COMPUTER SCIENCE ACCESS FOR STUDENTS OF COLOR IN CALIFORNIA: DISPARITIES AND OPPORTUNITIES

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Level Playing Field Institute

Mission

Level Playing Field Institute is committed to eliminating the barriers faced by underrepresented people of color in science, technology, engineering and mathematics and fostering their untapped talent for the advancement of our nation.





Areas of focus



To improve access and opportunity in STEM, LPFI:

- Operates **STEM**-Focused Education Programs
- Executes Innovative Computer Science Initiatives
- Conducts Research on STEM Equity and Opportunity.



CS Initiatives

- LPFI implements computer science initiatives designed to provide underrepresented students opportunities for exposure, engagement, and technical skill development within the field of computer science:
 - -An NSF-Funded AP Computer Science preparatory sequence from 9-12th grade within our five-week, three-summer SMASH (Summer Math and Science Honors Academy) program designed for underrepresented students of color.
 - •Computer science exposure courses designed for African-American middle school boys through SMASH: Prep
 - •Hackathons to increase exposure and "Level the Coding Field" for 6-12th grade students.



Session Flow

- Need for Computer Science
- Underrepresentation in CS
- Recent Report Findings
- Promising Practices & Resources
- Discussion/Q & A



The Need for Computer Science

- Computing occupations are among the highestpaying & fastest-growing occupations.
- Will be 1.3 million job openings in computing and mathematical occupations by 2022.
- Yet, across California, 65% of public high schools offer NO computer science courses and only 13% offer the AP Computer Science course.
- Just 8,688 of the state's 1.95 million high schoolaged students (.04%) took the AP Computer Science exam in 2015.
 - Without access to AP CS, students are 8 times less likely to pursue CS in higher education.

Sources: California Department of Education, 2014; College Board, 2014; Mattern, Shaw, & Ewing, 2011

Underrepresentation in CS

- African Americans and Latinos combined account for only:
 - 17% of all computer science Bachelor's degrees
 - 7% of all computer science Ph.D.'s
 - 6% of computer science faculty
 - 9% of the computing workforce nationwide

Underrepresentation in CS

African-American and Latino students make up **59%** of California public school students but were just **11%** of 2014 AP Computer Science test takers. Percentage of AP Computer Science Test-takers and Statewide HS Population, by Race/Ethnicity



* California Department of Education demographic data for Asian students aggregated with Pacific Islanders and Filipino students

Underrepresentation in CS





Barriers to Participation in Computer Science

- Social and psychological barriers affecting CS perceptions
 - Misconceptions about computer science
 - Negative racial and gender stereotypes about ability
 - Lack of diverse role models and peer networks
 - Stereotypical cues in CS environments
 - Implicit bias & unwelcoming school and workplace environments
- Structural barriers to participation in CS
 - Inequitable school funding, technology and resources
 - Lack of engaging and culturally relevant computing curriculum
 - Lack of opportunities for students to participate in CS activities & exposure in out-of-school settings
 - Lack of access to introductory and advanced computer science courses and a focus on basic computer applications or typing

Sources: EdTrust West, 2012; Margolis et al., 2008; Goode & Margolis, 2011; Scott, Aist, & Hood, 2009; Anderson, et al., 2008; Williams, et al., 2007; Peckham, et al., 2007; Cheryan, et al, 2009, 2011



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Key report findings

In California public high schools:

- Nearly <u>75%</u> of schools with the highest percentage of underrepresented <u>students of color</u> offer no computer science courses.
- Just 2% of schools with the highest percentage of underrepresented students of color offer AP Computer Science.
- Over <u>75</u>% of schools with the highest percentage of <u>low-income</u> students offer no computer science courses.
- Only 4% of schools with the highest percentage of low-income students offer AP Computer Science.
- In San Francisco Unified and Oakland Unified School Districts combined (Silicon Valley's backyard), under 2% of students are enrolled in computer science.
- Of the more than half a million high school students in California's largest 20 districts, just 1% are enrolled in any computer science course.
- 5 out of the largest 20 districts in California do not offer any computer science courses.
- 10 out of the largest 20 districts in California do not offer AP Computer Science.



Definitions

- "Computer science course" refers to courses with either "computer science" or "computer programming" in the title.
 - Doesn't include the often conflated computer-based courses on information technology & computer literacy/usage.
 - Informed by the CSTA's definition of Computer Science Education.
- We define "underrepresented students of color" as African American, Latino, and Native American (populations that are disproportionately underrepresented in computing).
 - While disparities also exist within Asian and Pacific Islander populations, there isn't sufficient data to disaggregate by subgroups within these categories.
- We define low income students by Free/Reduced Price Lunch eligibility.
- "English learner" students are defined by the California Department of Education as having a primary language other than English.
- Methods: Level Playing Field Institute analyzed data from the California Department of Education & the College Board (computer science course offerings, school and district demographic data, & student enrollment data).
 - With the exception of alternative/continuation schools, and schools with fewer than 100 students, all California public high schools were included in analyses.
 - Analysis is based on most accurate data available, though there may be reporting errors from schools or districts.



