The Importance of Computer Science Education in M7 Region

Strong District Leadership, Regional Collaboration Critical

The need to develop a **strong tech talent pipeline** to support the needs of both industry and society is not new and is not going away. Diversity drives innovation and contributes to both personal and regional economic prosperity. The region is not lacking organizations willing to lean in. But **the power of this movement lies in the hands of district leaders** who believe that a foundational knowledge of computer science is an integral part of delivering their graduate profile.

The MKE Tech Hub Coalition sponsored Wisconsin's first CSforALL SCRIPT cohort in 2020 to help seven local school district teams develop individualized plans to ensure all students have access to high quality computer science education. This cohort has met quarterly for two years to share best practices. Additional supports and opportunities were provided along the way.

Competing priorities during a pandemic has certainly impacted their progress. However, five of the seven participating districts are continuing to make progress on the goals set during the initial workshop. Two of the seven have indicated that as important as it is, they are unable to staff the positions that would make it possible at this time.

This brief summarizes the current state of computer science education in the region along with the Coalition's commitment to continue to influence and support those charged with this important work in Southeastern Wisconsin.

MKE Tech Coalition's "Why?"

The MKE Tech Hub Coalition is committed to inclusively doubling tech talent in Southeastern Wisconsin. The Coalition's K-20 Education Committee was chartered to ensure students in the greater Milwaukee region understand their potential to contribute to the #mketech ecosystem and to increase retention of graduates with diverse backgrounds interested in working in tech-related fields. Regional workforce data demonstrates that without intentional strategies to change the status quo, there will be limited progress towards that objective. Attraction alone is not the answer as the lack of diverse tech talent is a national problem. Expanding access to computer science education (and related disciplines) at the primary, secondary, and post-secondary levels is critical to the Coalition's mission and for economic success in the region. Diversity in our tech workforce drives innovation and contributes to both personal and regional economic prosperity. Collaborating with districts with shared objectives will increase the retention of those who choose to stay (or return) to the region for work following post-secondary education and/or training.

> *"Education leaders understand that technological literacy is an important part of college and career readiness in a digital economy. But they need both state and regional support to effectively chart and execute on plans to ensure all students feel confident enough to take advantage of the opportunities available."*
>
> *-Laura Schmidt, Chief Talent Development Officer, MKE Tech Hub Coalition*

Current State of CS in Wisconsin

Technology is transforming every industry, product, and service – and changing the jobs we are preparing students for along the way. Indeed, tech roles are increasingly central to the regional economy. Overall, jobs in Southeastern Wisconsin are expected to grow 6% by 2028, while tech roles are expected to grow 10-28% (Wisconsin Long Term Occupation Employment Projections, 2020-2030 2022). This trend continues in 2022 where most of the hiring for tech occupations is occurring in industries with strength in Wisconsin including manufacturing, finance/insurance, and professional services (CompTIA, Inc. 2021). These roles are life changing, with higher average salaries at $80,546 (Code.org, CSTA, & ECEP Alliance 2021).

ALTHOUGH 86% OF WISCONSIN HIGH SCHOOL STUDENTS ATTEND A SCHOOL THAT OFFERS COMPUTER SCIENCE, ONLY 4.6% ARE ENROLLED IN A FOUNDATIONAL COMPUTER SCIENCE COURSE.

However, despite having the sixth highest concentration of college students among large metros, the current tech talent pipeline is insufficient to meet the need. Neither our current national tech workforce nor collegiate pipeline will increase diversity, as women, veteran, and individuals of color are significantly underrepresented. Ensuring a robust and diverse tech talent pipeline in the Milwaukee region has many benefits beyond economic advantages, including increased innovation, higher quality products and services, and the mitigation of unintentional (or sometimes intentional) bias. Therefore, a strategic focus on ensuring equitable access to computer science courses will center on creating domestic pathways to tech employment within the state education system.

