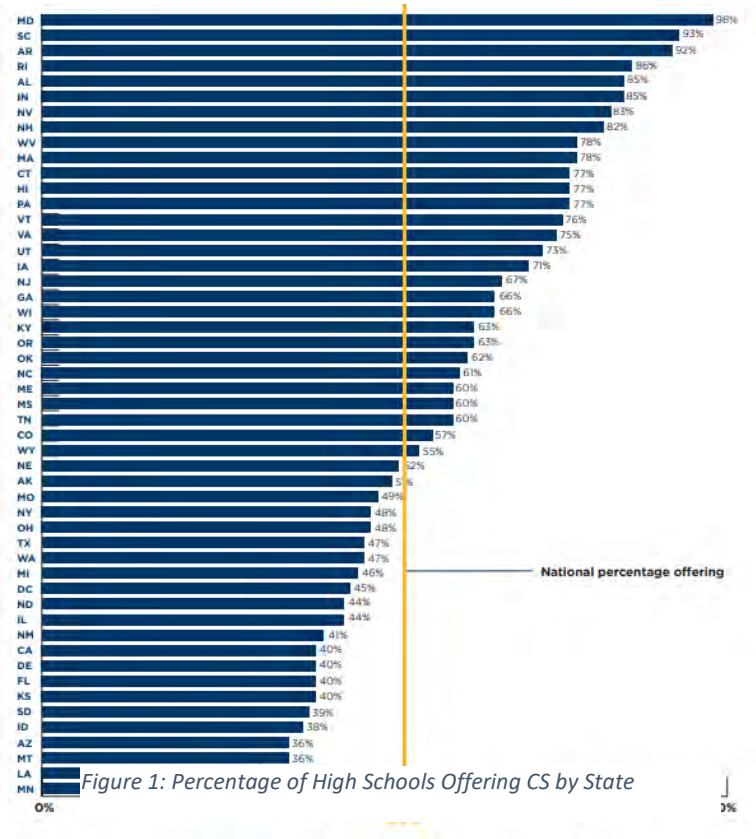
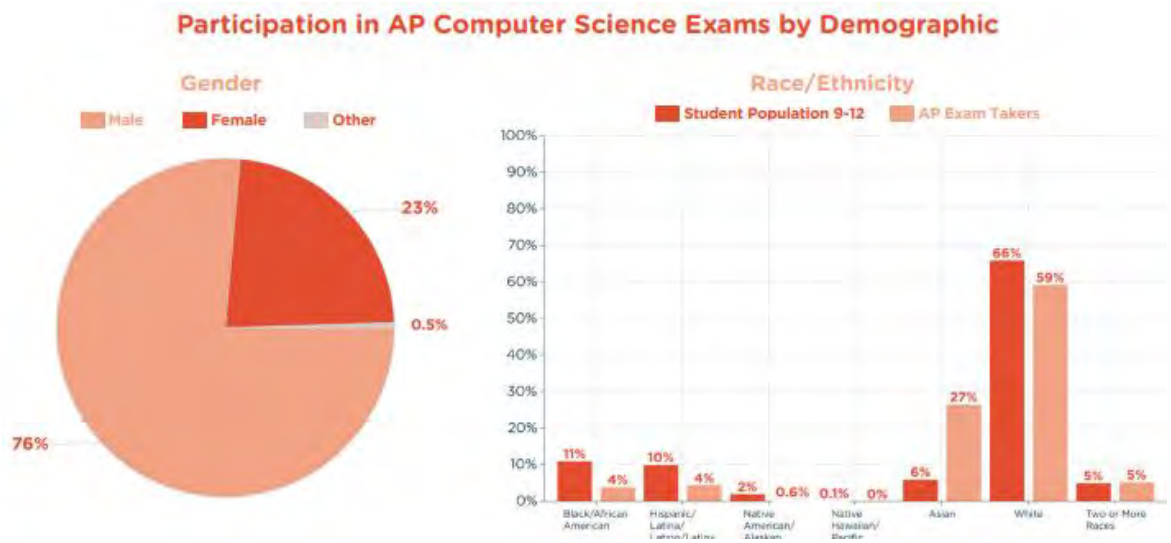


Figure 1: Percentage of High Schools Offering CS by State

On the other hand, too few students are launched into technology career paths, e.g., with Minnesota's school's ranking last in a national comparison of high schools offering a computer science (CS) class. Demographics, with ~70,000 technologist projected to retire within the next 10 years, propel these problems into a continuously growing gap and crisis.

Especially minorities, which in terms of CS include women, are less likely to participate in high school CS programs and subsequently take the advanced placement (AP) exam. This is highlighted in figure 2. Reasons among others include perceived entry barriers, (perceived) inability to invest in technology career education and technology career biases.



However, a shortage of talents available to companies is not restricted to Minnesota's technology talent alone, as figure 3 on page 4 below shows, but part of a state-wide labor shortage crisis. But it is amplified in the technology sector. Figure 4, depicting negative rates of annual awards is clear proof of the gap between demand and supply further growing. Postsecondary institutions continue to underproduce technologist graduates at rate to meet local demand.

