DOI:10.1145/2856455

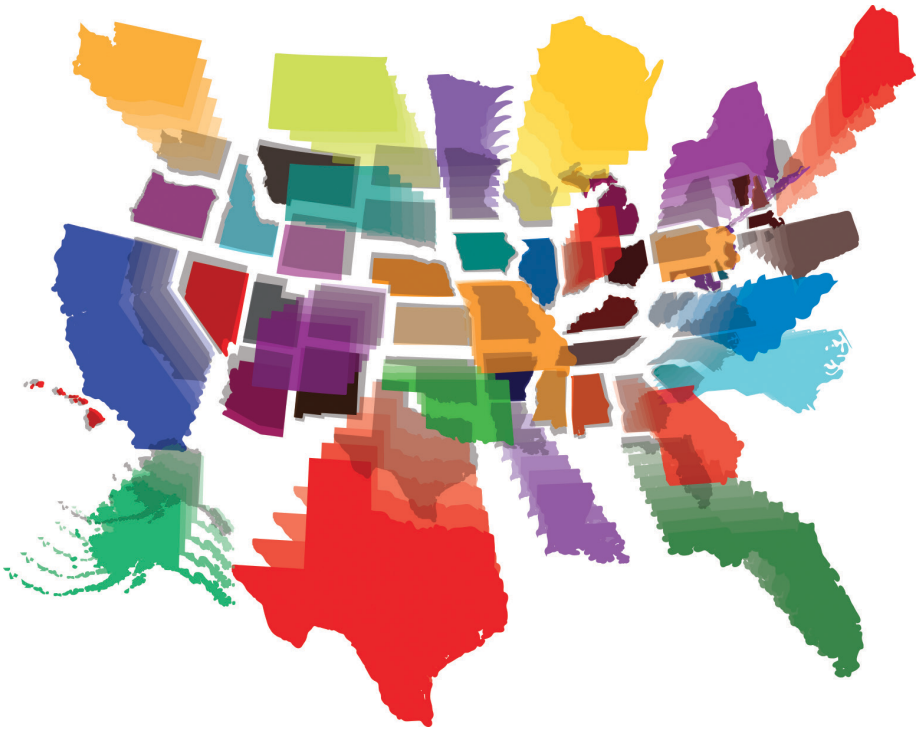
Rick Adrion, Renee Fall, Barbara Ericson, and Mark Guzdial

Education

Broadening Access to Computing Education State by State

Influencing computer science education at the state level.

Arkansas, San Francisco, Chicago, and New York City have made headlines with their announcements to make computer science available in every school to every student. That is a challenging goal. Actually making computing education available to everyone involves many policy decisions. Changing schools in the U.S. is difficult because education is largely a state prerogative. Standards, teacher certification, curricula, and graduation requirements are determined within individual states and territories, not by the federal government. Many states delegate the decisions down to cities, counties, or individual districts or schools, making the decision making even more distributed. Charter schools, magnet schools, virtual schools, homeschooling, school choice, and funding disparities among districts further complicate assuring broad and equitable access to computing education.



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Reaching everyone through formal education pathways. If we want to give everyone access to computing education, we need to begin to do it through formal education pathways, for example, primary or elementary school, middle school, high school, community colleges, and universities. Informal computing education is unlikely to reach everyone. The formal computing education pathways are our best chance to broaden participation in computing. Female students and underrepresented minorities are less likely to seek out afterschool computing clubs or summer computing camps—some will, but we will not reach everyone that way. Making computer science available in public school systems requires that states and districts create policies that address several questions: Where do you teach computing? Do you integrate computing into existing mathematics or science classes? Do you teach separate computer science classes? The answers are likely to be different at the elementary, middle school, and high school levels.

Who teaches computing? In most U.S. states, computer science is classified as a business or career-technical education (CTE) subject. That classification raises issues regarding how teachers are assigned or considered

highly qualified to teach computing. In turn, that affects in-service and pre-service professional development. Will a school, district, or state education authority require a business or CTE teaching credential? Can other teachers (such as math, science, technology) teach computing courses? Do you only provide the business and CTE teachers computer science professional development and education, or do you try to reach a broader range of teachers?

How do we certify that a teacher knows how to teach computer science? Most states offer no teacher certification in computing. Without a credentialing process, schools will not be able to tell whether a teacher is qualified to teach computer science. Without the possibility of earning some kind of credential, teachers may be unwilling to go through additional professional development. Current computing teachers may find new requirements for certification limiting their opportunity to continue to teach computing courses. Without certification, colleges are unlikely to create pre-service curricula and students planning to teach are unlikely to demand them.

Why do students take computing? Most high school computer science (CS) classes in the U.S. are elective; so few students take them—often only white or Asian males. If you want more students in computer science classes, require computer science (which is challenging to implement) or have CS classes meet some requirement that students care about. Some states count CS classes as meeting mathematics or science or even world language requirements for high school graduation. Georgia had a dramatic rise in the number of students taking the Advanced Placement CS exam after the AP CS course started counting as a science credit toward high school graduation.

What are we trying to teach? States set standards about desired learning outcomes. Some states are creating computer science standards, while other states are including computer science in existing standards (for example, in science). How will curricula and assessments be aligned with new, revised, or existing standards? Will they be tested or otherwise required?