Access to CS Education

Ensuring equitable access to computer science education at the K-20 level is essential to building the tech talent pipeline in the region. Computer science is recognized as a core literacy for students that supports the development of problem solving, creativity, metacognition, spatial skills, and reasoning skills. It also supports student success in other subject areas, including reading, writing, mathematics, and science (Code.org, CSTA, & ECEP Alliance 2021). Ensuring equitable access requires a mindset change from assuming that students are informed enough to 'elect' to build this required competency to one that ensures that it is built into the educational experience for all students so that they can see themselves as a part of an increasingly digital economy. This is especially true for historically underserved groups, including BIPOC, women, economically disadvantaged individuals, etc.

State leaders have the ability to send a clear message about the importance of computer science in our schools via public policy, funding, reporting, instructional support, and professional development.

Wisconsin ranks third in the Midwest in high schools offering computer science courses, with 62% of high schools offering computer science education, compared to 74% in Indiana, 64% in Iowa, 44% in Michigan, 43% in Illinois, and just 24% in Minnesota. Nationally, the state ranks 20th in percent of high schools offering computer science instruction. These rankings are almost certainly overstated; while schools can claim to offer computer science instruction, in practice the classes may not run due to lack of student interest or competing priorities, among other factors. Thus, although 86% of Wisconsin high school students attend a school that offers computer science, only 4.6% of students are enrolled in a foundational computer science course (Code.org, CSTA, & ECEP Alliance 2021).

Oftentimes, students do not understand the relevance of the learning outcomes of these courses to their academic and career plans. These plans are mandated by the state for all students within grades 6-12 and are required to prepare students for future employment and ensure technological literacy (Education for Employment Plans and Program 2015). District education to employment plans are also mandated but rarely include an action plan for how to ensure students receive this guidance.

Access to computer science education is also unevenly distributed across the state, creating geographic and socioeconomic barriers that are particularly impactful for historically underserved demographics (BIPOC, women, etc.). In 2020, urban access to computer science education was 47% - well behind suburban (73%), town (60%), and rural (66%).

Additionally, only 32% of schools with a free-and-reduced-lunch (FRL) rate greater than 75% offered computer science courses. At schools that did offer computer science courses, only 29% of economically disadvantaged students were enrolled, even though they account for 40% of overall enrollment. Enrollment is skewed heavily male: only 23% of students enrolled in 2020 identified as female (Code.org, CSTA, & ECEP Alliance 2021).

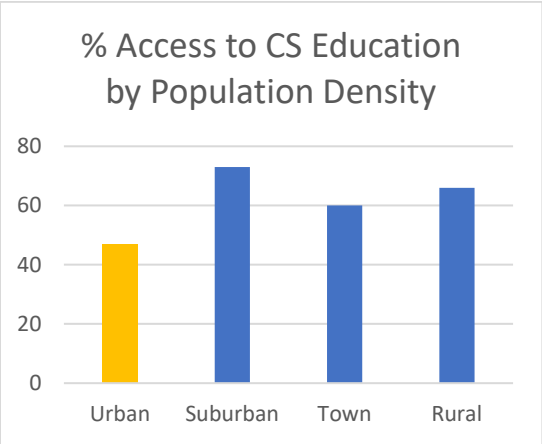

Figure 1: Percent of high schools offering computer science education in Wisconsin, by population density

Policy Adoption

The Code.org Advocacy Coalition has developed nine policy recommendations to make computer science a fundamental part of a state's education system (Code.org, CSTA, & ECEP Alliance 2021). Currently, Wisconsin has fully adopted four of these recommended policies and is in the process of adopting a comprehensive computer science plan that will provide a statewide definition for computer science, ensure all teachers have access to computer science licensing/certification resources, and encourage all K-12 schools to offer computer science instruction.

The Wisconsin Department of Public Instruction has developed the Wisconsin State Computer Strategic Plan to act as a roadmap for strategic decision making on resource allocation, implementation, and partnerships with industry and community organizations (Wisconsin Department of Public Instruction 2022). The state's plan has not yet been approved by Code.org.

