



UTAH COMPUTER SCIENCE EDUCATION MASTER PLAN

To give every student access to robust
computer science education by 2022

ADA Compliant: July 2019

I. EXECUTIVE SUMMARY

In the 21st century computing and technology touch our lives daily in a variety of ways. They are so seamlessly integrated into our daily routine that it is hard to imagine life without them. Computer science (CS), the discipline that makes the use of computers possible, has driven innovation in every industry and field of study. It is also powering novel solutions to many of our world's toughest challenges. Computer science helps students get on the path toward some of the highest-paying and fastest-growing jobs in America. It also helps inculcate crucial thinking skills, encourages students to think critically, develop problem-solving skills, and prepares our next generation of learners, teachers, thinkers, and innovators. Educating students in CS provides them with highly-valued skills in the 21st century workplace: creativity, collaboration, and an understanding of how to use technology.

As computing and technology have permeated our lives, there has been a high demand for availability of CS education. Most parents want their child's school to offer computer science (Google & Gallup, 2015), and most Americans believe computer science is as important to learn as reading, writing, and math (Horizon Media, 2015). Many of today's students will be using computer science in their future careers, not only in science, technology, engineering, and mathematics (STEM) fields but also in non-STEM fields (Change the Equation, 2015).

However, the demand for CS has far exceeded the availability of quality education opportunities and equal access to them across the nation. Most U.S. schools do not offer a single course in computer science and programming (Google & Gallup, 2015), and many existing classes are not diverse and representative of our population (College Board, 2016). Most students have to wait until high school before being able to access CS course offerings. Additionally, the tech industry is currently dominated by a narrow subset of the population, that does not equitably represent the diversity of society. Offering CS education to all students in Utah, including African Americans, Latinx, Native Americans, Pacific Islanders, women, English language learners, LGBTQIA, and students with special needs, is an important step to achieving equity and ensuring that children have a full range of opportunities in their future.

Computer science is not only important for the tech sector, but for almost all industries, including agriculture, transportation, healthcare, education, and financial services. In 2019, there are more than 5,000 open computing jobs in Utah—jobs that come with an average salary of over \$81,000, nearly double the state's average salary. But there are not enough qualified workers in Utah to fill many of these positions and the skills gap is continuing to widen. Only 16 percent of Utah's high schools offer intermediate and advanced computer science. An important aspect of educating and training our future entrepreneurs and innovators is that equitable access to CS has to begin in the K-12 space. The earlier students

are presented with quality CS courses, the better chance they have of closing the opportunity gap. Students who are exposed to computer science during their early years of education are much more likely to choose it as a major. Women are 10 times more likely to get a degree in computer science if they take an AP class in the subject, and minorities are seven times more likely if they do the same (Code.org).

Investment in, and expansion of Computer science education has emerged as a bipartisan issue across the United States. In Utah, Governor Gary Herbert, alongside the state's burgeoning tech industry set the goal of having computer science taught in every school by 2022. Two holistic methods of achieving the Governor's goal are: (a) the creation and implementation of a statewide Utah Computer Science Master plan, and (b) the professional development of teachers funded through the Utah Computer Science Grant program. Creating a state plan helps provide roadmaps to address a number of policy and implementation issues to integrate computer science as a new subject into Utah's existing K-12 system. [HB227](#), the Utah Computer Science Grant Act sponsored by Representative John Knotwell and Senator Ann Millner, will assist in providing grant monies to school districts. Utah needs more Computer Science teachers to provide high-quality and accessible CS education for all. Currently, Utah lacks enough teachers to teach additional computer science courses and elementary teachers need additional support to integrate the newly adopted computer science standards into their instruction. Through the grant process, school districts will have the opportunity to use funding for professional development and training of teachers. This will include increasing the number of teacher endorsements in CS, and resources for learning opportunities for all teachers, supported and approved by the Utah State Board of Education (USBE).

In this document, we use the National Science Foundation's definition of computer science, "the study of computers and algorithmic processes and includes the study of computing principles and theories, computational thinking, computer hardware, software design, coding, analytics, and computer applications." CS includes computer programming or coding as a tool to create software, including applications, games, websites, and tools to manage or manipulate data; or development and management of computer hardware and the other electronics related to sharing, securing, and using digital information. CS education is broader than just coding; the expanding field of CS emphasizes computational thinking and interdisciplinary problem-solving so students can apply computation in our ever increasingly digital world.

This Master plan was created and compiled by the authors over two months of interviews and meetings with key stakeholders. This report built upon years of work by the Utah State Board of Education, the Talent Ready Utah Board, Expanding Computing Education Pathways Utah, the

State legislature, the Governor’s Office of Economic Development and the Utah CS Task Force. This plan articulates the goals for computer science, strategies for accomplishing the goals, and timelines for carrying out the goals, along with identifying lead entities to implement each one.

The recommendations in this plan are not meant to be implemented all at once but are meant to serve as guidelines to meet the 2022 goal of having CS taught in every school in Utah. We offer actionable steps for educators, policymakers, industry, and other partners who – with appropriate resources and expertise available – can achieve the vision of providing equal access to Computer science to all students in the state of Utah.

The Utah CS Master plan is divided into six sections summarized in the figure below.

