EQUAL ACCESS

BRIDGING THE DIVERSITY GAP IN COMPUTER SCIENCE

Kevin O'Connell

Pittsburgh Public Schools students take part in the TEALS program to gain early access to computer science education.

Mark Stehlik thinks a lot about the state of computer science in America. And it worries him.

According to Stehlik, assistant dean for outreach in SCS, roughly 500,000 technology jobs remain unfilled in the United States. And while SCS strives each year to graduate more than 200 of the brightest computing minds, that number represents a drop in the proverbial bucket.

"The U.S. is at risk of losing preeminence in the tech economy if we don't get on this problem … and fast," Stehlik says.

Alongside SCS Dean Andrew Moore and other senior college leadership, Stehlik hopes to tackle this problem at all levels: sparking more interest in students of all backgrounds prior to college, working on tricky policy issues that inhibit growth and building greater capacity in the U.S. educational system.

Computer Science for All

A large segment of U.S.-born college-bound computer science students come from well-funded high schools. They're often the children of parents already working in technology, which makes attaining diversity in the field a difficult challenge.

Moore believes we are in danger of creating a technological hegemony in our society. "We can't afford to have large parts of the population disenfranchised from the technological revolution we're living in," Stehlik adds. "It's vitally important to change the demographics of computer science."

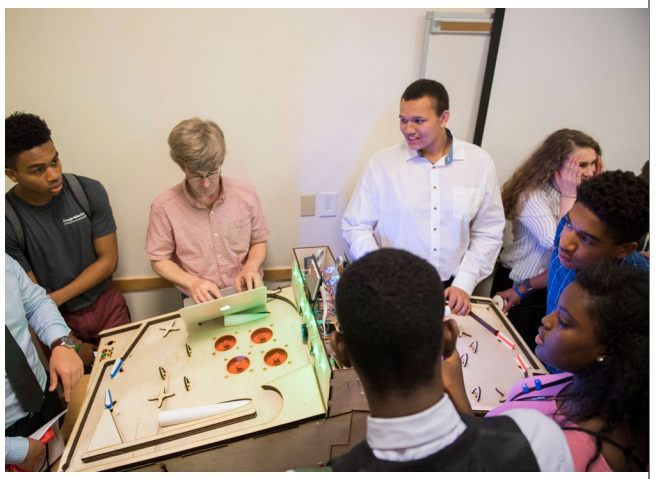
To address the lack of diversity in computer science and increase the capacity of students who want to study computer science in college, SCS works hand-in-hand with the TEALS program, a partnership with Microsoft Philanthropies. TEALS recruits computer science professionals to volunteer their time with teachers and students in high school classrooms across the country that lack quality computer science education and curriculum.

According to Jonathan Reynolds, SCS outreach project manager, the TEALS program reaches across the country, but this year has expanded to eight of the nine Pittsburgh public high schools, in part because CMU graduates make up the largest group of TEALS volunteers after the University of Washington. But there is plenty of room for growth.

More volunteers equates to more students gaining access and increased capacity. "The students we engage are very capable of learning the content and understanding the material, but no one has told them that before," Reynolds says.

Because computer scientists make more money than teachers, there is a dearth of qualified instructors. The knowledge gained in the industry never returns to the educational system — a problem that will compound as the U.S. economy becomes increasingly technology-based.

"We put this in the category of 'wicked' problems — those without clear beginning and end points," says Ashley Patton, director of engagement. "And those take a lot of thoughtful tactics to avoid doing more harm than good."



Reynolds sees growth of the TEALS program as vital. When kids get exposure to computer science at an early age, it piques their interest, and applications to college computer science programs across the country rise.

To spark further interest, CMU offers the Summer Academy for Mathematics and Science (SAMS), a precollege program that draws high school students from across the country. SAMS has offered STEM-related courses since 2001, but this past summer 36 students took courses in a new CS track, designed to simulate the rigor of attending an institution like CMU. Other universities have programs like SAMS, but CMU remains one of a few that cover costs for students who can't afford it.

"Some students come out of the program, and their decision to study computer science is absolutely crystalized by the experience," Reynolds says. "Others say 'The class was amazing, but computer science isn't for me. I'm going to go another route.' Both of those are wins for us."