Computer science course *availability is considerably lower* in California public high schools that have high populations of underrepresented students of color.

Schools with the highest percentage of underrepresented students of color offer **AP Computer Science** at a rate twelve times lower than schools with the lowest percentage of underrepresented students of color.



Percentage Underrepresented Students of Color in Total Student Body	Number of CA Public High Schools	Number and Percent of schools offering AP Computer Science		Number and Percent of schools offering Any Computer Science	
0-50%	523	126	24%	233	45%
51-90%	513	44	9%	144	28%
91-100%	248	5	2%	66	27%

Computer Science Availability by Percentage of Low-Income Students

- LOWEST % OF LOW-INCOME STUDENTS ------

— HIGHEST % OF LOW-INCOME STUDENTS



Schools with the highest percentage of low-income students offer **computer science courses** at a rate **less than half** that of schools with the lowest percentage of low-income students.



Schools with the highest percentage of low-income students offer **AP Computer Science** at a rate nearly **eleven times lower** than schools with the lowest percentage of low-income students.

BY THE NUMBERS							
Stu	Percentage Low Income Idents in Total Student Body	Number of CA Public High Schools	Number and Percent of schools offering AP Computer Science		Number and Percent of schools offering Any Computer Science		
	1-25%	198	85	43%	120	61%	
	26-50%	305	43	14%	101	33%	
	51-75%	403	33	8%	130	32%	
	76-100%	378	14	4%	92	24%	



Recommendations

- Develop <u>funding strategies</u> to create equitable access to introductory and Advanced Placement computer science coursework across all California public high schools.
- Ensure all California school districts allow computer science to count as either a mathematics or science high school <u>graduation requirement</u>.
- Develop a statewide <u>shared definition</u> of what courses constitute "computer science" for use in all California high schools, to create consistency as well as transparency in access.
- Ensure introductory computer science courses provide the necessary <u>scaffolding</u> and effective instruction for students of all backgrounds to succeed in advanced computing coursework.
- Ensure computer science curricula, pedagogy, and assessments are <u>culturally-</u> <u>relevant</u> and <u>inquiry-based</u> in order to engage underrepresented groups and broaden participation in computer science.
- Expand regional <u>partnerships</u> between technology companies and California high schools, to capitalize on the prevalence of computer science professionals who can serve as volunteer instructors, mentors, or guest speakers (from underrepresented backgrounds when possible).
- Expand access to in-school & out-of-school programs designed to develop computing interest among underrepresented groups, through hands-on projects, field trips, extracurricular activities, and mentorship programs.

Examples of CA Initiatives Addressing Gaps in Access

- Los Angeles Unified School District partners with Exploring Computer Science to provide curricula and professional development to educators teaching year-long Exploring Computer Science course at 40 LAUSD high schools.
 - Exposes over 2,300 high schools students (majority are from groups underrepresented in CS) to engaging and culturally relevant CS curriculum.
- San Francisco Unified School District partners with Code.org to broaden computer science access. SFUSD also recently passed initiative to make CS compulsory for all students in grades Pre-K through 8 and expand CS opportunities at all district high schools.
- Black Girls Code provides girls of color with opportunities to learn skills in computer programming through workshops, after-school programs, and Hackathons.
- Alliance for California Computing Education for Students and Schools (ACCESS) is a statewide network of computer scientists, teachers, policy advocates, & industry professionals dedicated to providing all CA students with high-quality CS education, specifically for traditionally underrepresented students.
 - Engaged in tracking, supporting, & monitoring implementation of bills and ensuring that CA's CS education legislation will fulfill its potential.



- CA chapters of the Computer Science Teachers Association work to develop strong communities of CS teachers. The organization supports CS teaching & provides opportunities for K-12 teachers and students.
- CA Governor Jerry Brown signed bills AB 1764, SB 1200 and AB 1539 in support of expanding CS education.
 - AB 1764 would allow California schools districts to award students math credit for a UC-approved course in computer science.
 - SB 1200 calls on the University of California and California State University systems to develop guidelines for high school computer science courses that would satisfy advanced math subject matter requirement for undergraduate admissions.
 - AB 1539 calls on the Instructional Quality Commission to consider developing K-12 computer science content standards.
 - 2015 legislation includes district grant funding programs, a community college CS enrollment initiative, and proposed "Women and Girls in STEM" Week.



