THE CALIFORNIA *Computer Science* ACCESS REPORT

September 2021

Authors
Sonia Koshy, Ph.D.
Laura Hinton
Lisa Cruz
Allison Scott, Ph.D.
Julie Flapan, Ed.D.

KAPOR CENTER

CSforCA
COMPUTERSCIENCEFORCALIFORNIA

SUMMARY

BACKGROUND

Given the significant role that technology plays in California's economy, computer science (CS) education is foundational to the success of its future workforce and it must take bold steps to ensure that all of California's students are sufficiently prepared. This report examines the landscape of computer science education across the state of California, and examines who has access, who participates, and where equity gaps by race, gender, income, and geography continue to persist. Findings indicate that, while some progress has been made in expanding access to computer science education, much work remains to increase equity in access and enrollment, particularly among Black, Indigenous, Latinx students, girls, low-income students, and rural students.

KEY FINDINGS

► Who has access to computer science education in California?

- **42%** of California's high schools offered a CS course in 2018-19; a three percentage point increase from 2016.
- California lags behind the national average and **behind 34 other states** in the percentage of high schools offering at least one CS course.
- **66%** of Santa Clara county high schools offered at least one CS course, leading the computing education efforts across the state.
- While **34%** of schools across the state offered a core CS course, only **14%** offered a specialized course and **13%** offered an Advanced Placement course.
- Schools serving low-income communities were **3x less likely** to offer core CS courses and over **2x less likely** to offer Advanced Placement courses than schools serving high-income communities.
- Rural schools were **2x less likely** to offer CS courses than urban schools.
- **34%** of schools serving high proportions of Black, Indigenous, Latinx, and Pacific Islander students offered CS courses in comparison to **52%** of schools serving a greater proportion of white and Asian students.

► Who participates in computer science across California?

- Only **5% of the 1.93M** high school students in California were enrolled in any type of CS course in 2018-19.
- While girls comprise **49%** of the high school population, just **30%** of students taking CS courses are girls; and girls from all backgrounds (except Asian) are vastly underrepresented.
- Just **561 Black and 44 Indigenous** students in California took AP CS courses in 2019.
- California ranks **ninth** among all states in the number of AP CS test takers.

► Are students successfully developing computational competencies?

- The overall passage rates for the AP CS A and AP CS P exams were **73%.**
- Over **80% of Asian and white** students passed the AP exam with a score of 3 or above, compared to roughly **50% of Black and Latinx** students.
- Latinx girls were the least likely to pass the exams, with only **30% passing the AP CS A** exam and **49% passing the AP CS P** exam.

► What policies should California implement to increase equity in access, enrollment, and success?

- **Develop incentive structures to recruit, prepare, retain, and diversify the pool of computer science teachers.** Both financial incentives for teachers and dedicated time commitments for professional development are essential to recruit, prepare, retain, and diversify the pool of CS teachers across the state.
- **Build comprehensive pre-service and in-service teacher education and training programs aligned to an equity-focused computing education framework.** Despite the growing diversity of the U.S. K-12 student body, girls and Black, Indigenous, Latinx, and Pacific Islander students remain vastly underrepresented in computing education. Incentivizing schools of education to provide educational opportunities through an equity lens will ensure CS educators are equipped for a rapidly diversifying classroom.
- **Engage strategic partners to better align K-12 learning goals with California's CS strategic plan to ensure student preparedness for a technology-driven future.** Policymakers, educators, industry partners, and community must collectively identify priority learning goals for K-12 education that align with California’s CS strategic plan to prepare and engage students for a technology-driven future, including college and career readiness as well as community engagement.
- **Integrate computational competencies and learning goals into multiple subject areas and in high school graduation requirements to engage all learners.** As computing knowledge becomes essential across all sectors and fields, computing education must move beyond solely specialized courses and integrate into other subject areas and across K-12 classrooms. This will require integrating computational competencies into subject area standards. Furthermore, to incentivize student engagement, CS must be adopted as a core requirement for high school graduation and postsecondary entry.