Programs like TEALS and SAMS help dispel the myth that you have to be a genius to work in computer science. Obviously not everyone will go on to become computer scientists. Along the way, learning computational thinking and problem-solving skills benefits everyone — regardless of their chosen field. But demystifying the technology field, inspiring confidence and providing all students with the option to participate remain vital to the SCS outreach team.

Making Computer Science Count

Piquing student interest and building capacity for computer science might not be the most difficult parts of this wicked problem. Achieving a cohesive governmental approach to policy and convincing disparate school districts to invest in computer science must also be addressed.

Computer science teachers are often poached from their school's mathematics department. So in a zero-sum game with tightening school budgets, a principal who hires a computer science teacher often loses a math teacher. That's a tough sell to school boards, even as they recognize the advantages of educating for a growing tech economy.

"The focus has been on math and reading, and then STEM," Stehlik says. "I think the key now is putting the 'C' [of computer science] into STEM — making 'C' a first-class player at this table."

Even when school districts do hire CS teachers, most of them receive little to no training in CS certification before standing in front of a classroom. A full third of U.S. states still consider computer science education an elective, and the states where it counts as a science credit still value physics and math over computer science curriculum. Most of those CS curricula are not very good and are certainly inconsistent. Computer science does not exist on any of the college entrance exams, which inhibits potential incentives for teaching it. Since no national and few state standards exist for CS, no broadly adopted standardized textbooks have been written. And because all school districts make their own decisions, there are thousands of tiny governing bodies to try to convince. These are all large-scale challenges.

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CS Academy

SCS has a history of solving big problems, and it's tackling the challenges inherent in increasing the CS workforce on many fronts and through numerous channels. SCS experts routinely speak before Congress and at all levels of government, to school boards, and to any and all potential influencers. Workforce redevelopment, a summer "Teach the Teachers" program and a variety of other outreach efforts all have their place in the equation.

But a new effort led by Stehlik and David Kosbie, associate teaching professor, tackles these problems head on. In the spring, SCS will launch a pilot program called CS Academy that will provide high-quality computer science curriculum and teacher support — all developed and chiefly maintained by CMU undergraduate students as part of a class taught by Kosbie.

According to Kosbie, the planets have aligned and the time is right.

"There's this strong consensus that high school administrators are looking to CMU to provide leadership and guidance in this area," Kosbie says. "Even places that have a strong teacher still need curriculum and support for that teacher."

CMU's backing for this program makes an enormous difference toward its success. Kosbie also notes several other elements that will help the program succeed in high schools. First, it has to be offered free of charge because many high schools are financially strapped, and it must be made available to everyone. Second, the program has to be world-class. It needs to start great and get better. Third, it has to employ automatic grading to remove the burden of marking mountains of homework each night for the teachers. And fourth, it must include embedded professional development, down to the individual exercise level. This also includes videos describing how to derive the solutions, online teacher training and summer institutes.

The CS Academy pilot launching this coming spring deploys a Python course for ninth grade students. The pilot will run in 17 school districts mostly in the Pittsburgh region, initially reaching 700 students. For fall of 2018, Kosbie hopes to grow that number five to 10 times, eventually reaching Moore's ultimate goal of one million students within five years.

"That's a home run," Kosbie says. "But we are seriously trying to hit that goal. We are making the decisions we need to do that."

After the ninth grade Python course, a slate of follow-up, second-level courses has been planned, including computational math, computational art, computational science, AP computer science test principles, and perhaps web development and robotics. Level three will be the more difficult AP Computer Science A exam and advanced topics courses. In the vision, level four — which is for very few people — will be CMU's 15-112: Fundamentals of Programming course, offered for college credit.

As an added benefit, the CMU students developing the CS Academy are gaining real-world experiential learning. "They're leading and being part of real development teams," Kosbie says. "They're working in the field with high school students and the process of developing the product for them. There's a lot of excitement in the class right now over these possibilities. There's also a lot of consternation in the class, because this is not just a class. It's not sanitized for their protection."

The CS Academy represents a huge effort to bridge an equally huge gap.

"We are going to succeed or fail in a big way, either way," Kosbie says. ■