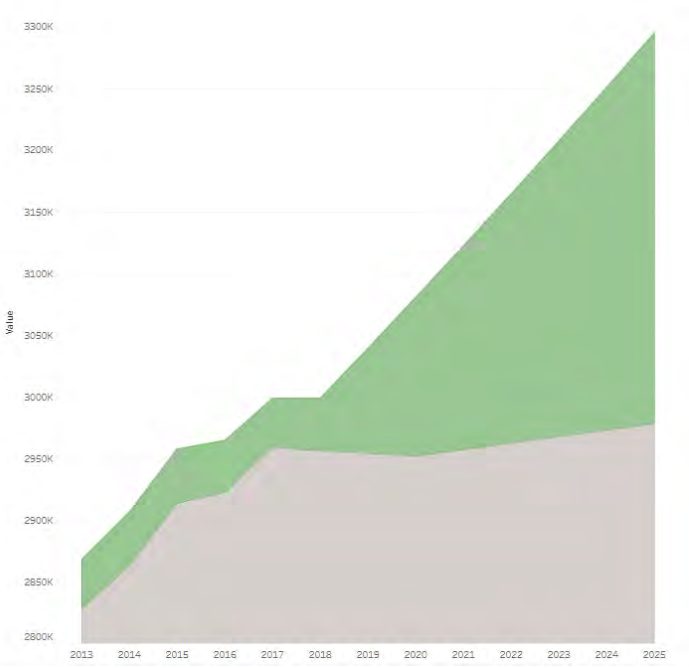


Figure 3: Minnesota's Labor Shortage

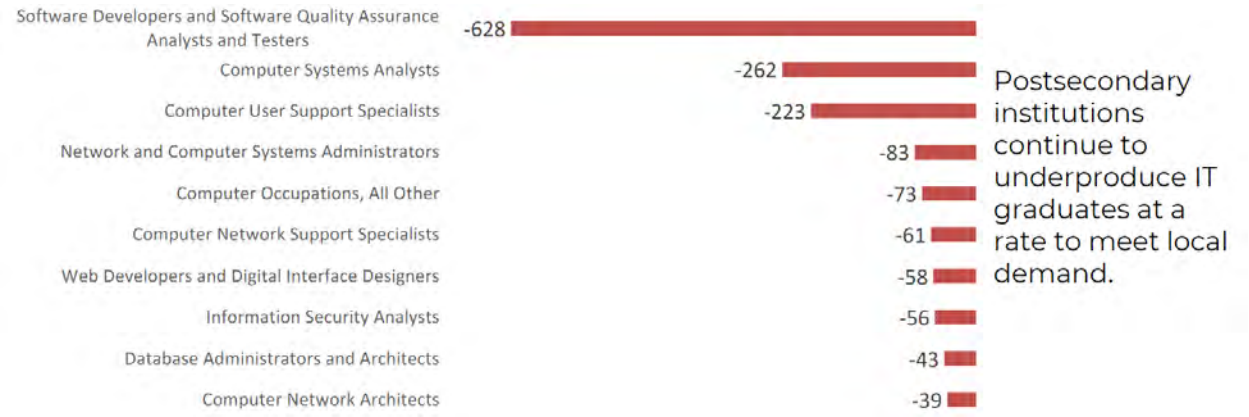


Figure 4: Annual Award Gaps by Occupation

Opportunity

As evidenced above, it is clear Minnesota is facing a significant shortage of technology talent crisis and the problem will only continue to persist. To address this long-term challenge, we have an opportunity to target young talents to build a pipeline of future technologists. Given the saturated market of pathways to technology already available in Minnesota, minorities being the most unemployed across educational levels and not all high schools having computer classes to launch students' interest in technology careers, we believe the following opportunities could be achieved through targeted marketing and partnerships:

- Bridge the gap between employers, students, and programs by bringing awareness to the existing pathway-to-technology programs with the following desired outcomes:
    1.) Inform and educate students to build early interest in technology careers
    2.) Connect students to programs
- Tap into the minority student population
- Influence both students and parents on technology as a career choice

As there is shortage of labor in a lot of industries, our focused goal is to direct young talents to focus on technology careers through targeted marketing by showing them the benefits of a fast-growing and high-paying field.

Investment Strategy

Investment Grid	6-12 CS Education	Internships (HS or College)	2- and 4-Year Degrees	Apprenticeships or Bootcamps	Employee reskill or upskill
Policy					
Marketing and Awareness	**$900k**				
Partnerships with Companies					
Partnerships with Service Providers	**$100k**				
Funding Mechanisms or Incentives					

We would spend our $1 million to create interest and education regarding technology careers through a 3-year targeted marketing campaign aimed at 14–18-year-old high school students with a tailored emphasis on minorities. We would spend $25k per month for 36 months targeting social media platforms used by high school students such as Instagram, Snapchat, TikTok, Twitch, and YouTube as well as directly to high schools and their communication teams. This marketing campaign would be accompanied by a website of existing Minnesota programs including bootcamps, apprenticeships, job boards, corporate work studies, etc. to bring visibility and direct students and companies to the great programs that are already active. We would invest $100,000 on the partnership website and our marketing campaign would drive traffic to that site.

We took this approach for two main reasons. One, increase awareness and the attractiveness of technology careers to high school students, especially to groups of minorities and hence, lowering the perceived entry barrier. Two, to bridge the gap between talent and employers by providing visibility and awareness of the programs in place to bring these groups together.

We focused our investment narrowly to maximize our technology ecosystem impact to demonstrate maximum results with our dollars and not add to the saturation of programs already in the market.

Key Recommended Measurements

Measurement 1 (Short Term):

In the short-term, we need to measure engagement of high school (HS) students in the platform campaigns. Engagement rates are metrics that track how actively involved your audience is with your content. Typically, engagement is measured at likes, comments, and shares over a series of and expressed in percent of total followers. Social media experts consider the following engagement rates to be a normal distribution:

Less than 1%	low engagement rate
Between 1% and 3.5%	average / good enagegement
Between 3.5% and 6%	high engagement rate
Above 6%	very high engagement rate

Table 1:Engagement Rating Scale [Scrunch.com]

For this purpose, we will assume all high school students in Minnesota that have access to social media to be followers of this campaign. This is 297,000 total students' times 70% equaling 207,900.

We do not expect to see a sharp increase in engagement, but rather a gradual built of interest within the students. How quickly this builds highly depends on the frequency of published engagement opportunities. Based on above mentioned campaign, we should see the engagement rate to rise to 4-5% within 10-12 weeks and as an average over time to stay consistent. This means, after the 12 weeks, on average we should see 8,280 – 10,350 likes, comments, and shares.

Due to the volatility of the consumers in this market, we suggest measuring the engagement across a sample of no less than 10 engagement opportunities.

Measurement 2 (Long Term):
In a second step, to assure reaching the long-term goal of doubling Minnesota's technology talent by 2032, we must measure the long-term effectiveness of the platform campaign. If it is effective, it will build HS students,' especially of those belonging to a minority (e.g., females, people of color, Latino, etc.), interest in technology and CS careers and in return will result in an increase in CS class and CS AP exam participation.