The WI CS Strategic Plan leverages CSTA's definition of computer science. Specifically, "an academic discipline that encompasses the study of computers and their algorithmic processes, including their principles, their hardware and software designs, their applications, networks, and their impact on society," (Wisconsin Department of Public Instruction 2022). In 2017, the state adopted comprehensive K-12 computer science standards in collaboration with business, industry, and education professionals. These standards were also based on the standards previously developed by CSTA. These standards provide guidance to educators in developing and continuously improving computer science education in five topical areas: (1) algorithms and programming, (2) computing systems, (3) data and analysis, (4) impacts of computing, and (5) networks and the Internet. These standards can be customized by districts, taught, and integrated across a variety of disciplines (Wisconsin Standards for

Computer Science 2017). Computer science courses that are aligned with these standards can count as core mathematics credits for graduation from high school (Computer Science as High School Math Credit 2022). Success on the AP exam for AP computer science courses can translate to computer science credits at the post-secondary level, but they do not satisfy a higher admission requirement.

The state has established standards to ensure that Wisconsin teachers have access to materials and programs need to achieve licensure as computer science instructors. Teachers with an existing license can receive such certification by passing the Praxis Computer Science exam (Additional Subject Area Certification 2022). Additionally, a variety of Educator Prep Programs (EPP) are offered to support teachers on the pathway to certification. In the Milwaukee area, computer science licensure programs are offered by a variety of school districts, institutions of higher education, and community organizations, including Cardinal Stritch University, Carroll University, CESA 1 PBL Program, Concordia University, Marquette University, and the Urban Learning Collaborative (WI Educator Preparation Program (EPP) Lookup 2022). Wisconsin's vision for computer science is to ensure all graduates have the tools and skills necessary to thrive in an increasingly digital world (Wisconsin Department of Public Instruction 2022). Continuing to pursue these policies to expand access to computer science education at the K-12 level presents an opportunity for policymakers to collaborate to address equity, workforce, and education issues that act as barriers to enhancing and expanding computer science education in the state.

Primary Barriers

Teacher Shortage

While it is possible for a teacher to be prepared to teach to computer science standards (and receive licensure if required) before being put into service in local K-12 schools, it is not the norm. Rather, teachers typically need to upskill on their own and search out districts who value computer science education for employment. This issue was brought before the Education Deans of Greater Milwaukee in 2018 but was not picked up at the time as a priority for further discussion. WI DPI could implement a change to the requirements for pre-service education programs in the future.

The state has supported the implementation professional development programs to produce new computer science teachers. From 2016-2020, the number of schools with a certified computer science instructor rose steadily from roughly 120 to 160 (All Staff Report 2022). However, the state itself has not allocated funding for computer science teacher professional development; most funding has been provided by external granting agencies (including the federal government and

Create a state plan for K-12 computer science	Define computer science and establish rigorous **K-12 computer science standards**	**Allocate funding** for computer science teacher professional learning
Implement clear **certification pathways** for computer science teachers	**Create preservice programs** in computer science at higher education institutions	**Establish computer science supervisor** positions in education agencies
Require that **all high schools offer** computer science	Allow a computer science credit to satisfy a **core graduation requirement**	Allow computer science to satisfy a **higher education admission** requirement

Figure 2: Code.org: Nine Policies to Make Computer Science Foundational[1]

[1] Green = Adopted; Red = Not adopted; Yellow = In progress

philanthropic organizations). As a result, the state reported just four new computer science teachers were produced in 2020; the state has not reported more than two per year since 2015, when ten new teachers were produced (2021 Title II Reports - National Teacher Preparation Data (Wisconsin) 2021).

Adequately implementing and funding both pre- and post-service computer science professional development will be necessary to increase computer science teacher production and ensure quality of instruction.

High School Electives Alone Insufficient

Computer science education has historically been limited to high school electives. But electives are typically reserved for exploration vs. something that is required to support a district's graduate profile. Consequently, the CS4ALL movement calls for the integration of CS standards throughout the continuum of K-12 education with a scope and sequence that supports success in AP Computer Science Principles (AP CSP) and/or AP CSA (Java programming) courses (including a passing score on the AP exam). Although the number of students taking the AP exam for these courses in Wisconsin increased by 98% between 2015-20, there were fewer AP exams taken for computer science than for any other STEM subject. Additionally, despite more recent introduction in 2016, AP CSP exam takers also exceeded AP CSA exam takers by 2018.

