

# Diverse Learners, Diverse Courses, Diverse Projects: Learning from Challenges in New Directions

Owen Astrachan  
Duke University  
ola@cs.duke.edu

R. Brook Osborne  
Code.org  
brook@code.org

Irene Lee  
Santa Fe Institute  
lee@santafe.edu

Bradley Beth  
University of Texas  
bbeth@cs.utexas.edu

Jeff Gray  
University of Alabama  
gray@cs.ua.edu

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## 1. SUMMARY

Several changes and reforms in teaching computer science have been proposed and championed as part of the CS10K initiative [1-4]. The CS Principles (CSP) project and the overarching CS10K initiative include a public/private partnership offering curricula, curricular frameworks, professional development, online support, and a community of practice to support individual and systemic reforms at scale. In this special session, we hear from those leading large CSP projects and from the teachers participating in these large projects. The session is designed to inform the education community of these efforts and to situate them in the context of understanding how a diversity of approaches to implementing the CSP framework is necessary to succeed with different and diverse student populations, schools, districts, and teachers. Knowledge of these approaches will help those teaching these students as they move from high school to college, bringing related but diverse experiences because of how each student is learning the material that is based on the same curricular framework. This framework is part of the CS Principles project, but the efforts we report on in this session realize the framework at different scales, in different populations, and with different pedagogical approaches.

In this session the PIs on several CS Principles/CS10K initiatives will talk briefly and at a high-level about the projects they are leading, the approaches they are taking to scale their

projects, and the curricula, pedagogy, and professional development they are employing to expand and enable teachers and students. Pilot teachers who are part of each of the projects will offer a different, on-the-ground perspective of how each approach is succeeding and the challenges faced from a teacher perspective.

Outlining issues related to equity in the classroom, broadening participation, pedagogical approaches, and supporting diverse learners will be the responsibility of the leadership group from the CS Principles project. They will facilitate the discussion related to these diverse initiatives and call-on or represent pilot teachers from these different projects.

## 2. Overview (Owen Astrachan)

The projects highlighted in this special session are three of many designed to introduce CS Principles at local, regional, state, and national levels. In this overview we will situate these projects and their work in the context of other, related projects to highlight the diversity of approaches that can and should inform related efforts in expanding and transforming computer science education. This session is designed to present these projects in the context of transformational approaches, not simply as exemplars of one facet of the CS10K initiative.

*As the PI of the CS Principles project, Owen Astrachan works to help the community of educators working on this and related projects achieve their goals.*

## 3. Project Engage (Bradley Beth)

Project Engage uses the framework from CS Principles to deliver a course rooted in the inquiry-based pedagogies of problem-based-learning. Each of its units (a.k.a. modules) is built around a combination of an authentic problem and project, collaboration, student-centered learning, and engaging multimedia and narratives for information delivery. Teaching and learning are supported via a variety of Problem Based Learning (PBL) scaffolds including rubrics, group contracts, and intermittent checkpoints for feedback.

In addition to a course and professional development for teachers delivering the course, Project Engage includes a research component to understand and evaluate the project's effects on teaching and learning in a variety of contexts.

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Classroom observations, multiple surveys, interviews, focus groups, grades, scores, and web analytics address a variety of research questions whose answers we hope will inform both practitioners and academic researchers.

*Bradley Beth is the Senior Program Coordinator for Project Engage: Changing the face of computer science through inquiry-based education.*

#### **4. CS4Alabama: A Model for Statewide Deployment of CS Principles (Jeff Gray)**

The CS4Alabama project is building a professional development program based on in-person training and distance learning collaboration. It provides year-long professional development, rather than the week-long summer institutes that are typical of most AP training programs in other STEM areas. A statewide “Teacher Leader” model is being developed to help new peer cohorts as they establish CS Principles in their schools. Teachers in these cohorts will collaborate together on content and pedagogical learning experiences, fostered by peer leaders and facilitated through A+ College Ready (A+CR), the NMSI partner for Alabama. The pedagogical approach will be centered on inquiry/discovery-based techniques that introduce computer science as a broad set of topics built on the CSP curricular framework and learning objectives. The project not only considers issues of differentiation among students in the CSP classes, but also designs professional development for teachers who have diverse backgrounds and experiences.

*Jeff Gray is the PI for the CS4Alabama project.*

#### **5. Computing for All (Irene Lee)**

In the New Mexico Computer Science for All program the first cohort of teachers have completed their preparations to serve as learning coaches / TAs for the lab portion of a university dual credit (CS 151L) course at their high schools. The first cohort of teachers just started teaching CS to students at their high schools. Preparing this cohort of teachers with different backgrounds, interests, and experience engendered several challenges. These challenges are likely relevant as we face preparing so many high school teachers to become computer science teachers, from those with STEM experience to those for whom computer science is an introduction to STEM.

The dual credit course is designed to attract, prepare and retain diverse groups of students in computer science. The new teachers are successfully attracting and engaging a very diverse group of students (primarily Hispanic and Native American). A primary factor of this success is *relevance* - modeling local issues as complex systems - and through practices within the classroom that promote partnering and collaboration such as peer-instruction, pair programming, and problem based learning (PBL).

Both teachers and students ultimately get to experience being computational scientists - they create computational models of a local issue of importance to themselves and their communities then (after varying degrees of analysis of the model) use those models as experimental test beds to test a proposed solution or

mitigation strategy. This experience is both authentic to the learner and prepares the learner with a fundamental understanding of computational thinking.

*Irene Lee is the Director of the Learning Lab at Santa Fe Institute. She is the PI of GUTS y Girls, New Mexico Computer Science for All, and Program Director of Project GUTS: Growing Up Thinking Scientifically.*

#### **6. Challenges of Piloting at a large scale (Brook Osborne)**

Both code.org and the College Board/NSF sponsored CS Principles project work directly with pilot instructors teaching the future AP CS Principles course. In her current and former roles working with teachers in these projects, Brook is deeply connected to the experience of those teaching CSP at a variety of levels. In this session she will represent and discuss the successes and challenges scaling up CSP programs present for both teachers and project leadership.

*Brook Osborne is the 9-12 Program Manager at code.org. Previously, she was the Outreach Director and pilot coordinator for CS Principles and the National Director of Outreach in Computer Science at Duke University. She has a plan to change everything.*

#### **7. Intended Audience**

This special session is designed for all educators, especially those interested in introductory computer science where students move quickly from high school to college, and from one course to the next. The session is intended for educators interested in research- and experience-proven approaches to teaching and learning, including inquiry-based approaches, problem-centric and problem-based learning, and pedagogical approaches rooted in supporting diverse learners.

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