



## **2017 White Paper Series**

# **Exploring Computer Science Education in Maine: 2014-2017**

Thomas E. Keller

May 2017

For more information:

Email [tkeller@mmsa.org](mailto:tkeller@mmsa.org)

Or visit [www.mmsa.org](http://www.mmsa.org)

## **Executive Summary**

Although there were scattered efforts around computer science education in K-12 schools in Maine, no systemic effort was undertaken until 2014. Prior to that time, courses were taught in computer programming, web design, computer repair, and similar topics, largely in a few high schools and Career and Technical Education Centers. The Maine Learning Technology Initiative (also known as the ‘Laptop Program’) began in 2002 when over 17,000 computing devices were provided to students and educators in 7th and 8th grade classrooms. The intent of this program was “to seize the potential of technology to transform teaching and learning in classrooms statewide” rather than to teach computer science.

In 2014, the Maine Mathematics and Science Alliance proposed a project to a special solicitation of the National Science Foundation’s STEM+C grant competition for grantees who had had a Math/Science Partnership (MSP).

The STEM+C project, “CSE Expansion: Building Capacity for CS Teaching in A Rural State” was awarded in 2015. At this point in time, the CS landscape in Maine was relatively barren, and characterized as follows:

- 33 high school teachers were identified by the Maine Department of Education as teaching a CS topic or course. In fact, no teachers were teaching an actual computer science course. Instead, they were teaching isolated topics typically included within computer science.
- The prominent organization of Maine educators at the time was the Association of Computer Technology Educators of Maine (ACTEM), whose members tend to be system operators and network specialist rather than computer science educators. No professional learning community for educators teaching computer science existed either statewide or on a regional or community level.
- No computer science methods course existed at any Maine public or private institution of higher education, hampering the acquisition of content and pedagogical content knowledge for teaching computer science.
- There were no Maine based workforce examples for students and teachers—nothing to enable them to “see the myriad applications of computer science in their own backyards”.
- There was no systemic effort to have instruction in computer science available to all K-12 students in Maine.

Today the picture is quite different.

### **Current teaching staff and curriculum**

Under the leadership of Dr. Tom Keller, MMSA and its partners UMA and RSU 26/Orono School Department have introduced 41 teachers to the Exploring Computer Science (ECS) curriculum. This has been done through a week-long institute and four follow up days of professional development, totaling some seventy contact hours. In the summer of 2017, we plan on training an additional 20 teachers.

Response to this training and curriculum have been extremely positive. Many teachers came to the training with great trepidation since they had not ever taught computer science and feared that the course would be too demanding with respect to computer programming. Other teachers came to the training extremely competent in computer programming and were initially disappointed that programming was not an extensive component. With the ECS foundational concepts of equity, inquiry and computer science principles, teachers experienced the curriculum as it was to be taught, in an individual and group problem solving context, with personal and group reflection time, in a safe and culturally relevant environment. By ‘safe’, we mean safety in risk taking, and in trying new things individually and with others. When asked

how the course was going, one teacher who approached the course with palpable concern announced that it was “shockingly awesome”.

In addition, with the advent of programs such as Hour of Code and the Advanced Placement Computer Science Principles (AP CSP) exam, computer science education is rapidly increasing in the state. Maine had 111 whole school Hour of Code events in 2016 (<https://hourofcode.com/us/events/schools/us/me>). AP CSP is a new exam from the College Board and it will be offered for the first time in the spring of 2017. We know of several teachers preparing students for this exam.

In December of 2016, MMSA and Educate Maine signed an agreement with Code.org to become the Regional Professional Learning Partner for Maine. This should expand professional development opportunities for Maine teachers across the state in two Code.org curriculums, Computer Science Discoveries and AP Computer Science Principles.

### **Communities of Practice**

Regarding professional learning communities, we now have several in place. The Exploring Computer Science teachers have an on-line space at CSforAll, the home page for all of the NSF STEM+C projects. We have established a Maine chapter of the Computer Science Teachers Association with an active listserv open to all. A Slack group has started for Maine Computer Science Educators ([mecse.slack.com](http://mecse.slack.com)) and at least two Facebook sites harbor Maine educators teaching computer science.

As part of MMSA’s project, Maine is also a partner within the AccessCSForAll program housed at the University of Washington. This program provides leadership and resources for the inclusion of students with disabilities. They do this by helping K-12 computing teachers to serve those students with professional development and creating accessible materials, both tools (including iterative refinement and deployment of the Quorum language) and curricular units that K-12 teachers and students can use in their classrooms.

### **Computer Science Methods and Certification**

Discussions are underway to determine options for certification of Maine teachers of computer science. An existing endorsement (termed a ‘680’) is titled Computer Technology K-12 and requires 24 credit hours in computer science. People who have this endorsement tend to be system operators and network administrators rather than teachers, but this is not always the case. Still, 24 credit hours in computer science requires a major commitment of time and funds. Consequently, if a teacher must have a ‘680’ to teach computer science, it is likely that many schools will not have a certified teacher.