Unfortunately, there has not been a corresponding increase in diversity. In fact, nationally, AP CSA has been least diverse of all programs offered by the College Board; more than 80% of students taking the corresponding exam were male. Additionally, only 10% of these students were identified as economically disadvantaged. These test takers were overwhelmingly White, while Black and Hispanic students were grossly underrepresented by a margin of 8-10% when compared to overall enrollment.

AP CSP was designed to introduce students to foundational concepts of computer science and challenge them to explore how computing and technology can impact the world (AP Central, 2022). Those who chose to implement AP CSP are making headway in increasing student engagement as well as diversifying participation due to its increased relevance to a wider group of students. The number of female AP CSP students has far outpaced overall growth, with an increase of 136% in 2020, and the number of Black and Latinx students taking AP CSP more than doubled. While this represents encouraging progress, additional supports are needed to ensure equitable access to AP CSP instruction and exams. Currently, AP CSP test takers are 75% male, only 12% economically disadvantaged, and Black and Hispanic students are similarly underrepresented (AP Program Summary Report 2021).

CHICAGO PUBLIC SCHOOLS IS THE FIRST SCHOOL DISTRICT IN THE COUNTRY TO ELEVATE COMPUTER SCIENCE AS A CORE REQUIREMENT FOR HIGH SCHOOL (2016).

Equitably increasing access to computer science early in students' educational experiences is necessary to increase the diversity of participation in standalone courses at the high school level. Aligning computer science education at the high school level with admissions requirements to institutions of higher education will further incentivize student participation.

School/District Leadership

School/district leaders, including Boards of Education, continuously balance a wide variety of competing priorities for scarce resources. Unfunded mandates rarely take root. State mandates on how teachers must spend

instructional time are perceived as a barrier to innovation. School/district leaders are called upon to advocate for the changes they want to see, balance competing priorities to provide a clear direction to staff and mitigate barriers to their progress. All of this within the backdrop of looming issues with school finances, staffing issues, learning loss associated with the pandemic, etc., as examined in the Wisconsin Policy Forum's recent body of education research.

For the CS4ALL initiative to take root, education leaders must first see computer science education as part of achieving their graduate profile and take needed action to promote a learning environment that ensures all students graduate with the confidence they could enjoy and succeed in a tech or tech-adjacent career. Boards of Education who believe that CS standards support their graduate profile are called upon to include CS in their graduation requirements.

Education leaders have indicated that their teams do not have the confidence or supports they need to adequately teach, guide, or fund an expansion of computer science education in their schools. They aren't sure how to integrate it into the school day, given competing priorities. This has been the focus of many community outreach programs including MKE Hour of Tech (exploration), SHARP Literacy and Microsoft TEALS (co-teaching), PUMP-CS (professional development), NCWIT Aspirations in Computing (diversity), CSTA (peer support), etc. However, districts will find it difficult to prioritize the integration of these programs and services if leadership does not consider computer science education a critical part of accomplishing their graduate profile.

CSforALL Script Program

Southeastern Wisconsin Pilot

Recognizing the specific barriers outlined above, the MKE Tech Hub Coalition sponsored the first CSforALL SCRIPT Workshop in the state on August 13-14, 2020. Districts were invited to participate based on their current demographic data (or a nomination by the Wisconsin Affiliate of NCWIT) and their willingness to assemble a district-led team to participate. During the workshop, district representatives worked in teams to identify core values around why computer science should be taught and articulate their visions for how this could be implemented in their individual districts.

CSforALL is a national organization that acts as a central resource for computer science education implementation by convening providers, schools and districts, funders, and researchers around the goal of providing quality computer science education to every student in the United States. As a central part of these efforts, CSforALL runs the SCRIPT – Strategic CSforALL Resource & Implementation Planning Tool – program, which includes a series of collaborative visioning, self-assessment, and goal-setting exercises to create or expand computer science implementation. The program is designed to be a collective effort at the district level to engage all impacted student support and curricular areas. It addresses five key areas: (1) leadership, (2) teacher capacity and development, (3) curriculum and materials selection and refinement, (4) partners, and (5) community (CSforALL 2022).