New AP Course Coming Fall 2016: Computer Science Principles

- Engaging, Accessible, Inspiring, Rigorous
- Focused on computational thinking, collaboration, exploration, creativity, innovation, access, equity, global impacts of computing
- Impetus for college curriculum reform

www.CSprinciples.org



LPFI's programs

- To engage underrepresented students, our summer and school-year CS programs include:
 - Diverse CS role models & peers
 - Speakers of color from tech industry
 - CS-focused field trips
 - Community-building activities
 - Family recognition events
 - Addressing misconceptions about CS
 - Youth empowerment (asset-based lens)
 - Rigorous, culturally-relevant CS curriculum



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- Curriculum content connects to students' life experiences
- Student-directed projects & topics
- Inquiry-based, social justice focus (solve community problems)
- High school: Exploring Computer Science and BJCx
 - Online freely available curricula
- Middle school: Communication technologies & mobile apps
 - App Inventor
 - Podcasting, web design, video game programming





Outcomes (2014 pre to post)





- 94% of students increased CS assessment scores
- Statistically significant increase in students' familiarity with programming languages
- Significant increase in students' attitudes towards CS
- Percentage of students who:
 - " "like" computer increased from 59% to 87%
 - see examples of CS in their everyday lives increased (69% to 86%)
 - believe CS can be a tool to solve community issues increased (63% to 80%)





"My computer science class had the biggest impact on me and I have learned that I have an interest in computer science."



EVEL PLAYING FIELD



"I learned how to connect social justice to mobile apps."



Broadening CS participation: Partnership examples

1) Teacher at underresourced OUSD HS created AP CS course from ground up



- 100% low-income students of color
- Industry volunteers co-teach through TEALs (nationwide resource of volunteer CS teachers)
- Crowd-funding for laptops
- Outside orgs for pre-AP exposure (Girls Who Code, Yes We Code, CodeNow)
- Guest speakers
- Coding club
- Hackathons (Black Code Girls, Qeyno Labs, Yes We Code, HackerFund, Technovation Challenge, NCWIT Aspirations in Computing)
- Family Engagement (Multi-lingual information on what is CS, parent-student workshops, CS Fair/ open house)



2) OUSD Computer Science Working Group

Co-founded by OUSD and LPFI



- CS, Math, & Science teachers, administrators, OUSD board member, non-profit partners
- Survey on assets & challenges to broadening CS sent to teachers & admins
- Committees formed based on results, to address challenges and design policy vision
- Offered recommendations to strengthen CS throughout the district
- District CS Coordinator now in place as a result



OUSD Assets & Challenges Map



District challenges

Unclear district priority regarding CS education	Limited capacity of Math Department to coordinate CS (due to district initiatives)	Unclear funding mechanism	Challenge hiring teachers with CS backgrounds
hared District CS vision/goal	CS coordination	Funding for CS	CS Teachers/PD Opportunities
Unclear course sequence and standards. Only limited # of courses currently available	Chromebooks inadequate for AP class. Spotty Internet. Equitable computer distribution including after- school. Computers/Reliable internet	Under- representation in some schools and linked-learning programs. Equity in CS	Ability to vet + quickly respond to partnership opportunities. CS partners/programs

OUSD CS Priorities

education funding paths (1) Determine CS education funding (2) Map out CS educational assets and challenges at each school

Determine Curricular Vision os te e ui a do c) te to c)

(1) Determine K-12 CS curricular sequence & standards based on NSF and CSTA materials

(2) Map exposure opportunities for elementary schools, basic intro in middle schools and a 2 course sequence (Intro and AP) at every high school Recruit and develop teachers

(1) Expand successful PD programs piloted in district (ex.TEALs, Code.org) and in line with curricular

sequence

- (2) Provide incentives for
- CS teachers including .2
- FTE prep

(3) Recruit potential CS teachers from Teach Tomorrow for Oakland, community college lecturers, industry professionals and Math/ Science professionals



Strengthening CS in your District/School: Your Turn!

District/school assets



District/school challenges



Strengthening CS in your District/School

- Action steps based on assets & challenges (example):
 - 1. Step1:
 - Ex: Coordinator gathers working group
 - 2. Step 2:
 - Create a vision for CS in the district with working group
 - 3. Step 3:
 - Send survey to interested stakeholders to understand CS landscape



CS Priorities Template





Discussion/Q & A

Thank you! Resource List - <u>http://bit.ly/1RvtPps</u>

For more information about this study, or related research and STEM programming for high-school students:

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