HS Student Progression in Computer Science AP Exams								
	2025	2026	2027	2028	2029	2030	2031	2032
Additional minority and female students taking the AP in CS (per year)	339	2171	6783	11395	13566	13566	13566	13566
Total minority and female students taking the AP CS Exam:	20075	21906	26519	31131	33302	33302	33302	33302
Additional none minority students taking the AP in CS (per year)	61	390	1219	2047	2437	2437	2437	2437
Total additional students taking the AP CS Exam	20136	22296	27737	33179	35739	35739	35739	35739
Total students taking the AP CS Exam	**73349**	**75510**	Point of no return	**2**	**88952**	**88952**	**88952**	**88952**

Table 2: Progression of HS Students taking a Computer Science AP Exam [Self]

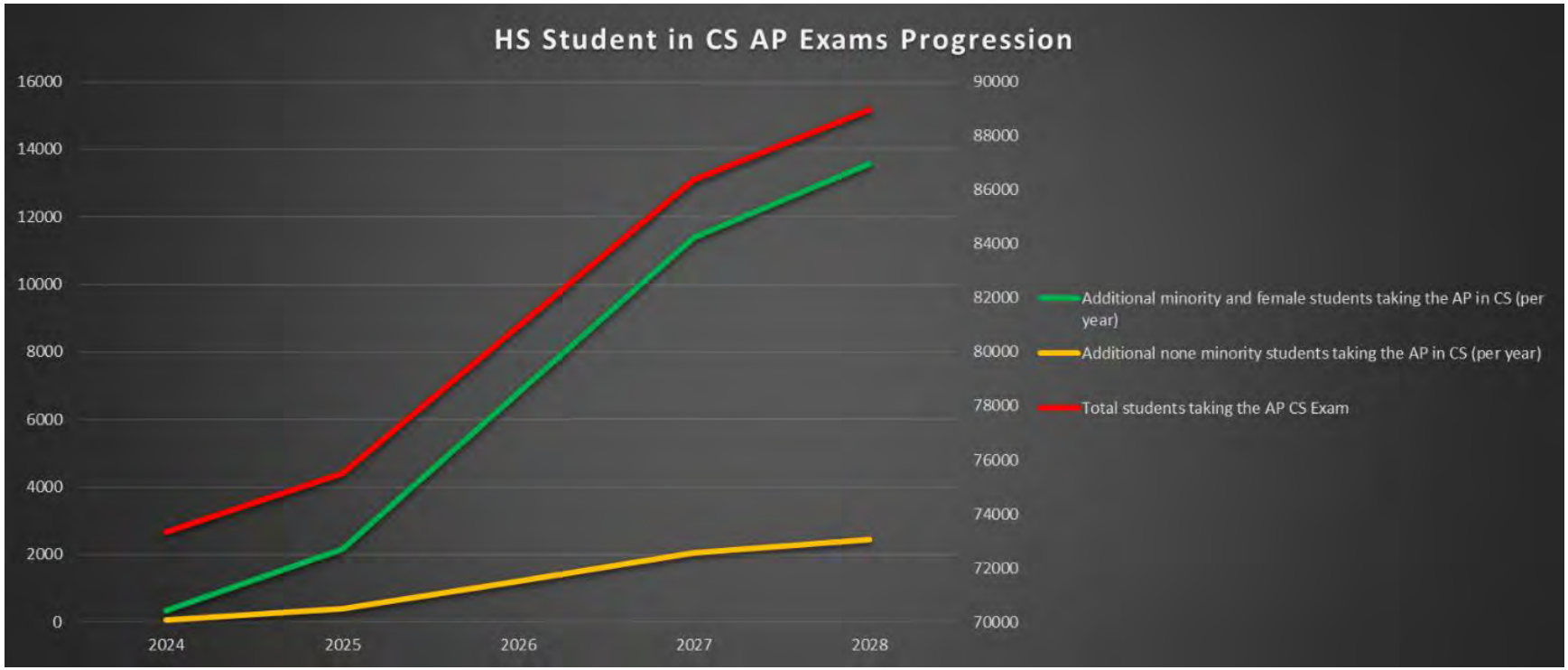


Figure 1: Progression of HS Students taking a Computer Science AP Exam [Self]

Table 1 and figure 1 illustrate the expected development of additional students taking the CS AP Exam We are not foreseeing any change other than demographical addition in 2023 and 2024. This is, as it requires ~2 years for the campaign to be planned, build, and launched and students to build interest and sign up for CS classes. Once the interest is built, we are expecting to see the students behave in line with consumers, when a new product (e.g., iPhone 14) is released to the market. Innovators (2.5% market share) will pick up the CS classes first, followed by the early adopters (13.5% market share) – see figure 2 for more details.

