# Applying CAPE to Assess Equitable CS Education

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*Abstract*—**Disparities in K-20 computing education are well documented and remarkably persistent. The purpose of this panel is to propose a more comprehensive and holistic view of inequities in computing education by applying a framework called CAPE. The CAPE Framework outlines four levels of the computer science (CS) education ecosystem: Capacity for CS Education, Access to CS Education, Participation in CS Education, and Experiences of CS Education. Panelists will discuss how issues of equity can be interrogated at each level within three different contexts: K-12 education, higher education, and philanthropic investment in CS education. Audience participants will then collaborate to discuss how they might apply CAPE in their own contexts to understand and challenge the root causes of disparities in the computing field.**

*Keywords—computing education; equity; diversity; policy*

## I. SUMMARY

The challenge of broadening participation in computing is a complex problem requiring new paradigms for interrogating the root causes of inequities in computing education at multiple levels of the computer science education (CSEd) ecosystem. Fletcher and Warner [1] introduced the CAPE Framework as a heuristic for assessing how issues of equity can play out across CSEd. CAPE encourages scholars, practitioners, policymakers, and funders to evaluate disparities in **C**apacity for CSEd, **A**ccess to CSEd, **P**articipation in CSEd, and **E**xperiences of CSEd (See Figure 1), all of which contribute to inequitable outcomes for marginalized students. Such an analysis can promote a more nuanced understanding of the manner in which leading indicators of disparity at the capacity and access levels can influence lagging indicators of disparity at the participation and experience level, thus promoting more finely tuned interventions that are appropriate for each level. For example, in both K-12 and higher education settings, lagging indicators of learning such as Advanced Placement (AP) test scores or degree attainment are often examined by disaggregating data by gender or race/ethnicity categories to determine if disparities exist. These measures of student **experiences** in CSEd have evidenced historical inequities in learning outcomes for individuals who identify as female (in CS degree attainment for example) [2] and students who identify as minoritized races/ethnicities such as Black and LatinX (in AP CS test performance for example) [3,4].

Focusing exclusively on gaps in student achievement, however, ignores the systemic barriers that are pre-determinates of such disparities in outcomes. For example, at the K-12 **capacity** level, students from low-income families are less likely to attend a school that employs a certified CS teacher as compared to students from higher-income families [4], which could influence the quality of early CS learning experiences for low-income students, even if their school offers a CS course. In terms of **access,** students from low-income families, Black students, and Hispanic/LatinX students are less likely to attend a high school that offers CS [4, 5,6], and even when they do, barriers such as prior math achievement resulting from the tracking of poor, Black and Brown students out of advanced math in earlier grades can limit minoritized student access to CS courses in high school significantly [7]. In higher education, policies that privilege prior experience in pre-collegiate computing in admissions can exacerbate inequities in **access** to CS majors and limited faculty capacity can reduce **participation** of diverse non-majors in CS courses.
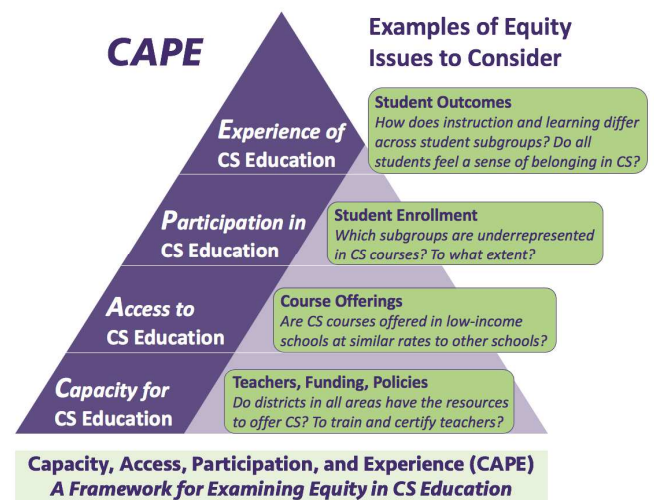