FOCUS AREAS OF UTAH COMPUTER SCIENCE MASTER PLAN		
1. Data and Reporting		Measure the state of computer science, education and technology in Utah across demographics and regions to inform the state’s goals.
2. Teacher Development		Provide a professional development pipeline for all teachers in Utah to have access to learn the concepts of computer science at the elementary, middle, and high school levels, to include pedagogy, and standards to meet updated licensure requirements.
3. Curriculum and Standards		Develop or adapt K-12 Computer Science standards and integrated computer science resources, lesson plans and computer science courses at each appropriate grade level/grade band for implementation and delivery across the K-12 system.
4. Diversity		Computer science for every student requires that equity and diversity be at the forefront of any transformative effort. When equity prevails, there is appropriate support based on individual students’ needs so that all have the opportunity to achieve similar levels of success.
5. Outreach and Communication		Increase awareness of the current computer science work and resources available in the state, communicate the state plan, and incorporate feedback from a variety of stakeholders.
6. Funding		Secure funding dedicated to expanding computer science education efforts, including professional learning for existing and future teachers from state, federal and local sources.

Focus Area 1: DATA & REPORTING

Currently, there is a need for relevant data on availability of Computer Science (CS), enrollment, and courses offered. This will help to measure the state of CS education in Utah (UT) across all demographics and regions. We recommend developing and publishing a UT CS Education Landscape Report which is updated annually.

The implementation of the Utah Computer Science Master Plan will require ongoing and evolving management, coordination, accountability and oversight to achieve the ambitious and necessary goals outlined here. A statewide CS Specialist position should be created to provide crucial leadership for statewide coordination in promoting and implementing the Master Plan. We also recommend organizing the reporting of student and teacher outcomes across current grants to clearly understand the efficacy of grants and programs to inform future investments in CS.

Focus Area 2: TEACHER DEVELOPMENT

An important goal of this plan is for all teachers to have access to learn CS concepts for K-12. Presently, there is a shortage of high school teachers proficient in CS, a lack of ongoing support for teachers, and roadblocks to access for teachers in rural areas. In order to resolve this, the plan (and appendix A) suggests pathways for professional development for teachers and incentivize and support teacher development. Coordinating grants and funding opportunities will play a huge role in incorporating professional development. We recommend that a teacher certification assessment be adopted and the process to develop a single subject computer science education credential be initiated. We also suggest using microcredentials to help address any current gaps in earning teacher endorsements.

Focus Area 3: CURRICULUM & STANDARDS

Currently, K-12 CS standards are being developed and integrated across the school system and ultimately curriculum will be linked to the Utah CS framework. We found that there is a need for quality lesson plans, since teachers lack time and training to determine which CS activities align with curricula and which have been shown to be effective. We recommend that a central hub for teaching resources be created and made easily accessible to educators, specifically resources that integrate CS curriculum into other subjects in elementary schools. Also, the statewide CS Specialist should advise the Talent Ready Utah Board on CS graduation requirements and recommended CS courses, annually. Additionally, Grades 6-12 curricula should be created and curated by Feb 2020, in partnership with industry programs to co-

create lesson plans. A system of accountability should be established by publishing an Annual Report which is made publicly available. We recommend empowering local leads to implement curriculum and develop champions for CS education.

Focus Area 4: DIVERSITY

Successful implementation of Utah's CS plan should ensure all students have the opportunity to achieve similar levels of success and equal access to high quality CS curriculum. Currently, female-identifying students, racial and ethnic minority groups, and people with disabilities are underrepresented in CS classes. Lower income districts and schools in rural Utah also lack equal access to CS.

In order to increase diversity in K-12 CS education we recommend partnering with organizations who offer “unplugged” curriculum, and curriculum to engage young girls and women, and people with disabilities. We also recommend tailoring nationally validated strategies and best practices to increase diversity and meet the needs of all students in Utah. The goal is to ensure that the demographic composition of secondary computer science courses reflects the demographic composition of each school by 2022.

Focus Area 5: OUTREACH & COMMUNICATION

Increasing awareness of CS jobs and CS education resources available in the state will be crucial for the success of this plan. We recommend communicating and receiving feedback from a variety of stakeholders and teachers, creating a plan to reach folks from each Local Education Agency (LEA) who will disseminate information from the state level down to each school in their district. We advise that a portal be created to keep stakeholders informed and keep information up to date. Partnering with organizations to implement best practices for outreach and communication will be crucial to generate buy in from educators, funders, parents, policymakers, students, and industry.

Focus Area 6: FUNDING

There is a need for sustained and dedicated funding streams for CS within all LEAs. Working with the state legislature and industry partners will be essential to ensure that there is funding for various programs and initiatives outlined in this plan. In the short term, dedicated funding for computer science should be allocated and the funding should emphasize the professional development of existing teachers for the purpose of expanding computer science education efforts. In the long term, funding streams from state & federal sources, as well as from

public/private partnerships, should support a system of high-quality computer science education. Realistically, lack of adequate funding will jeopardize successful implementation of the CS Master Plan. We recommend building in accountability metrics to ensure that only programs that result in positive teacher and student outcomes receive sustained funding.

Securing funding would support the professional development for existing teachers, administrators, and counselors, develop model curricula and standards, and expand CS offerings statewide.

In conclusion, implementation of a statewide computer science education plan is a bold undertaking but a necessity if the education system hopes to keep pace with the needs for a well-prepared workforce. Students in Utah will benefit from the vision and commitment of today's leaders to prepare children for the rapidly changing needs of the workplace. The leadership of teachers, adequately supported and resourced, will make this vision a reality in the classroom and Utah will stand ready to meet the challenges ahead.

Computer science is no longer a “nice to know” elective but rather a “need to know” core subject. The K-12 education system needs to start preparing graduates for rapid growth in computing jobs in every industry. The CS Master Plan is a tool to help address this need.