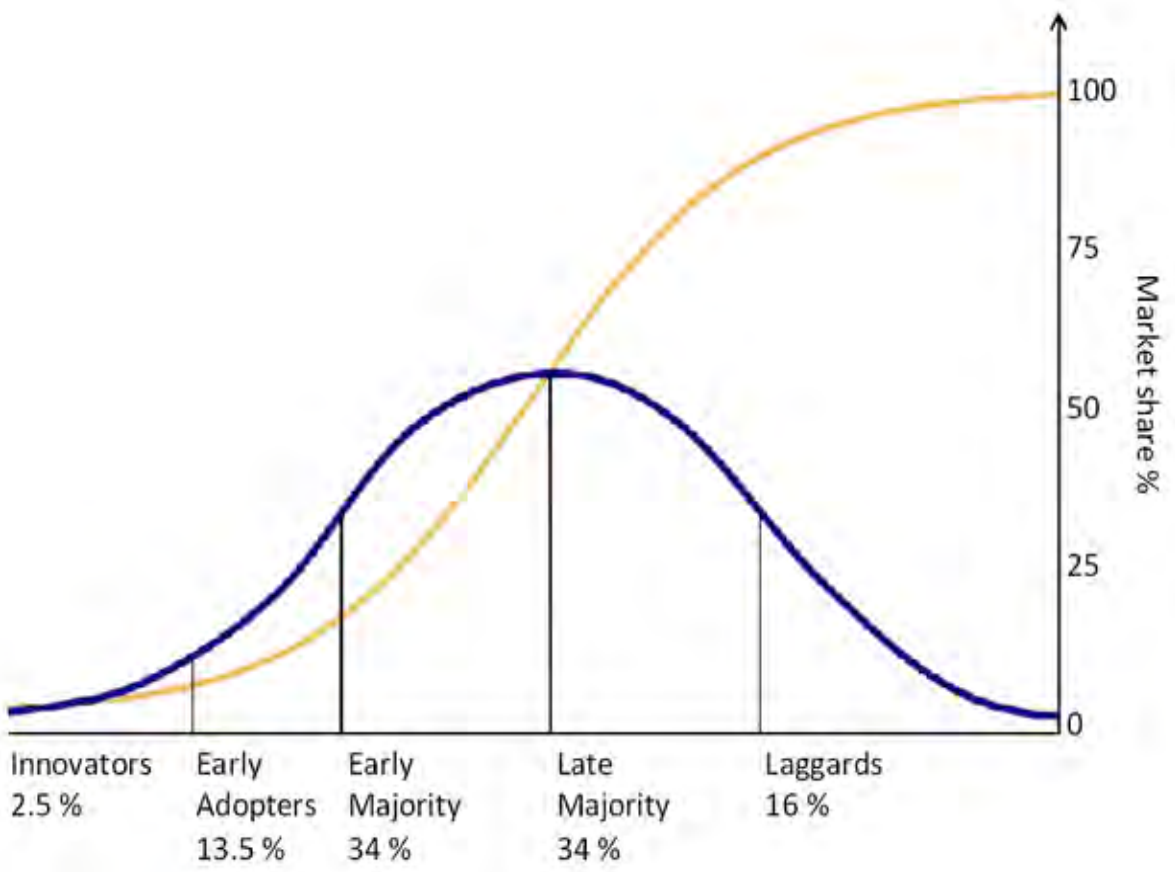


Figure 2: Distribution of consumers picking up a new product [...]

Between 2025 and 2032 we are expecting a total of 672,010 students to take the AP exam in computer science. Given that we need 205,000 additional technologists by 2032 to double technology talent in Minnesota, we require >= 30.5% of the above-mentioned students to pursue a career in tech. Where-as we must continuously measure to assure, we are on track, the end of 2026 provides a critical point of no return. If numbers have not increased as expected, at this point, we must identify the root-cause and implement corrective actions.

Constraints, Risks, and Assumptions

There are many known constraints and risks that come with targeting 14–18-year-old in marketing campaigns. The table below outlines these areas and description:

(C)Constraints, (R)Risks, & (A) Assumption	Type	Description
Diversity in Minnesota	C	Minorities make up only 20% of Minnesota's population (1,141,478). In addition, only 23% of Minnesotans are under 18 years old [10].
Technology & Social Media Limitations	C/A	Not all students have access to technology and social media platforms. Ninety-three percent of households have a computer and 87% have a broadband internet subscription [10]. Seventy percent of high students have access to social media platforms.
Conversion rates	R/A	Not all students will be interested in technology. Conversely, students may gain interest in technology through these campaigns.
High School – Resource constraints	C	Schools may not be able to manage the rising demand in computer science. This may include technology, teacher, and experience limitations. In addition, not all high schools offer AP computer science. Only 19% of Minnesota High Schools offer AP CS. [8]
Service Providers – Resource constraints	C	Service providers may not be able to manage the increased demand and placement of students. In addition, not being able to provide the attention and care needed to appropriately place students.
Social Media Campaign limitations	R/A	May potentially take 2 years to create and launch an effective social media campaign
Skipped Ads	R/A	Sixty-five percent of users skip ads as soon as presented a chance to do so [9]. Therefore, the full message of campaign may not get across to the targeted market.
Marketing campaigns will be directed to program partners	A	Partner with employers to act from leads generated from marketing initiatives; thus, connecting employers to students

Sources

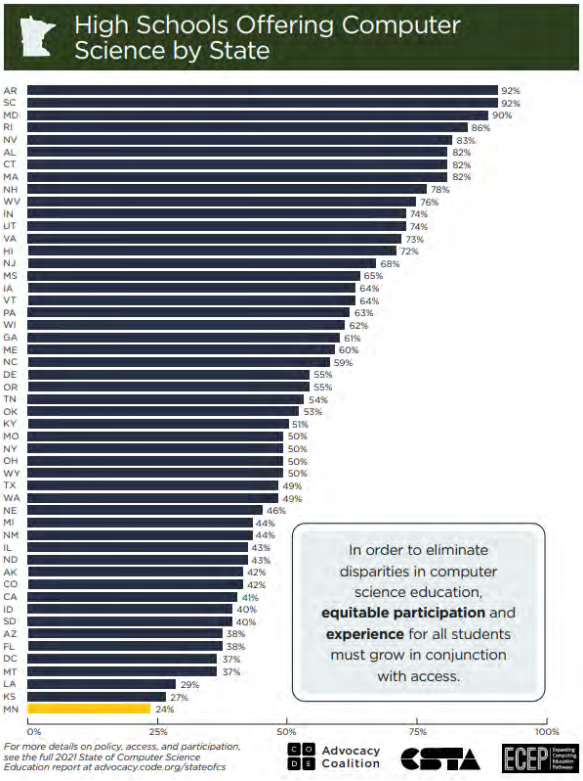
	Name	URL
1	2021 State of Computer Science	https://advocacy.code.org/state_handouts/Minnesota.pdf
2	Support K-12 Computer Science Education in Minnesota	https://code.org/advocacy/state-facts/MN.pdf
3	The Great Smartphone Debate	https://districtadministration.com/the-great-smartphone-debate/
4	Let's Encourage Kids to Get Excited About a Career in Tech	https://medium.com/@natashamulla/lets-encourage-kids-to-get-excited-about-a-career-in-tech-152ce8ba1aa
5	Minnesota's Labor Shortage	http://www.realtimetalent.org/research-2/mnlaborshortage/
6	Help Wanted Minnesota: When it comes to STEM hiring, Minnesota is geeked out	https://www.bizjournals.com/twincities/news/2019/05/01/the-mystery-of-the-missing-techie-why-minnesota.html
7	How Much Should I Spend on Social Media Marketing	https://evolvemedia.com/how-much-should-i-spend-on-social-media-marketing/
8	AP CS High School	https://code.org/advocacy/state-facts/MN.pdf
9	Skipped Ads	https://www.cnbc.com/2017/02/16/sixty-five-percent-of-people-skip-online-video-ads-heres-what-to-do.html
10	Census (MN)	https://www.census.gov/quickfacts/MN

