What he wanted to do

- Expand the investment of CS teacher PD statewide

- Create an environment that fosters teacher self-efficacy in CS education

- Increase AP CS exam participation among underrepresented students statewide

- Prepare students for the state's high-tech job market

What he did

- Created a face-to-face PD program for teachers based on the AP CS Principles curriculum

- Developed a MOOC mapped to the AP CS Principles curriculum so teachers could participate from anywhere in the state, with expansion to national participation

- Built a train-the-trainer model for Alabama CS educators that is being modeled nationwide

What he accomplished

- 130 teachers now offer AP CS Principles classes statewide, compared with just three teachers in 2007

- 2,000 teachers enrolled in MOOC course on AP CS Principles nationally during summers of 2014 and 2015

- 1,700 Alabama high school students took the AP CS Principles exam in 2017, compared with 27 students in 2007

- Over 150 African American students in Alabama took the AP CS Principles exam in 2017, compared to only 3 African American students in Alabama taking the AP CS A exam in 2007

# Creating opportunities for rural communities through CS PD

## About Jeff Gray

As a first-generation college graduate and now an esteemed faculty member at the University of Alabama's College of Engineering, Dr. Jeff Gray is a national leader in computer science (CS) education. Since 2003, Gray has trained high school teachers to integrate computer science into technology courses. He also works on various aspects of piloting with the College Board and creating resources for a new Advanced Placement Computer Science course to increase secondary and post-secondary educational interest in CS and STEM. Gray is the recipient of several National Science Foundation grants, and from 2014 to 2017 was a member of Code.org's Education Advisory Council. He hosts an annual Alabama Robotics Competition for students from all K-12 grades and a summer camp attended by students from over 15 states each year.

## Challenge

Jeff Gray grew up in Appalachia with a love of science. As a first-generation college student, Gray's parents realized the benefits of supporting his exploration of science and technology. "I look back at my own experience at science fairs, and I know that's what got my own passion started," he says — he clearly saw the value of being exposed to science and technology at a young age.

When he became a CS professor at the University of Alabama, Gray realized that few high school students in the state, especially in rural areas, were receiving early exposure to CS education. Without CS knowledge, Gray realized students wouldn't be prepared for job opportunities, especially since Alabama has become a hub for CS-related jobs over the past few decades, particularly in the Huntsville region with the technology outgrowth from NASA's influence.

But connecting students to these opportunities posed barriers. In many rural school districts in Alabama, which contain some of the most impoverished counties in the United States, CS education is scarce. In 2007, there were only three full-time high school teachers approved to teach CS in the entire state (out of 454 high schools statewide). Out of the twenty-seven students who

took the AP Computer Science A (AP CSA) exam that year, there were only three women and three African American students who sat for the exam. In a state where African Americans make up twenty-five percent of the population, it was evident there was a large divide in equitable access to CS education.

"We needed to close this gap," explains Gray, who believed teacher professional development (PD) would improve CS education at the individual school level. Unfortunately, in the late 2000s, there was little state funding allocated for CS education, much less CS PD for teachers. Initially, Gray tried to build student knowledge of CS through summer programs at the university. "We could only influence about forty students at a time," Gray says. Though impactful, small summer programs were not a practical way to scale his efforts.

## Solution

Gray saw an opportunity to amplify his efforts by helping teachers hone in on their CS skills. "If we could train thirty to forty teachers at a time, the influence on students can be an order of magnitude larger," Gray says. In 2011, Gray received the first of six annual Google Educator PD grants to provide introductory CS PD. He focused on pedagogy and engagement strategies for high school teachers across the state.

The funding, Gray says, provided mentorship and support to sustain a budding group of CS educators, a key element to creating sustainable CS education in Alabama. "We focused on the community-building aspect for teachers first – not a one-time class," he explains. Gray continued teaching introductory CS PD through 2013, reaching close to 100 educators since receiving the initial grant.

Given the pressing demand for PD, Gray needed a better way to "train the trainer" so that teachers could then return to their local community to train other teachers. He broadened his PD program in 2014 by creating a Massive Open Online Course (MOOC) to help teachers prepare for the AP CS Principles (CSP) exam. The course, which includes 120 videos focusing on various exam components, was built to reach teachers not only in Alabama but across the country and is still available as an online course.

"The geometric growth of the train-the-trainer model of professional development is vital toward addressing the needs of scalability and sustainability in K-12 CS education."

— Jeff Gray, Professor of Computer Science, University of Alabama College of Engineering

## Benefits

### Planting a seed to grow local CS education

Gray attributes his success of CS education in the K-12 space to Google's Educator Grant. After being awarded his first Google grant, Gray went on to receive an additional $1 million in funding from the National Science Foundation (with A+ College Ready) to expand CS PD programs throughout Alabama. Gray believes that training educators to teach CS will encourage more students - especially historically underrepresented minorities - to study the discipline. He now co-chairs the Governor's Task Force for CS education in Alabama and is working with colleagues at his College of Education towards a pre-service pathway for Secondary Math Education majors at the University of Alabama.

## Expanding the impact of professional development

Gray's approach to PD, whether through personalized learning or through a custom built MOOC, has raised teacher expertise in Alabama and nationwide. Experienced CS teachers around the state can now train teachers in their own schools. Today, there are 130 teachers trained in teaching AP CSP statewide, compared with just three teachers in 2007. The CS Principles MOOC has virtually trained over two thousand teachers since 2014.

## Sparking self-efficacy in CS educators

Gray and his colleagues are seeing the growth of a budding community of CS educators by investing in teacher development for the past six years. "We're watching our teachers step up as national leaders," Gray says – such as Carol Yarbrough, a CS teacher at the Alabama School of Fine Arts in Birmingham, who's now a member of the College Board's AP CS Principles Development Committee.

## Reaching students who are underrepresented in CS

"Students don't need to all become engineers, but we think it's as important for them to understand the fundamentals of how the messages they create every day are encrypted, as it is to dissect a frog," he says. "Students need to understand how technology works underneath so many subjects." In 2017, 1,700 Alabama high school students took the AP CS Principles exam, compared with just twenty-seven students in 2007, prior to Gray's CS teacher training and MOOC course. Over 150 of the 2017 AP CS Principles test-takers were African American, compared to three who took the AP CS A in 2007; over 500 women took the AP CS Principles in 2017, compared to only three taking the AP CS A in 2007. Students "need to see it to be it," says Gray of the value of having diverse role models among CS teachers and professionals.

## About Google's CS PD Educator Grants

Google's Educator grants increase access to CS education by providing funding to equip and empower CS teachers through PD programs. Administered by a PD CS expert, each funded program has three key components of successful and sustainable CS PD:

1. The development and delivery of content that increases educators' knowledge of computer science and computational thinking;

2. Educators and PD providers co-create content to meet local student and educator needs;

3. A platform to support teacher learning throughout the school year through a community of practice, professional learning network or other educator support resource group.

For more information on CS Professional Development, visit *g.co/CSedugrants* and join our G+ Community.