

Computer Science For All

1. **Overall purpose of MSP Grants Showcase:** The MSP Showcase is designed to support partnerships among state education agencies, local school districts, and institutions of higher education to improve student achievement in mathematics and science through sustained professional development programs that enhance teachers' content knowledge and teaching practices.
2. **Individual MSP Grant Project**
 - a. Project Title: Computer Science for All
 - b. Goals:
 - a. To increase the number of teachers who have the capacity to teach computer science in the participating schools using the ECS curriculum
 - b. To develop in students the computational practices of algorithm development, problem solving, and programming within the context of problems that are relevant to the lives of today's students.
 - c. To increase the number and diversity of students who have the opportunity to take a computer science course.
3. **Project Design**
 - a. Research:

Scientific research is a secondary focus of the Computer Science for All project as its primary focus is to provide middle and high school teachers with the opportunity to receive training in the pedagogy of computer science instruction in order to effectively teach computer science content, concepts, and applications to a diversity of students across the state. As the project unfolds collected data is being studied by the external evaluator to determine if evidence exists that demonstrates that the training provided by Exploring Computer Science (ECS) is sufficient to prepare middle and high school teachers to meet the needs of the State Department of Education in regards to K-12 computer science education. Additionally the evaluator continues to work with the project to determine if project trained instructors, implementing ECS, are having an impact on student's interest, attitudes, and knowledge of computer science, including their possible future computer science college and/or career interests.
 - b. Needs Assessment:

In 2016 President Obama developed a new initiative to empower a generation of American students with the computer science skills they need to thrive in a digital economy, stating in the State of the Union Address, "In the coming years, we should build on that progress, by ... offering every student the hands-on computer science and math classes that make them job-ready on day one." A part of the initiative called for

expanding K-12 computer science by training teachers, expanding access to high-quality instructional materials, and building effective regional partnerships. The Computer Science for All project answered this call in the State of Connecticut by proposing to provide high quality computer science training through the evidenced-based program *Exploring Computer Science* to middle and high school teachers across the state. In partnership with the State of Connecticut, the Hartford Public Schools, and Central Connecticut State University this training fills a gap in the state, provides an initial cohort of teachers prepared to facilitate the federal and state government's call for all students to receive access to hands-on engaging computer science classes, and meets the needs of schools and districts to engage a diverse group of students across the state with effectively trained computer science teachers.

c. Participating Districts:

- Ansonia Public Schools
- East Lyme Public Schools
- Capitol Regional Education Council (CREC)
- Consolidated School District of New Britain
- Hartford Public Schools
- Milford Public Schools
- Oxford Public Schools
- Regional School District 12
- The Archdiocese of Hartford, Office of Catholic Schools
- Wallingford Public Schools
- West Hartford Public Schools

d. Number of Students Impacted: Approximately 3,000

e. Training:

The Computer Science for All MSP Grant provides middle and high school teachers with a professional development experience designed to introduce the field of computer science through an exploration of engaging and accessible topics focused on content and computational practice, including computer science pedagogy and accessibility for all students. The professional development/training designed for the MSP grant uses the nationally prominent Exploring Computer Science (ECS) curriculum to guide its development, with teachers engaged in a 5-day (30 hour) summer course, with four formal follow-up sessions during the school year. The summer course focuses on the first two units of the ECS curriculum, with teachers working on the computational practices of algorithm development, problem solving, and programming within the context of problems that are relevant today. The Saturday sessions complete the curriculum focusing on web design, programming, computing and data analysis, and

robotics. Teachers participate in two rounds of training, taking on peer leadership roles in their second year of training as they mix with new attendees. The instructional methodology used during the sessions requires that teachers take on the role of reflective practitioners, both engaging in learning activities as “students” and examining how instructional pedagogy influences student learning, particularly for underrepresented students. The learning process also includes direct instruction, small group activities, hands-on problem solving, and opportunities to collaborate with colleagues. In addition to the curriculum training, the second year of participation includes specialized Saturday sessions that supplement previous learning by focusing additional instruction on areas of interest or need. During the school year when implementation of the curriculum occurs participating teachers also receive targeted technical assistance as needed and engage in monthly online “Hang-Out” sessions designed to share successes and challenges and to “troubleshoot” problems as a community of learners.

f. Implementation:

The Computer science for All project was implemented fully as a professional development initiative during the Summer of 2016 with one cohort of 27 middle and high school teachers engaging in 5 days of training based on the ECS curriculum and computer science pedagogy for all students. The training for the first cohort of teachers continued into the 2016-2017 school year with four full day Saturday professional development sessions. During the school year a number of teachers began teaching ECS-aligned computer science classes in their schools and for their districts. The project supported these efforts by providing ongoing technical assistance and monthly online learning community opportunities to share instructional successes and challenges. A second round of professional development was offered during the summer of 2017 for both a mixture of a new cohort of teachers and the first cohort. In order to accommodate the 57 participating teachers, the professional development week was repeated in order to facilitate a second year of professional development for cohort one teachers in which they would be mixed with the new cohort 2 teachers to serve as peer leaders, sharing their teaching experiences with the new teachers. Nearly all teachers completing the professional development process during the summer are anticipated to continue or begin teaching computer science classes during the current school year. They will also participate in four additional Saturday sessions, optional specialized sessions, receive technical assistance, and participate in online “Hang-outs” as a means of continuing and growing the community of learner engaged in CS teaching across the state.