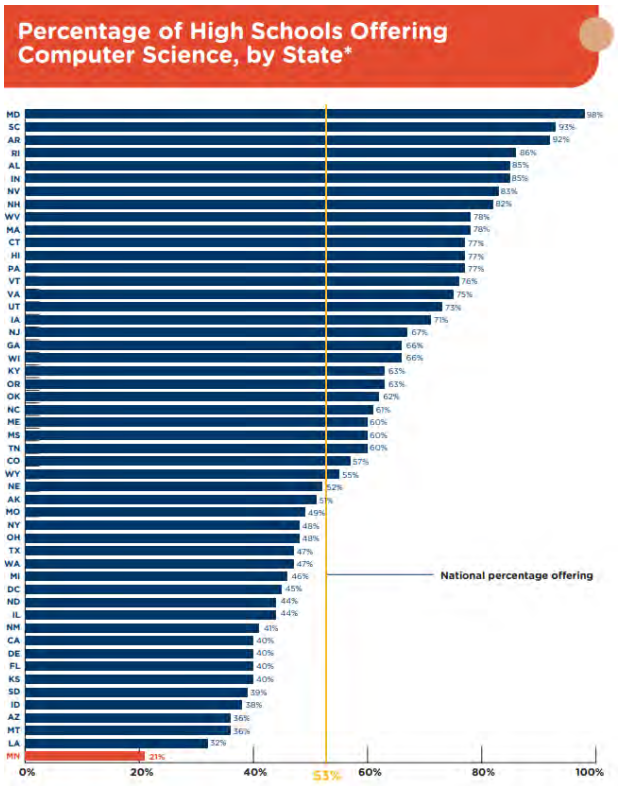
GROUP 4

Jerel Thompson, SPS Commerce; Thomas W Kwong, University of Minnesota; Ginger Ovall, Land O' Lakes; David King, Digineer

Evidence of Challenge

1. Minnesota is in last place for computer science classes offered to high school students in the US[1].





2. Minnesota does not offer dedicated funding for rigorous computer science professional development and course support for teachers.[2]

[1] Minnesota.pdf (code.org) – Graphs show decline in CS classes offered at Minnesota high schools (24% to 21%)
[2] MN.pdf (code.org)

[3] (Graphic showing no funding offered for professional development)

3. Minnesota does not yet require that all secondary schools offer computer science.[4]

Opportunity

We see a huge opportunity in moving Minnesota off the bottom of the list in computer science classes offered to high school students. We recommend a marketing campaign to raise awareness of this issue to pressure MN State legislature into action. At the same time, we propose investing in lobbying efforts to require all Minnesota secondary schools to offer computer science classes.

We also recommend investing in a *Tech for Youth* regional technology career fair, aimed at meeting high school students where they are at and providing pathways to technology careers. The *Tech for Youth* fair will partner with local companies and technology education providers to showcase the possibilities of technology careers.

Our goal is to increase access and awareness of technology careers in Minnesota. We want to expand the number of homegrown technologists to help strengthen our communities and meet MnTech's stated goal of doubling the number of technologists in 10 years.

[3] 2022_state_of_cs.pdf (code.org)
[4] MN.pdf (code.org)

Investment Strategy

Investment Grid	6-12 CS Education	Internships (HS or College)	2- and 4-Year Degrees	Apprenticeships or Bootcamps	Employee reskill or upskill
Policy	**$300k**				
Marketing and Awareness	**$300k**				
Partnerships with Companies	**$125k**				
Partnerships with Service Providers	**$125k**				
Funding Mechanisms or Incentives	**$150k**				

Overall, we would recommend:

- **High School Policy:** Lobbying for dedicated funding for computer science professional development and requiring all secondary schools to offer computer science classes.
- **High School Marketing and Awareness:** Marketing campaign for 50 out of 50 (MN in last place for computer science education). Our goal is to drive constituent advocacy towards our funding and computer science policy objectives.
- Marketing of *Tech for Youth* technology career fair
- **High School Partnership with Companies:** Partner with regional companies to participate in *Tech for Youth* fair
- **Partnerships with Service Providers:** Partner with tech career opportunity providers to participate in *Tech for Youth* (This includes teachers, universities, college bound programs, internship providers)
- **Funding Mechanisms or Incentives:** Efforts to gain public and private sponsorship for *Tech for Youth* fair

Key Recommended Measurements

- Increase percentage of high schools offering computer science classes from 21% to 50% within 5 years
    - Short term measurement to ensure Minnesota is moving in the right direction
- Measure attendance of high school students that participated in *Tech for Youth.*

    - Goal is to have 50% of students per high school invited participate in *Tech for Youth*
- Increase number of AP Computer Science exams given in Minnesota high schools (currently at 1,806 in 2020)[5]
- Track college enrollment in Computer science programs

Constraints and Risks

- Lack of support with MN legislature to change policy on computer science education
- High school students may not be interested in computer science as a potential career
- Unwillingness from companies to sponsor or participate in *Tech for Youth* career fair
- Teacher availability/ interest in teaching computer science classes
- High schools may not want to participate in *Tech for Youth* career fair

Sources

	Name	URL
1	Support K-12 Computer Science Education in Minnesota	https://code.org/advocacy/state-facts/MN.pdf
2	Council on Integrity in Results Reporting	https://cirr.org/standards
3	2021 State of Computer Science Education	https://advocacy.code.org/state_handouts/Minnesota.pdf
4	CODE Advocacy Coalition	https://advocacy.code.org/

[5] MN.pdf (code.org)

GROUP 5

Abbi Butterfield, Digineer; Andrew Niederhauser, SHE; Irenius Eremon, Rimage Corp; John Ahrens, CHS; Kristen Thurber, Donaldson

Evidence of Challenge

1. Over ¾ of public high schools in MN do not offer Computer Science classes. (State map) Over ¾ of those schools that do offer CS classes are in the metro. (State map)
2. Minnesota is behind all other states in the amount of Computer Science education policies. (code.org)
3. There are currently no state certification programs, leading to 0 Minnesota certified teachers.