CONCLUSION

Despite the progress made by California in increasing access to high quality CS education, the majority of California’s students still do not have access to CS education in their schools, and equity gaps in access, enrollment, and success persist. Policy changes are needed to expand access for all students and ensure communities historically excluded from CS are equipped to lead and participate in our technological future.

INTRODUCTION

The tech sector remains one of the greatest drivers of the United States economy, accounting for 12.4 million jobs, contributing $2.0T in economic output, and comprising 10.5% of the U.S. economy. Technological innovation plays a significant role across all other industries and sectors, with advancements in artificial intelligence, Internet of things, autonomous vehicles and biotechnology impacting sectors ranging from transportation and finance/banking to health, telecommunications, and energy. Labor market trends and projections demonstrate that the need for a skilled technology workforce will only continue to grow over the next decade — with computing occupations projected to grow 13%, add roughly 667,600 new jobs.

California has become a global leader in this technological revolution, leading to unprecedented heights of economic growth, innovation, and sociopolitical influence. California leads the nation in tech employment (1.88M tech workers), the economic impact of the tech sector ($520Bn), and is home to 5 of the top ten highest-grossing global tech companies. And despite the economic downturn brought on by the COVID-19 pandemic, the state's 15 largest technology companies had sales of $1.35T in 2020, equivalent to the 15th highest gross domestic product in the world. The startup ecosystem in California also continues to thrive, with more venture capital invested in the San Francisco Bay Area in 2020 ($60B) than any other geographic region of the country.

To maintain economic competitiveness and drive innovation, California must invest in the development of a skilled and diverse technological workforce.

Despite technology's role in every aspect of our lives and our economy, the technology sector nationwide — and in California — does not reflect the demographic diversity of the state, with Black, Latinx, Indigenous populations and women vastly underrepresented. The lack of diversity in California's tech sector contributes to income and wealth inequality by restricting access to the highest-paying and fastest-growing sector of our economy. Additionally, recent reports have revealed numerous troubling byproducts of technological innovation impacting consumers and communities of color, in areas including algorithmic bias and hiring and loan decisions; facial recognition software and wrongful arrests and surveillance; and the proliferation of misinformation, disinformation and extremism on social media.

California must ensure its future workforce is prepared with the knowledge and critical thinking to develop, design, and make sound decisions about technology to ensure its ethical and equitable deployment and utilization.

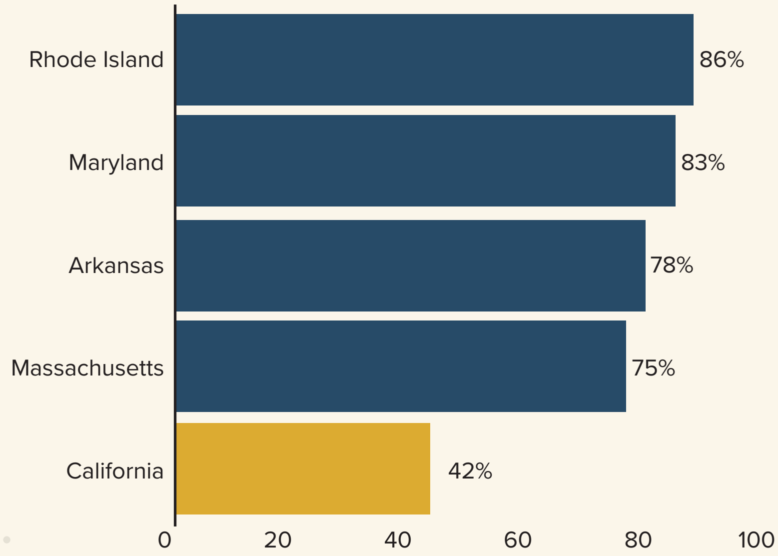
Given California's leading role in the technology economy, significant investment must be made in K-12 education to ensure the future workforce is prepared to succeed in a tech-driven economy — and computer science has now become a foundational literacy. Yet, in our 2019 report, *Computer Science in California's Schools*, data indicated that computing education is not universally or equitably accessible to students across the state, and far too few students in California have the opportunity to take CS courses and develop core computational competencies. Two years later, as the computing industry continues to revolutionize society's relationship with technology, this follow-up report reveals the current landscape of computer science education in California's public schools and the extent to which California's current students are being prepared to participate and thrive in our digital future. This report answers the following questions:

1. Who has access to CS in California? Have we made progress in increasing access and closing equity gaps?
2. Who participates in CS across California? Have we made progress in increasing enrollment and closing equity gaps?
3. Among those who enroll in CS, are students successfully developing computational competencies?
4. What policies should California implement to increase equity in access, enrollment, and success?

Who has access to computer science education in California?

In 2018-19, 42% of the 2,646 high schools in California offered computer science courses, a three percentage-point increase from 2016 when 39% of high schools offered computer science courses. Yet, California lags behind the national average (47%) and behind 34 other states, in the percentage of high schools offering at least one computer science course.[1] National data show Arkansas, Rhode Island, Maryland, and South Carolina lead with a considerable majority of high schools in their states offering computer science (89%, 86%, 83%, and 80%, respectively; See Figure 1).

Figure 1. Top States in Percent of High Schools Offering CS Courses in Comparison to California



Advanced Placement CS courses (AP CS Principles and AP CS A) are available in 13% of California's high schools. Notably, while course availability across California has increased over time for core computer science courses and Advanced Placement CS Principles (AP CS P), the state has seen a drop in the number of schools providing Advanced Placement CS A (AP CS A) courses.

[1] As of the writing of this report, the most recently available data from the California Department of Education are from the 2018-2019 academic year.

Figure 2. Number of High Schools in CA with CS Course Offerings, by Course Type[2]

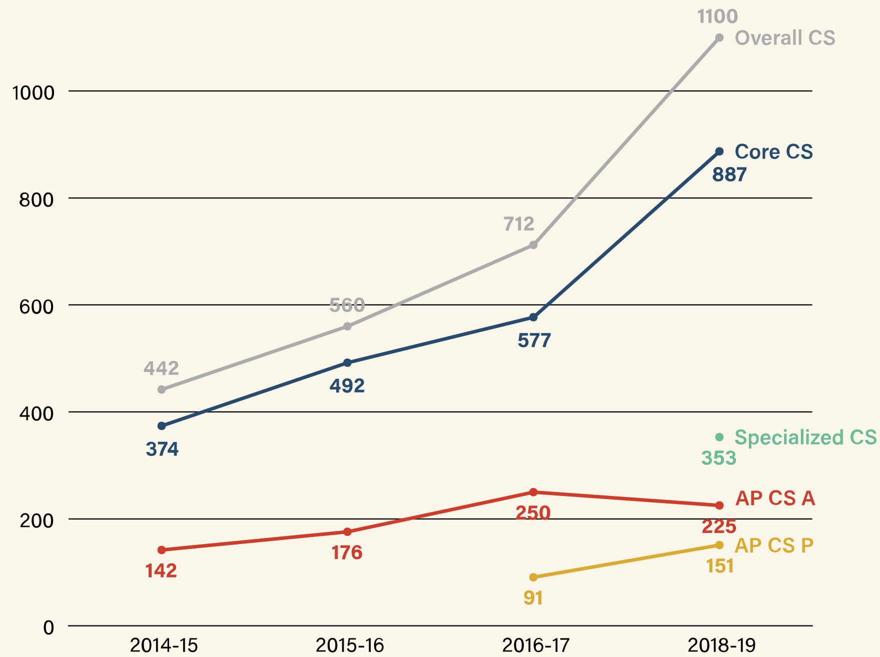
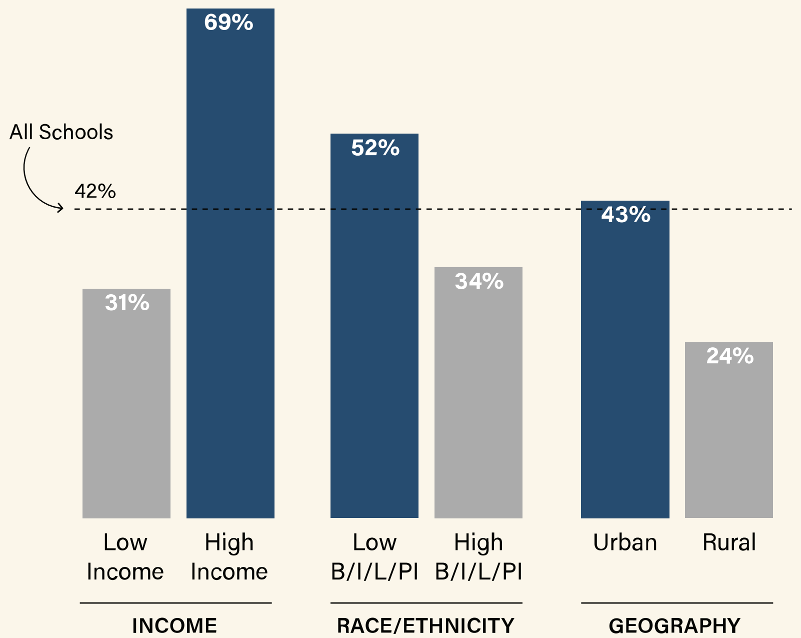


