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# Broadening Participation in Computer Science Education

## Why is it important to address issues of equity in computer science (CS) education?

Innovations occur when individuals with a diversity of life experiences, perspectives, and histories work together to make bold new ideas come to life.

The lack of diversity in CS-related fields creates barriers to innovation. Most CS jobs are held by men identifying as white or Asian. Women are employed in just 25 percent of CS jobs, and less than 20 percent of jobs in CS or related fields are held by people identifying as black, African American, Hispanic, Latinx, American Indian, Alaska Native, or members of other indigenous groups.

Many students from groups that are underrepresented in the CS workforce are keenly interested in CS, but have limited avenues for pursuing that interest. This is unacceptable from an equity standpoint; all students should be able to access high-quality CS learning. It also represents a vast, untapped well of talent that our country cannot afford to overlook. Our workforce, and its degree of innovation, will weaken and wane if we do not broaden all students' access to high-quality CS education.

With government, foundation, industry, and education partners, EDC is working to ensure all students have high-quality CS educations. Not all students will be drawn to CS fields. However, we want all students to

benefit from learning CS concepts and practices—including logical, critical, and abstract thinking, data analysis, and troubleshooting—that will serve them well, no matter what career path they choose. And we want to make sure our country can produce not just a diverse pool of advanced computer scientists, but citizens who have computational thinking (CT) skills, such as using the power of technology to frame, understand, and solve complex problems. Our world can never have enough adept problem-solvers.

# How can we expand access to CT and CS learning?

## Weave support for CT skills and CS learning into all in-school and out-of-school learning, starting early and making the learning engaging, rigorous, and relevant for all.

In response to research that suggests it is critical to develop students' CT skills at a young age to support later achievement in STEM, CS, literacy, and other disciplines, EDC is leading several initiatives that focus on fostering CT in the early years. In ***Monkeying Around***, we are working with WGBH to explore ways to introduce CT concepts through media and hands-on activities; investigate how learning tasks can demonstrate children's understanding of CT; and identify ways to help parents support their children's CT learning.

EDC is partnering with the ***Massachusetts Department of Elementary and Secondary Education*** to design, develop, and test 18 classroom modules that integrate CT into grades 1-6, and is working with elementary teachers to build their capacity to integrate CT into their math and science lessons. In our ***Think Math+C*** project, we are developing and testing high-quality K-5 instructional materials to support teachers and students in engaging in programming activities that strengthen mathematical and computational thinking. And in 2017 EDC received a grant from ***The Robin Hood Learning+Technology Fund*** to conduct research on the integration of CT in elementary schools serving large populations of children from low-income communities.

In another key stream of work, EDC is deepening understanding of how to expand and scale up CS learning for youth of color and young women in informal settings. As Google's evaluation partner for ***Google Code Next***, we are examining the impact of its efforts to engage African-American and Latinx youth in Oakland, CA and Harlem, NY in exploring CS and encourage them to consider CS as a career. Our findings will help inform the program's nationwide expansion. We are also evaluating ***Computer Science Pathway***, a partnership between Microsoft and Boys and Girls Club of America designed to encourage youth to pursue coding and expose them to CS careers. The program works with over 1,000 youth in 25 locations to break down barriers and stereotypes that keep underrepresented populations out of CS fields.

Studies indicate that young girls feel isolated in CS classes due to social and environmental factors such as irrelevant curriculum, lack of collaboration, few opportunities to take risks and make mistakes, and lecture-based learning. To provide new insights into effective strategies to tackle this issue, EDC is evaluating the impact of Twin Cities Public Television's ***SciGirls Code*** program. SciGirls Code is working with 16 partners to develop and implement a CT and coding curriculum for girls; provide training to prepare women tech professionals to serve as role models; and deliver training to support STEM educators in successfully engaging girls in CS learning.

To learn more about what ignites girls' interest in STEM and CS, EDC is evaluating the impact and scale-up of a California-based afterschool program, ***Techbridge***, on the STEM learning and career interest of girls in grades 4-12.

# How can we help educators broaden participation in CS?

## Support teachers in delivering CS content and implementing programs that engage all students.

EDC and Berkeley have adapted Berkeley's ***Beauty and Joy of Computing (BJC)*** for high school students and are training New York City teachers—including providing in-person training, an online course, and a community of practice—who are teaching the course to over 2,000 students. The primary goals of BJC are to close opportunity gaps, broaden participation in high-quality learning, and contribute to STEM-related career pathways. In 2017, the College Board endorsed BJC as an Advanced Placement (AP) CS Principles course. Almost 76% of the students who completed BJC and took the AP CS Principles exam passed—a higher-than-average passing rate.

Through the ***Massachusetts Exploring Computer Science Partnership (MECSP)***, EDC is working to broaden CS education across Massachusetts high schools. Part of this work involves establishing a cadre of teacher leaders who help fellow teachers engage more, and more diverse, students in CS learning. This PD model involves regional PD hubs; an online professional learning community which can reach teachers in more rural districts; and industry representatives from the tech community who engage with teachers and students to explore the value of CS education and careers. MECSP seeks to address issues of equity within CS, and project partners plan to share their lessons learned nationwide to inform future efforts to diversify CS and other STEM fields.

Beyond professional development, it is essential for schools, districts, and states to build strong systems that give teachers the tools and ongoing support they need to broaden students' participation in CS. A 2017 report written by EDC, Code.org, and other partners, **State of the States Landscape Report: State-Level Policies Supporting Equitable K-12 Computer Science Education,** explains the systems-change work needed to ensure all students can access CS learning that prepares them for their futures.

Launched at a national CS summit that EDC led in 2017, the report was developed as

part of EDC's leadership of a comprehensive statewide initiative—***Massachusetts Computing Attainment Network (MassCAN)***—which brings together industry leaders, educators, and policymakers to improve CS opportunities for Massachusetts students. Through MassCAN, EDC has provided PD in CS education for K–12 teachers, facilitated the state's development of new K–12 CS standards, and worked to expand CS opportunities for students from underrepresented populations. MassCAN has had a powerful impact in the Commonwealth and is sharing its findings to inform the work of other states.

## How can we sustain efforts to broaden participation in CS?

### Address opportunity gaps from multiple angles, engage stakeholders, collaborate, and build capacity.

Complex challenges demand multi-faceted solutions. Across the U.S., EDC is leading 20 complementary projects focused on CS/CT education research, systems-change support, instructional design, professional development, and evaluation. A key part of our work to sustain efforts to broaden participation in CS education is collaborating with other organizations and engaging stakeholders in national forums focused on the design, implementation, and evaluation of CS education initiatives.

In 2016, EDC experts and members of the education research community gathered at the ***CS Knowledge Forum*** to help build an agenda for CS education in New York City and to connect stakeholders representing academia, research firms, consultancy firms, practitioners, and funding agencies. During our 2017 ***National Computational Thinking Workshop***, EDC convened researchers, K-12 educators, and disciplinary scientists to identify effective strategies to support CT for K-12 students and develop products that advance knowledge of evidence-based approaches to weaving interdisciplinary CT into K-12 education and assessing CT.

Finally, to sustain improvements in the quality and accessibility of CS education, EDC studies the impact of large-scale CS education systems-change efforts. We are the evaluator for the National Science Foundation's ***Broadening Participation in Computing Alliance Program***. And, in collaboration with Research Alliance for New York City Schools at New York University, we are conducting a 10-year evaluation of the ***Computer Science for All (CS4All)*** program in New York City. With the findings from these initiatives, as well as from our full body of CS/CT work, we seek to ensure that all students are adequately prepared for the diverse, technological, and ever-changing world in which we live.

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