Opportunity

1. Lobby for the passage of MN State CS education policies (HF 3243 and SF 3578).
2. MnTech Project Team will partner with organizations to:
    a. Review and standardize High School (HS) Computer Science (CS) curriculum.
    b. Develop standardized HS CS teacher accreditation.
    c. Outreach and advocacy to MN school boards to establish HS CS program.
    d. Provide support and resources to program participants.

Investment Strategy

Investment Grid	6-12 CS Education	Internships (HS or College)	2- and 4-Year Degrees	Apprenticeships or Bootcamps	Employee reskill or upskill
Policy	**$250k**				
Marketing and Awareness	**$250k**				
Partnerships with Companies					
Partnerships with Service Providers	**$250k**				

Funding Mechanisms or Incentives	**$250k**				

To equitably build Minnesota's (MN) technology talent pipeline, we propose that the MnTech Board and MnTech Foundation invest $1m to advance High School (HS) Computer Science (CS) policy and develop a HS CS proof-of-concept (POC) for outstate MN. These parallel efforts address both short and long-term opportunities to double the number of technologists in the State in ten years. While education policy will have the greatest long-term impact on the State's talent pipeline, it is uncertain if and when that policy will be passed so the HS CS POC will provide a repeatable framework for implementing HS CS education in the interim.

According to Code.org, MN is behind all other states in the number of CS education policies. The lack of policy limits funding opportunities and results in a fragmented approach to HS CS and hinders our technology talent pipeline. There is currently legislation pending, MN House File 3243 and MN Senate File 3578, that will develop a statewide CS blueprint for K-12 education. We propose spending $250,000 to lobby for passage of these bills. If passed, the resulting blueprint will increase the quantity and quality of HS CS policies at the state, increase potential funding for HS CS, and increase the number of HS CS programs, teachers, and students.

In addition to the lobbying initiative above, we propose spending $750,000 to develop an interim HS CS POC should the policy above not pass or be delayed. If the legislation above does pass, then the POC will also provide a framework for statewide programming. MnTech will establish a HS CS Project Team to support this initiative. The team will include a manager/director, analyst, and support staff. The team will review and standardize HS CS curriculum already available from other states and non-profit organizations. A standardized HS CS teacher accreditation framework will also be developed to support the curriculum.

Once the curriculum and teacher accreditation frameworks have been standardized, the team will reach out to various MN school boards for interest in participating in the POC and establishing a HS CS program. While the curriculum that is developed can be leveraged by school boards across the State, the POC will target outstate MN school boards to increase HS CS equity as over 75% of the HS CS programs in the State are in the TC Metro area. After the school boards have been identified for the POCs, the project team will collaborate with the school board to identify teachers to pursue accreditation. Support staff from the MnTech Project Team will help with curriculum support as well as coordinate with Tech4Success for hardware and software.

This collaborative between public and non-profit organizations to implement policy and educational frameworks will help equitably build MN's technology talent pipeline. MnTech's catalytic investment will nurture opportunities for high school students to learn about technology and in turn make MN a technology hub for future generations.

Key Recommended Measurements

1. Number of additional policies to be passed in MN over the next 10 years.
2. Number of high schools that have a HS CS program.
3. Number of accredited teachers that participate in HS CS programs.
4. Number of students in HS CS programs.

Constraints and Risks

1. State policies might never pass or be significantly delayed.
2. Policies will take time to implement once approved
3. Teachers' unions push back – on policies and mandates. The Teacher's Union may oppose class 3 certification for computer professionals who could lead the classes
4. Some High schools have limited capabilities and resource constraints including computers and classroom space.
5. Interest, time, and funding for Teacher Training

Sources

	Name	URL
1	Support K-12 Computer Science Education in Minnesota	https://code.org/advocacy/state-facts/MN.pdf
2	Council on Integrity in Results Reporting	https://cirr.org/standards
3	2021 State of Computer Science Education	https://advocacy.code.org/state_handouts/Minnesota.pdf
4	CODE Advocacy Coalition	https://advocacy.code.org/

GROUP 6

Ian King, CHS; James Luster, Comcast; Nicole Mewes, Best Buy; Kris Patrow, Padilla; Emily Paulson, Digineer

Evidence of Challenge

According to The World Economic Forum, *over 50% of all employees around the world need to upskill or reskill by 2025 to embrace the changing nature of jobs. Many organizations in these situations are turning toward reskilling to build the talent they cannot acquire or productively deploy.*

Rebuilding a sustainable technology talent pipeline for the long-term requires a comprehensive public-private approach to making the state's education system, economic policies, recruitment practices and tech-innovation positioning more competitive with those of other states.

We see a great opportunity in an under-tapped resource Minnesota companies already have: their existing employees. *When companies take advantage of workforce ontology (related set of skills and their relationships between one another), it is six times less expensive to upskill and reskill the workforce than to hire external talent.* By initiating and/or improving tech upskilling programs within their own companies, employers can effectively and more quickly fill open tech positions with less cost, easier onboarding, and greater retention - not only for their open tech jobs now, but also for the new tech jobs that will evolve along with the companies' innovations in their industries.