Figure 3: CSforALL SCRIPT Visions: Values & Impacts

During the workshop, representatives from seven school districts participated in the workshop, including Elmbrook Schools, Kenosha School of Technology Enriched Curriculum (KTEC), Milwaukee Academy of Science, Milwaukee Public Schools, School District of New Berlin, St. Francis School District, and Whitnall School District. Each team developed and committed to advancing goals including the development of a strategic plan to build an inclusive culture for computer science within their districts. They agreed on specific goals, which included:

- Establishing a shared vision and culture of support – rethinking computer science in relation to the vision of a college and/or career ready graduate
- Building district/building teacher leadership capacity
- Reinforcing the value proposition of computer science (via technological literacy) for diversity, equity, and inclusion
- Including computer science in curriculum renewal process across subject areas (priority standards, authentic alignment)
- Including new metrics in school/district Key Performance Indicators (regardless of report card requirements)

The MKE Tech Coalition convened the cohort quarterly over the next two years for peer discussion. Additional supports (e.g. District Curriculum Toolkit developed by Marquette University), and opportunities (e.g. free aiEDU resources) were provided along the way.

Feedback from participating districts indicated that despite challenges posed by staffing, difficulty in generating student interest, and the pandemic, they remain optimistic about continued efforts to integrate computer science instruction beyond the goals set in the SCRIPT Workshop. Five of the seven participating districts consider computer science an integral part of delivering their graduate profile and are continuing to make progress on the goals set during the initial workshop. Two of the seven have indicated that as important as it is, they are unable to staff the positions that would make it possible at this time.

District representatives expressed confidence in the statewide strategy on computer science and the continued opportunity to align with other districts by communicating best practices. At a July 28, 2022, quarterly meeting of district representatives, the team cited many benefits they had gained from participating in the Coalition-sponsored CSforALL workshop, including:

- The development of a team-based approach to articulate goals and action plans designed to move the district from current to desired state with the help of established rubrics.
- Communication and sharing of best practices among districts in how computer science education is implemented
- Connections to the latest resources in computer science education
- Alignment to other projects, opportunities, and grants
- Ability to expand opportunities for young students (summer school offerings, etc.)
- Ability to provide students with a background and encourage students to pursue computer science (or computing electives) in college

In our follow-up survey of participating districts in September 2022, respondents indicated that they have a clear vision and mission for **WHY** they want to teach computer science and a clearly articulated strategy for **HOW** to reach all students (including those from underrepresented backgrounds). However, not all respondents felt as though they had a clear instructional vision for **WHAT** teaching and learning what computer science should look like (and how to create strong curricular

alignment throughout grades K-12) despite feeling as though they were in alignment with state standards and leveraging both regional and state resources available to them.

Goals for 2022-2023 center around:

1. Addressing identified gaps in the alignment of K-12 scope and sequence (including AP) to meet computer science standards; select instructional materials; supplement with additional enrichment activities
2. Providing professional development opportunities to build the capacity of K-12 teachers and school leaders
3. Building awareness for the WHY behind computer science education with both district/building leaders and student families
4. Increasing opportunities for students to connect what they are learning to real world experiences.
5. Measurement of impact of action steps in relation to goals to inform continuous improvement.

Milwaukee Public Schools, Milwaukee Academy of Science and the School District of New Berlin reported that they have established internal working groups led by central office administration to further engage district and school administration, teacher specialists,

"Technological literacy is part of our vision of a college and career ready graduate. We want all students to understand the nature, behavior, power, and consequences of technology from a real-world perspective and appreciate how they can make a positive difference regardless of their career aspirations. We approach the delivery of computer science in grades K-12 with that in mind."

- Joe Garza, Superintendent, School District of New Berlin

"We believe in computer science (CS) education. It provides an equitable, inquiry-based environment for our PK-12 students to become active digital citizens. We are building a talented group of young minds ready to contribute to a modern and ever-changing workforce."