Figure 3. % of High Schools Offering Any CS, by School Demographics



Note: Blue represents any sub-category percentage that falls above the overall percentage.

[2] The re-coding of course codes from the California Department of Education has limited the ability to assess year-over-year changes in Specialized Computer Science courses.

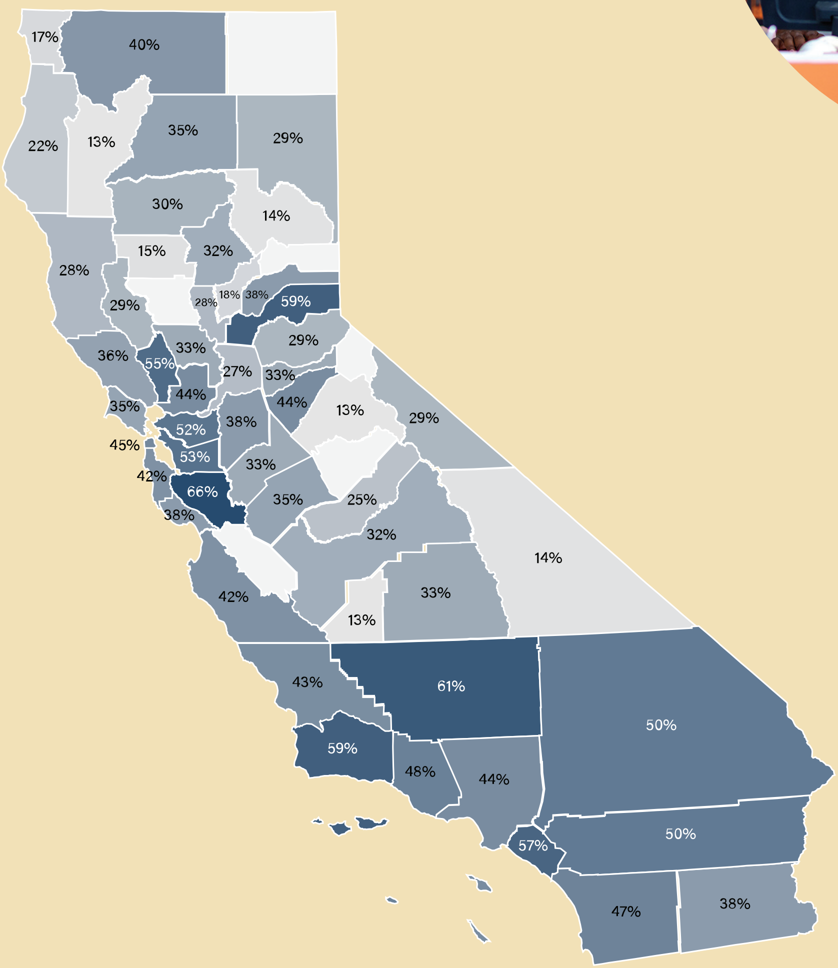
Students in low income communities were over two times less likely to have access to computer science courses in comparison to their counterparts in high income communities. Similarly, schools serving high proportions of Black, Indigenous, Latinx, and Pacific Islander students were less likely to have access to computer science in comparison to the schools serving a greater proportion of white and Asian students (34% and 52%, respectively; Figure 3).