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Reduce higher-education friction. Public college and university systems are also under state control to varying degrees. Community and technical college computing programs tend to serve more diverse communities. Easing the community college to four-year college transition can contribute to increasing diversity and broadening access in college and university computer science departments. Two-year college systems and articulation mechanisms vary by state. If you want to get more community college students to successfully transfer to state universities, you solve that problem at the state level.

Building a Community of State CS Education Leaders

In 2012, two National Science Foundation Broadening Participation in Computing (BPC) Alliances merged (CAITE and "Georgia Computes!") to create the Expanding Computing Education Pathways (ECEP) Alliance.[a] The authors of this column are the leads on ECEP. We aimed to use the lessons learned in Massachusetts and Georgia and the expertise of leaders in computing education to help other states improve and broaden computing education.

ECEP began working with four states: Massachusetts, Georgia, California, and South Carolina. We soon realized we could not just "translate the lessons learned" from one state to another. States vary dramatically, for example, in terms of how much control the state department of education has versus individual school districts, how teacher credentialing works, and who decides whether a particular class "counts" toward high school graduation requirements. States like Georgia and South Carolina are more centralized, meaning the state department of education defines classes and high school graduation requirements. States like Massachusetts and California distribute control down to local districts. The process for creating new requirements in Georgia is unlikely to work in California.

In 2015, we added additional states to ECEP so that the cohort now includes 11 states and Puerto Rico. We host face-to-face and virtual meetings where leaders of CS education reform in these states talk to one another about the issues they are facing in their states. This community of state leaders is the most important resource we have to offer in ECEP.

The lessons learned from Massachusetts and Georgia are useful for states joining ECEP, but so are the lessons from the other states. We have been surprised at how much our state leaders draw ideas from each other. South Carolina leaders used a teacher survey that was invented in Massachusetts. Utah draws inspiration from a Texas teacher recruitment strategy. What our state leaders find most useful about ECEP is access to other state leaders who share similar goals, for example, to broaden participation in computing by changing education pathways in their states.

A Model for State-based Efforts

Based on the ECEP experiences with states making public policy changes to improve K–16 computing education, we have developed an initial set of steps that we recommend to any state planning an effort to broaden access to computing education for K–12 and higher education students. We require states to have taken the first three steps in this process before they can join our ECEP state cohort, but we also believe it applies to any state whether or not they hope to partner with ECEP.

Step 1: Identify a State Leader. A state should have one or more leaders who are willing to participate in the ECEP cohort. The current ECEP state leaders cover the spectrum of computing education stakeholders, including high school teachers and administra-

a See http://ecepalliance.org

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tors, university faculty (from both CS and education), industry leaders, and staff from state departments of education. It is a more difficult requirement to meet than we expected. Some potential leaders are in state departments of education, and their participation is limited by department policies. Some states have a lot of people working in computing education, but no one who is willing to coordinate efforts across the state.

Step 2: Figure out where you are and how change happens. As we described earlier, states vary in many, but predictable, ways. There must be a process by which high school graduation requirements are determined. There must be some process for managing teacher certification. We do hear from potential state leaders who have no idea how education policy works in their state, or even whether they have CS classes being taught in their state. That is a baseline requirement: change cannot start until you know where your state is and how change happens in your state.

Step 3: Organize a cross-sector committee. The leaders who are most successful influencing computing education public policy join forces across sectors. In Georgia, we started out with a coalition that crossed universities, high schools, and the department of education. We really got the attention of the legislature and the governor when industry started pushing for change, too. South Carolina has a steering committee that crosses all these sectors. Some states have computing education organizations—California has ACCCESS, Texas has TACSE, and Massachusetts has MassCAN. State leaders should be working with people from education, industry, and government.

Step 4: Find initial funding. The first three steps are essential. The fourth step is necessary to make change, and ECEP provides some small financial help to its members. Improving and broadening computing education requires some significant funding, for example, for teacher professional development. There are smaller-ticket items that are useful early in the process.

▸ Several of the ECEP cohort states have written landscape reports describing the current state of computing education and setting priorities for change. California leaders called their landscape report *In Need of Repair*.[b] The landscape report speaks to education policy stakeholders, to describe why and where computing education needs to change in the state.

▸ A summit meeting on computing education is where the computing education leaders gather and invite in the stakeholders (for example, public policymakers in the state government, industry leads, district superintendents, and school principals) who need to hear about the landscape report. Summits galvanize the community and generate shared goals for making progress in improving and broadening participation in computing education.

Those of us leading the ECEP Alliance do not have a recipe for change that works in every context. We do see a set of steps in a process that is working in several states. We have learned we cannot always predict what states will most need in order to make progress or what pitfalls lie ahead along the path. We are finding that, together, our cohort of state leaders is helping each state figure that out. C

b See http://www.exploringcs.org/wp-content/uploads/2010/09/InNeedofRepair.pdf

Rick Adrion (adrion@cs.umass.edu) is Professor Emeritus in the School of Computer Science at the University of Massachusetts Amherst.

Renee Fall (rfall@cs.umass.edu) is project manager for the Commonwealth Alliance for Information Technology Education in the College of Information and Computer Sciences at the University of Massachusetts Amherst.

Barbara Ericson (ericson@cc.gatech.edu) is Director of Computing Outreach and Senior Research Scientist at Georgia Institute of Technology, Atlanta, GA.

Mark Guzdial (guzdial@cc.gatech.edu) is a professor in the College of Computing at Georgia Institute of Technology, Atlanta, GA.