Fig. 1. CAPE Framework

## II. PANEL STRUCTURE

This 60-minute panel will include a brief introduction (7 minutes) to the CAPE Framework and panelists by the moderator, Carol Fletcher, followed by a deeper dive into its

application in three different contexts. Amy Ko will explain how CAPE can be applied to broadening participation in computing (BPC) efforts in higher education, with particular emphasis on policies and practices in computing departments that either support or inhibit BPC goals at each level of CAPE. Bryan Cox will address how the state of Georgia is examining equity at each level of CAPE in K-12 computer science. Leigh Ann DeLyser will address how CSforAll uses the CAPE Framework to help funders of CS education equity projects understand the CSEd ecosystem and how their investments can be leveraged to impact many of the underlying capacity and access challenges that lead to disparities in student outcomes. Each panelist will have approximately 10 minutes to describe their experience using CAPE to address equity challenges in their organizations or institutions. Questions to be addressed include:

1. How are you using CAPE to examine equity issues in your context (higher education, K-12, philanthropy)?
2. What data are you collecting to evaluate potential inequities in capacity, access, participation, or experience in CSEd?
3. When you began looking at your CSEd equity work through the lens of CAPE, were there any new insights you discovered?
4. What actions have you taken as a result of applying CAPE to your work?

Following panelist comments, the audience will be placed in breakout rooms (ideally) to discuss potential applications of CAPE to their own context (13 minutes). Audience members will share on a Jamboard (or other tool provided by the conference platform), strategies for applying CAPE as well as questions for panelists. The final 10 minutes will be spent back in large group on Q&A for panelists and reporting out one compelling idea from each breakout group.

## III. POSITION STATEMENS

**Carol Fletcher** is the director of the Expanding Pathways in Computing (EPIC) program at The University of Texas at Austin's Texas Advanced Computing Center. She is also the PI of the ECEP (Expanding Pathways in Computing) Alliance, an NSF funded BPC Alliance, which seeks to increase the number and diversity of students in the pipeline to computing and computing-intensive degrees by supporting state-level computing education reforms. Carol will serve as panel moderator and provide a brief overview of the CAPE Framework and its origins.

**Bryan Cox** is the Computer Science Specialist for the Georgia Department of Education, where he leads strategic planning and execution of Georgia's CSforGA initiative. Prior to working for the Georgia Department of Education, Bryan spent 8 years as a High School STEM teacher, teaching math, computer science, and engineering courses. Bryan also serves as a state leader for the Georgia ECEP Alliance team. Bryan capitalizes

on his deep well of experience in both the policy and practice of K-12 computing education to guide the broadening participation efforts of the state of Georgia. Bryan will discuss how he has used the CAPE Framework to develop a data dashboard for tracking equitable K-12 CSEd across the state of Georgia.

**Leigh Ann DeLyser** is the Executive Director and Co-Founder of CSforAll as well as a national leader for the ECEP Alliance. At CSforAll, she oversees programs, leads strategic planning, and supervises research to build support for high quality CS education at all levels. A former high school and university CS educator, Leigh Ann understands challenges faced by teachers, administrators, and students developing their competency in the field and accessing high-quality learning opportunities and resources. Leigh Ann will use her experience engaging with industry stakeholders, philanthropic donors, and other funders to share how the CAPE model has helped CSforAll define points of leverage for investors interested in making substantive and systemic impacts on CSEd that will improve outcomes for historically underrepresented students.

**Amy Ko** is a Professor in The Information School at the University of Washington. She is also a state leader for the Washington ECEP team and a founder of the CS for All Washington coalition, which advocates for universal K-12 CS education. Her scholarship focuses on the individual and collective struggle to understand computing and harness it for equity and justice. Amy will share how she has utilized the CAPE Framework to examine systemic barriers to diversity and inclusion in computing and information sciences at the University of Washington.

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