Data also showed differences in access by geographic regions of the state. Students in Santa Clara county had the greatest access to computer science courses, with 66% of county high schools offering at least one computer science course. In the southern California region, Kern county led with 61% of high schools offering at least one computer science course.

Students in five counties (Colusa, Mariposa, Modoc, San Benito, and Sierra) had no access to any computer science courses. A comparison between urban and rural areas revealed that students in rural areas were almost two times less likely to have computer science courses than those in urban areas (Figure 4).

As computational skills are anticipated to grow in demand, a stronger statewide strategy will be required to rapidly expand access to relevant coursework and provide all California students with the opportunity to succeed. Communities that have been historically marginalized and excluded from technology careers are at most risk of falling further behind and statewide policies must include strategies to effectively expand access to schools serving rural and low income communities and those with greater proportions of Black, Indigenous, Latinx, and Pacific Islander students to truly ensure access for *all* students.

Figure 4. % of High Schools Offering Any CS, by County[3]



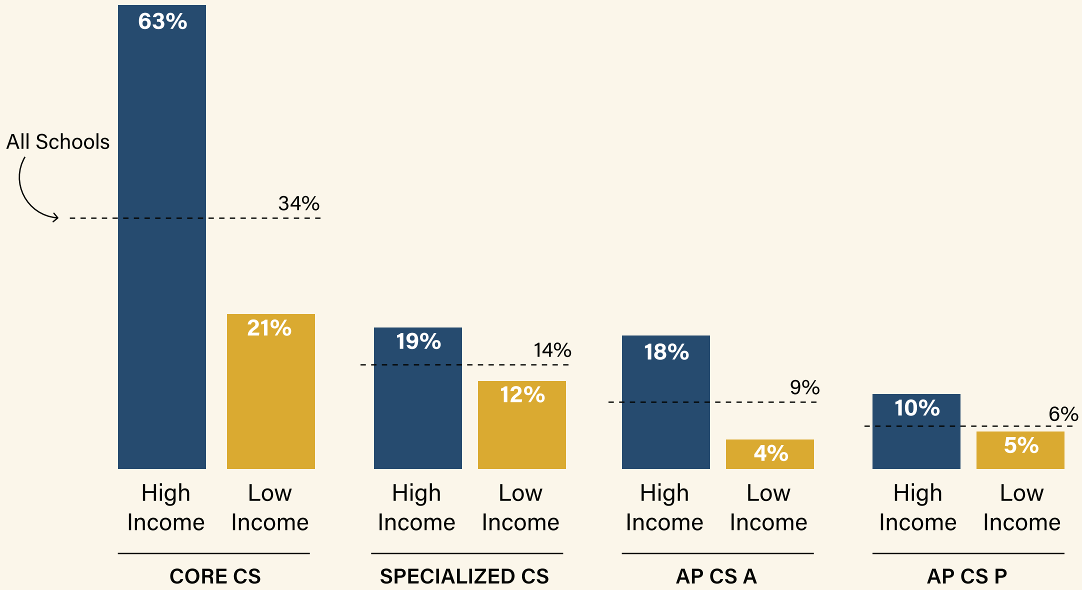
[3] Alpine county does not have any high schools, thus, does not have a number representation. All other counties with high schools, but no CS offerings in the 2018-2019 academic year were also left blank.