For example:

- At 3M, SAP was being implemented across Plants/Distribution Centers globally. To be successful, help would be elicited from workers at the plants/distribution centers where the technology was being rolled out. These workers would take teams through the warehouse, help build out useful test scenarios, then learn the system. By the time the software was implemented, these workers had become SAP experts with real life business knowledge. 3M would often tap these workers to move into IT roles within SAP. This allowed the company to advance the careers and skillsets of internal employees, while also reaping the benefits of that employees' and it also benefited them to have someone who had the business and technological expertise to assist in future rollouts.
    - More efficiently and cost-effectively fill IT roles with workers who 1) were already onboarded and familiar with the 3M culture, systems, and operations, 2) had the business and technological expertise to assist in current and future rollouts and 3) were less likely to leave due to their established tenure with 3M and with their local communities.
    - Advance the careers and skillsets of current employees, which in turn 1) could help improve retention due to demonstrated investment in employee growth

and 2) be leveraged as a recruitment asset to candidates who prioritize professional development opportunities offered by their employer.

- At Amazon, hourly employees who work in its fulfillment centers can now take advantage of free education and skills training opportunities to help them secure high-growth jobs within the company. This $1.2 billion investment in upskilling its existing workforce underscores the value both Amazon and its employee places on professional development and career growth opportunities, which in turn improve retention and engagement.

Investment Strategy

Investment Grid	6-12 CS Education	Internships (HS or College)	2- and 4-Year Degrees	Apprenticeships or Bootcamps	Employee reskill or upskill
Policy					
Marketing and Awareness					
Partnerships with Companies					**$500k**
Partnerships with Service Providers					**$500k**
Funding Mechanisms or Incentives					

Making a substantial impact with $1M in a two-year time frame is a tall order, especially when we look at the ecosystem of causes for the talent crisis: lack of primary and secondary education in tech; policy issues/MN tax status being unfavorable to tech/startups, MN no longer being a leader in IT innovation, IT employees being hired away by corporations in other states, etc. What really could make a measurable difference in the short-term as myriad other efforts are underway to address the longer-term solution?

Our solution: *Why not upskill the employees you already have?*

To make $1M "catalytic" in a two-year span, we will partner with MN corporations to create and rollout a MnTech "upskilling " initiative for members' current employees. We would:

- Perform secondary research on upskilling/re-skilling trends, value, and opportunities among Minnesota companies (to get buy-in and best practices)

- Convene an employer advisory council to:
    - Align on needs, approaches, milestones, metrics
    - Share best practices (and meet quarterly for at least two years)
- Research and develop partnerships with proven tech upskilling partners/experts, to help advise on the development of this initiative across companies
- Develop a hub/landing page of upskilling program resources for MnTech members, including:
    - a list of MnTech/employer council advisors
    - guidelines for creating and instituting internal IT upskilling programs
    - a list of vetted local providers of IT upskilling, HR/Internal comms guidance, and a bi-weekly or monthly IT trends that may influence upskilling programs

Approach

Phase I: Hire discovery/change management consultant to do primary/secondary research on providers/user companies); make recommendations

- $100K est.

Phase II: Stand up program development team with MnTech investment to oversee program development and launch

Benefits of this approach

- Have people already familiar with the company's tech systems (are end-users, if not super-users of the company's tech); will be able to upskill quickly and hit the ground running
- Demonstrate to employees that the company is invested in their personal growth and development (improves engagement and retention: also, makes employer more attractive to outside candidates)
- Have employees who are already established in Minnesota and have chosen to build lives here - less likely to be "coasted" by out-of-state competitors (helps improve retention)
- Can more easily fill the job openings left by upskilled employees as they tend to be non-tech or less tech-focused roles, thus reducing recruitment and onboarding costs

Key Recommended Measurements

Starting from a researched baseline, track the number of employers who join the MnTech Upskilling Initiative in Year 1, then Year 2:

- Per employer, track the number of current employees who have been recruited to, joined, and completed an upskilling program with their current employer
- Assuming we can identify the number of open tech jobs at MnTech member companies, we can track how many of them have been filled because of upskilling at the end of Year 1, then Year 2

Companies could also measure:

- Percentage of internal tech openings filled by program graduates
- Attrition rates

Constraints and Risks

- We are assuming a majority of employers do not invest significantly in tech upskilling programs. If most of them *do*, then we would recommend an audit of tech upskilling programs across a representative group of employers to ID what is and is not working. We would then function as an advisor on a more impactful approach to upskilling.
- Employers might say they do not have the capacity/budget to invest in upskilling (we would need to have the research to back up its cost/benefit vs. other recruiting efforts
- Employees may not sign up for the programs.

Sources

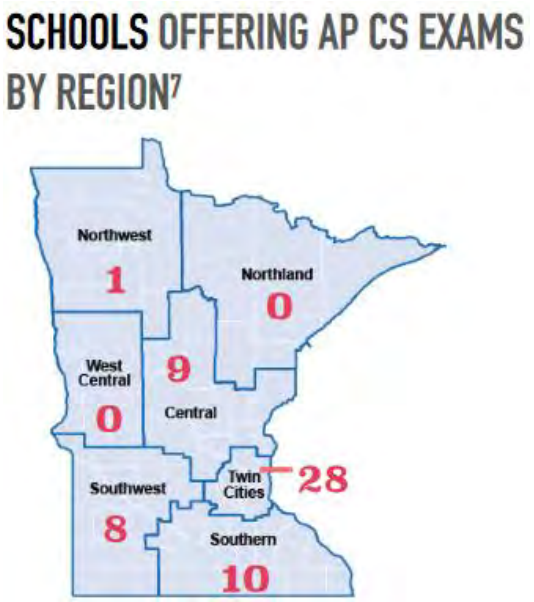
	Source	URL
1	Support K-12 Computer Science Education in MN	https://code.org/advocacy/state-facts/MN.pdf
2	Council on Integrity in Results Reporting	https://cirr.org/standards
3	CODE Advocacy Coalition	https://advocacy.code.org/
4	2021 State of Computer Science Education	https://advocacy.code.org/state_handouts/Minnesota.pdf
5	Future of Jobs 2020 Image: World Economic Forum	https://www.weforum.org/agenda/2020/12/4-ways-to-reskill-the-global-workforce/
6	Future of Jobs 2020 Image: World Economic Forum	https://hbr.org/2022/04/6-strategies-to-upskill-your-workforce#:~:text=global%20skills%20crisis.-,The%20World%20Economic%20Forum%20estimates%20that%20more%20than%20half%20of,cannot%20acquire%20or%20productively%20deploy.
7	Accenture: Reskilling Oil Gas Workforce	https://www.accenture.com/us-en/insights/energy/reskilling-oil-gas-workforce
8	Minnesota State I.T. Center of Excellence	https://mnstateitcoe.org/tech-training-program/
9	MN chamber	Minnesota 2030 industry chapter: Tech Sector

GROUP 7

Amanda Swan, SPS Commerce; Chad Boelter, Mayo Clinic: Dave Loveridge, Securian Financial; Lisa Oezalpay, Comcast; Ted Ellefson, Seagate Technology

Evidence of Challenge

Minnesota ranks 50th out of 50 states in the percentages offering computer science classes. (Jeff Tolson Link). As of today, there are no real standalone computer science standards for students and very minimal incentives for teachers to participate (MN Gov Ed Computer Science Acknowledgment).