- Dr. Keith Posley, Supersuperintendent, Milwaukee Public Schools

"Our work with the Milwaukee Tech Hub and CSforALL allows schools like Milwaukee Academy of Science to take on the collective work of building a K-12 computer science education program. All young people in Milwaukee deserve to be included in this important and growing career field. Having a CS education roadmap is a necessary first step for schools to help close the gap in representation of girls and students of color in the technology field."

- Anthony McHenry, CEO, Milwaukee Academy of Science

counselors, higher education partners, local industry/workforce partners, and nonprofit groups to support their district's efforts to advance CSforALL best practices using SCRIPT rubrics and resources within their districts.

Next Steps for the Greater Milwaukee Region

While the region may have limited ability to influence state policy and funding that could transform computer science education across the state, there are still many actions that our region can lean into. For example:

Educational Service Agency Support

- The state of Wisconsin is now funding CSforALL SCRIPT workshops and has trained a facilitator at participating CESAs. CESA1 has since launched a CSforALL Network and invites districts to participate at no charge. This network includes the CESA2 service area, and non-members can still participate for a fee. The goals for this network are to (1) create a space of collaboration, (2) identify/address barriers, and (3) apply continuous improvement to support CSforALL cohorts.
- CESA1 has developed a consolidated network of services to include Academic and Career Planning (ACP), Regional Career Pathways (RCP), and Career & Technical Education (CTE) under the brand name of ARC. The goals of this network are to (1) facilitate best-practice sharing, (2) explore the connection between career readiness and social emotional learning through the framework of the portrait of a graduate, (3) highlight specific topics of interest by network members, and (4) share success stories of business partnerships with school districts.

Community-Based Organization Support

The K-12 Computing Alliance was formed by the Coalition to provide community-based support to those districts participating in CSforALL. It is certainly not inclusive of all community and/or regional economic development organization support but served as a good starting point. This group was disbanded as it appeared to be duplicative to the efforts of the GM-STEM initiative which has since completed their charter. These organizations continue to work together to have a collective impact on the region. The MKE Tech Coalition is open to resuming this working group if there is an interest.

MKE Tech Coalition Support & CSforALL Commitment

We plan to leverage the power of the Coalition to support state and regional efforts highlighted within this brief. In addition, the Coalition will:

- Support conversations where education leaders convene upon request (Wisconsin Policy Forum, Wisconsin Association of School Boards, Wisconsin Association of School District Administrators, Association of Wisconsin School Administrators, Wisconsin School Counselor Association, Education Deans of Greater Milwaukee, Higher Education Regional Alliance (HERA), Milwaukee Area Internship Consortium (MACIC), etc.)
- Advocate to supplement the state CS education plan to include data literacy (which could include recognizing statistics as a math class for graduation at the secondary and post-secondary levels) and artificial intelligence standards (which were not intentionally built into computer science standards when first written).
- Sponsor the Greater Milwaukee Hour of Tech Challenge annually and develop key programs (e.g., FUSE) that address identified gaps

- Improve or disband the CS Toolkit on the STEM Forward website and continuously improve the Explore Tech Careers page on our website
- Reconsider the merits of convening the K-12 Computing Alliance to supplement the ongoing work of STEM Forward to reflect the importance of CS within STEM (nearly 70% of all new STEM jobs are in CS disciplines) (Zilberman and Ice 2021).
- Provide a deeper level of support to a select number of schools to help develop/retain computer science talent in the region (criteria TBD)

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About the MKE Tech Hub Coalition

The MKE Tech Hub Coalition is a non-profit organization working to inclusively double tech talent in the Milwaukee region. We serve as a unifying voice for Milwaukee's tech community, working with others to grow a vibrant, inclusive ecosystem where tech and innovation create enduring regional prosperity and life-changing jobs. Formed in late 2019, over 125 member organizations collaborate to attract individuals and businesses to the region, grow a diverse talent pipeline, scale the innovation ecosystem, and unite community. Underlying all initiatives is an intentional focus on increasing the diversity of our tech talent. To learn more and signup for our newsletter, visit www.mketech.org.