We are exploring the concept of a micro credential to produce qualified teachers who will be certified with a new teacher endorsement number. This micro credential could consist of either a 70-hour professional development experience, a 3-credit computer science methods course, or a combination of these. Concerns with establishing a separate full track for computer science educators are: 1) having enough certified teachers for every district in Maine; 2) the challenge of establishing a distinct department or set of courses in computer science, and 3) the difficulty of integrating computer science into other curriculum areas.

The University of Maine at Augusta as a partner with MMSA in its ECS grant developed a Computer Science Methods course and obtained approval from the Maine Department of Education to offer it as an authorized course. Provost Joseph Szakas was instrumental in establishing this course and getting it authorized by the DoE. This will be offered for the first time in the fall of 2017, and is the first time a Maine institute of higher education has offered such a course.

## **Maine Workforce Examples**

We felt it was important for students and teachers to have actual examples of CS in action in Maine. Our first attempt at creating Maine workplace examples centered on interweaving activities from [tryengineering.com](http://tryengineering.com) and [trycomputerscience.com](http://trycomputerscience.com) with the activities of major Maine businesses. This resulted in multiple page, complex lesson plans that did not connect well to the ECS curriculum. While teachers appreciated the efforts to provide workplace examples, there were three challenges that limited the success of the workplace examples: First, the activities related to the workplace examples were flawed. The second interesting limitation was that Maine students did not identify with some of the iconic businesses in Maine that use CS, such as LL Bean and the Jackson Laboratory. They either had little knowledge of these organizations or felt intimidated by the institutional feel of them. And the third finding is that the teachers did not have enough time in their curriculum to do workplace activities.

Despite two of MMSA's project staff (Lisa Marchi and Dr. Dusty Fisher) having done excellent work in identifying computer science people within organizations, interviewing them, tweaking activities, and developing five full Maine workplace lesson plans, we shifted to a more local and organic model. Our current plan focuses on very short (3-5 minute) videos made with a hand-held smartphone of people who use computers in ways consistent with the ECS curriculum unit. For example, one video is of a dental hygienist who describes using the web to determine potential drug interactions and to verify the authenticity of that information (Human Computer Interaction). Another has an automobile technician walk the interviewer through a flow chart (algorithm) as a means to diagnose and solve car troubles (Problem Solving). An unexpected benefit to these fast and cheap videos is that teachers can then challenge their students to make a better one, using the same or similar interview questions, in their hometown communities.

## **Systemic Effort**

In the fall of 2014, MMSA's Reach Center convened all the computer science education projects that could be identified in Maine. Twelve people attended representing nine organizations having some stake in computer science education in Maine. The organizations were the Maine Mathematics and Science Alliance, Gulf of Maine Research Institute, IEEE, Maine Department of Education, MIT Scheller Teacher Education Program, Orono School Department, Falmouth School Department, Code.org, and Educate Maine. A 'wall chart' was begun to map the computer science education activities in the state.

This meeting was followed up by a meeting in March 2016 attended by many of the people from the 2014 meeting as well as representatives from Microsoft and Maine Robotics. At this meeting, a strategy emerged to meet with educational leaders in Maine and CS rich business to advocate for computer science education in Maine schools.

Finally, a meeting was held November 16, 2016 was facilitated by Dani McAvoy of Code.org to reach a broader audience of stakeholders and promote buying into a CS framework. Dani led the group through an activity to define the scope of CS education. It was at this meeting that a legislator announced his intent to submit legislation requiring computer science education in Maine.

Thus, in three short years, we have gone from a shotgun, isolated, individual school approach to computer science to a multi-pronged professional training and policy development strategy that is having real impact.

Our next steps are:

1. To recommend a framework for an effective K-12 computer science education in Maine and outline a strategy to ensure Maine students have access to this education system.
2. In determining the system strategy described above, investigate best practices and barriers to implementation as defined by a bill currently before the Maine Legislature (LD 398).

### **Timeline**

2014 – the Coalition for Excellence in Education reconfigures as Educate Maine with Project>Login as a primary program. Project>Login’s goal is to double the number of college computer science graduates within four years.

November 2014 – MMSA’s Reach Center organizes first meeting of K-12 computer science educators in Maine.

December 2014 – Maine STEM Council releases the Maine STEM Education and Workforce Plan 1.0 that recommends that the legislature and Maine Department of Education consider adding a computer science requirement for high school graduation and that the Maine Department of Education develop stakeholder-based content advisory committees in STEM including computer science.

January 2015 – MMSA start date for its three-year National Science Foundation Math/Science Partnership STEM+C grant.

March 2016 – MMSA’s Reach Center organizes the second meeting of K-12 computer science educators in Maine.

November 2016 – MMSA, Educate Maine, Code.org and the Maine Department of Education organize the third meeting relative to K-12 computer science education in Maine.

November 2016 – Maine STEM Summit highlights integrating computer science into the K-12 curriculum as one of the six core recommendations of the Maine STEM Council.

January 2017 – MMSA and Educate Maine join with Code.org to be the Regional Professional Learning Partner for Maine.

February-May 2017 – LD 398, An Act to Recognize Computer Science in the Path to Proficiency was presented to the Education and Cultural Affairs Committee of the Maine Legislature and modified through several work sessions.