Opportunity

MN Students are high performing and rank #6 in the US; yet have minimal access to computer science education.

We have a population of smart, willing students with minimal access to computer science education. Minnesota ranks sixth overall for the best public schools and sixth for quality. Minnesota students also rank as the second-highest math test scores in the U.S. (World Population Review). Given the state's educational performance, we have the foundation, capacity, and confidence to successfully make a larger investment in technology and computer sciences curriculums.

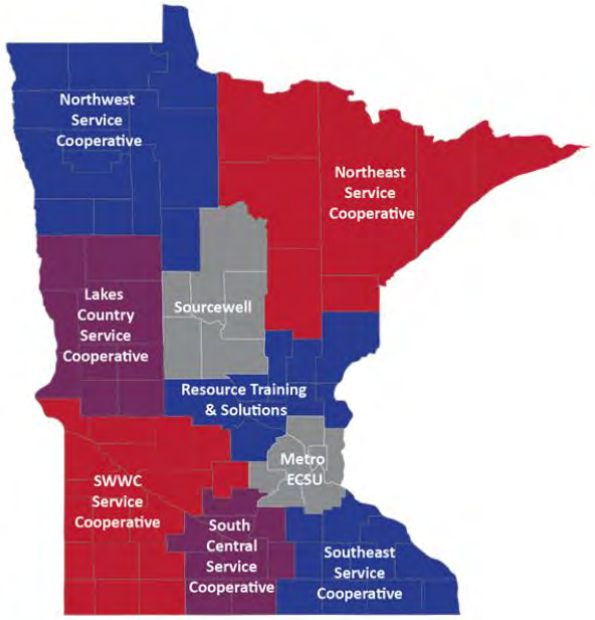
MN has Teachers that produce high performing students.

With these rankings, MN teachers are outstanding and produce students that achieve great results. Given these insights, it is important to incentivize our educational system and teachers to lean their expertise into technology and computer science.

MN has organizations focused on bringing interested parties together

There are MN Service Cooperatives (MSC) of established business partners, educational resources and staff that harness collective efforts to create curriculums, align strategic

partnerships and implement statewide initiatives. We are focusing on the Southeast Service Cooperative as our pilot area.



Resources are available to support a strong computer science curriculum:

MN has CS as an option in every school, but it is not required nor available in every school

Offering CS in every school and allowing elective SC courses to satisfy high school graduation and university admission requirements can encourage students to explore their interest in CS. (As referenced by the Arkansas case study of implementing a new computer science curriculum). As of today, computer science classes are not required for graduation in MN (State of MN Educational Requirements) We would look to MN Tech and other partners to lobby for the inclusion of these classes in MN

Investment Strategy

Investment Grid	6-12 CS Education	Internships (HS or College)	2- and 4-Year Degrees	Apprenticeships or Bootcamps	Employee reskill or upskill
Policy	**$100k**				
Marketing and Awareness					
Partnerships with Companies					
Partnerships with Service Providers	**$400k**				
Funding Mechanisms or Incentives	**$500k**				

- Fund cooperative partners for their support in creating a curriculum for teachers and students
- Fund lobbyist activity to change MN graduation requirements to include a computer science elective
- Fund a bonus to teachers. Paid upon completion of a bootcamp or computer science class to incentivize them (potentially during summer break or during the school year)

Key Recommended Measurements and Results

Measures of success: number of certified teachers and number of students completing computer science courses

We will ensure we have skilled teachers, available course curriculum, and graduation requirements.

Goals in 10 years:

- 1,244 Teachers certified and teaching
- 100K students complete a computer science course over the next 10 years
- Goals: MN Rank for Computer Science becomes competitive

	Year	Schools	Teachers	Students	Total Students
	2023-24	3	3	25	75
	2024-25	6	6	25	150
	2025-26	12	12	25	300
	2026-27	24	24	25	600
	2027-28	48	48	25	1,200
	2028-29	96	96	25	2,400
	2029-30	192	192	25	4,800
	2030-31	384	384	25	9,600
	2031-32	768	768	25	19,200
	2032-33	1244	1244	25	31,100
	2032-33	1244	1244	25	31,100
Totals					**100,525**

(1,244 total number of private and public MN schools combined)

Constraints and Risks

- Lobby – we can only influence this, but cannot guarantee it would have an impact
- Teachers – capability, availability, and motivation for a teacher to take on this new topic area – e.g., would an English teacher want to teach this?

- Equipment – Is it available? Do all schools have computer equipment for these classes?
- Students – might not have as much interested as we would like – so end up with about the same people that would take electives today are the same ones taking it in the future.
    - 50th out of 50 states is the key gap; we have room to improve, even if we do not get all we are looking for.

Sources

	Name	URL
1	Support K-12 Computer Science Education in Minnesota	https://code.org/advocacy/state-facts/MN.pdf
2	Council on Integrity in Results Reporting	https://cirr.org/standards
3	2021 State of Computer Science Education	https://advocacy.code.org/state_handouts/Minnesota.pdf
4	CODE Advocacy Coalition	https://advocacy.code.org/
5	MN State Education	https://education.mn.gov/mde/dse/gradreq/
6	Arkansas Case Study	https://www.brookings.edu/wp-content/uploads/2021/09/How-Arkansas-implemented-its-CS-education-program-FINAL.pdf