g. Accountability:

Accountability for the Computer Science for All MSP grant project is provided by an external evaluator who works with the project leadership to formatively monitor

ongoing project implementation and summatively assess the project's impact on teachers and students and its realization of its overall goals and objectives. The evaluation design includes a pre/post comparison-group study without matching comparison groups but within-subjects to examine changes occurring in the group of teachers participating in the project, especially concerning increases in content knowledge and changes in instruction. The evaluation instruments and protocols to be used are designed to investigate project outcomes of increased teacher knowledge and improved capacity to apply computer science content and concepts into the classroom through the effective use of the Exploring Computer Science (ECS) curriculum. During the summer sessions the primary focus is on content acquisition, with a pre/post CS assessment administered to measure content gains. Additional qualitative data is collected from informal interviews, observations, and from comprehensive evaluator developed impact surveys to verify and further explain quantitative data. During the instructional phase of the project the evaluation includes impacts on instruction, as well as assessment of participating middle and high school student's interest, engagement and learning. This data is collected on teacher assessments, impact surveys and self-report surveys following the Summer Institutes, follow-up school year sessions, and periodically throughout the school year.

4. **Outcomes**

a. Teacher:

At this point in the life of the grant the first year evaluation has been completed, with information available for reporting processes, while the data for the second year of operations is currently being processed and, thus, not available in a reporting format. To measure growth in content knowledge during both summers the project administered pre-post assessments drawn from the SRI Education's ECS Unit 1-4 Assessments. Of the first year participants 60% demonstrated substantially significant increases in computer science content knowledge. Supplementing the objective scores are teacher responses to items on a project developed pre-post self-report survey in which teacher ratings also showed increases in content knowledge. In addition to ratings teachers provided written and oral comments identifying increases in content understanding as a result of the course. Many teachers also recognized that upon implementation in the classroom more content knowledge is still needed. To measure change in *thinking* about instruction among cohort 1 teachers, the project used a pre-post survey protocol. Survey items included teacher's level of confidence with various computer science teaching strategies. In every case confidence increased overall from "somewhat confident to confident," with teacher's experiencing the greatest confidence increases in strategies for teaching computer science content and concepts and on using equitable practices to support student learning. Confirming these ratings one teacher wrote that "teaching an actual lesson during the institute improved confidence levels." Although not all participants were able to begin using their new knowledge in the classroom, those that did begin teaching computer science indicated in survey comments and

during informal interviews that the carryover from the course to the classroom was seamless, with many stating that they had established collaborative learning groups and promoted inquiry-based teaching strategies in their classrooms. The most often mentioned comment both after the summer institute and during the school year focused on the importance of providing students with foundational understandings of computer science and computer-based thinking and the need to ensure that the teaching of computer science takes into account an equitable pedagogy that encourages and engages a diverse group of students. For many the computer science pedagogy promoted by ECS was new, changing original thinking that computer science is coding only to a new thought process that computer science teaching and learning needs to promote the use of computer-based thinking to engage all students and to advance skills that lead to more effective applications for everyday life.

b. Student:

With few teachers providing instruction during the first phase of the project and year two data is still being reviewed and analyzed, results on the impact of the implementation of ECS classes on students is limited to comments provided by teachers who have formerly implemented the curriculum. According to initial comments the impact on interest and engagement has increased among the enrolled students. Although not documented as of yet it is expected that increased engagement will lead to improved achievement. Teacher observational comments also identify increased interest in computer science among students, especially girls and students not invested in other courses, with teachers noting that all enrolled students are fully engaged in the class activities.

5. **Conclusions/Reflections:**

The Computer Science for All MSP grant project has developed an effective professional development course that is providing the state with a cadre of computer science teachers trained to facilitate the State's mandate to include computer science courses in the middle/secondary school curriculum. As implemented through this project, the MSP funding is allowing for the training of a large cohort of teachers from districts across the state to engage students in computer science learning. It is also providing an opportunity for the state to train a cohort of ECS trainers who can extend the professional development opportunities to other teachers beyond the grant funding. As with all new educational initiatives, many pieces need to come together at the same time which takes creative planning and consideration. This is certainly true of the State's mandate to provide every student with computer science courses which requires a group of teachers trained and eventually certified to provide this instruction. The timelines for setting up the courses and training and certifying teachers do not always overlap. As such the Computer Science for All MSP grant is providing the intermediate step necessary for securing a trained cohort of computer science teachers who can facilitate the initial steps of the "change process" as the more formal steps are put into

James K. Vesekis
Project Coordinator
Computer Science for All

place over time. As a result the initial ECS trained teachers have the opportunity to serve as school, district, and state leaders as this process moves forward.