Are students afforded the opportunity to build specialized and advanced computer science competencies in high school?

In order to build students' computational competencies, not only must they be offered courses that introduce them to foundational knowledge in computer science but they must also have opportunities to advance their knowledge with more specialized or advanced content. Yet, high schools in California were much more likely to offer introductory courses, with far fewer opportunities for students to take specialized or advanced placement courses. While 34% of schools across the state offered a core computer science course, only 14% offered a specialized course and 13% offered an advanced placement course[4].

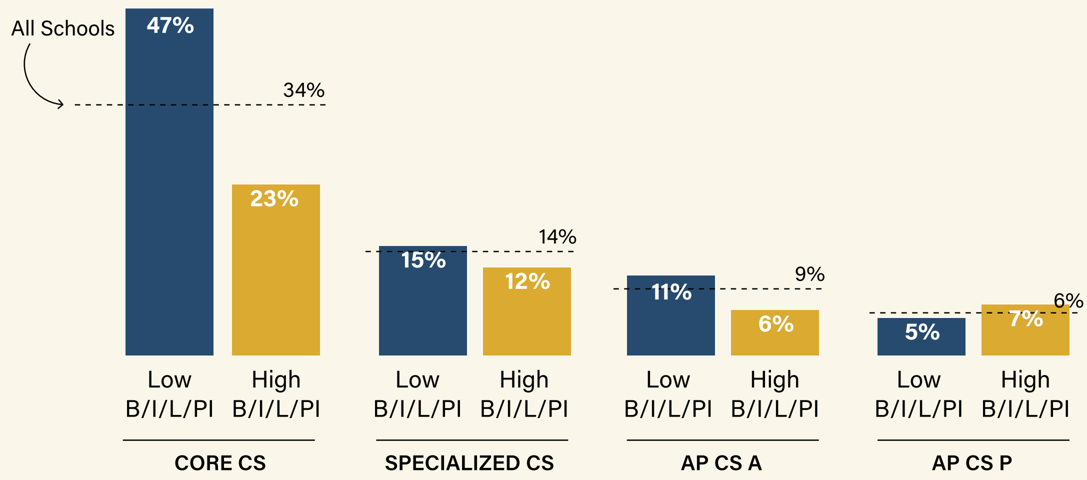
These opportunities were even more scarce in schools serving rural and low income communities as well as those with greater proportions of Black, Indigenous, Latinx, and Pacific Islander students. Low-income schools were two times less likely to offer core CS courses (or Advanced Placement courses than high-income schools. Only 12% of schools in low income communities offered specialized courses and only 4% of these schools offered Advanced Placement CS A (compared to 19% and 18% of high-income schools, respectively; see Figure 5). In similar trends, schools with greater proportions of Black, Indigenous, Latinx, and Pacific Islander students were less likely to offer specialized and AP CS A courses in comparison to schools with greater white and Asian student populations. However, these data reveal that AP CS P courses are gaining slightly greater traction in schools with greater proportions of Black, Indigenous, Latinx, and Pacific Islander students (see Figure 6).

Figure 5. % of High Schools Offering CS by School Community Income Level



[4] See Appendix for detailed description of course categories.

Figure 6. % of High Schools Offering CS by School Racial/Ethnic Makeup



Access to specialized and advanced courses also varied by geographic location. In urban areas, 14% of schools offered specialized courses, 9% offered AP CS A, and 6% offered AP CS P. Yet, in rural areas, just 5% of schools offered specialized courses to their students and startlingly, no schools in these areas offered advanced placement courses. Data revealed that 26 of the 58 counties in the state do not offer any advanced placement CS courses. Santa Clara County again led in advanced placement CS course offerings (see Figure 8), yet even in this county, only 33% of schools offer these courses. These data reveal ongoing challenges that California's public schools face in providing opportunities to advance students' skills in CS in alignment with post-secondary education and career requirements and to build the capacity of teachers to teach advanced content.

Figure 7. % of High Schools Offering CS by School Urbanicity

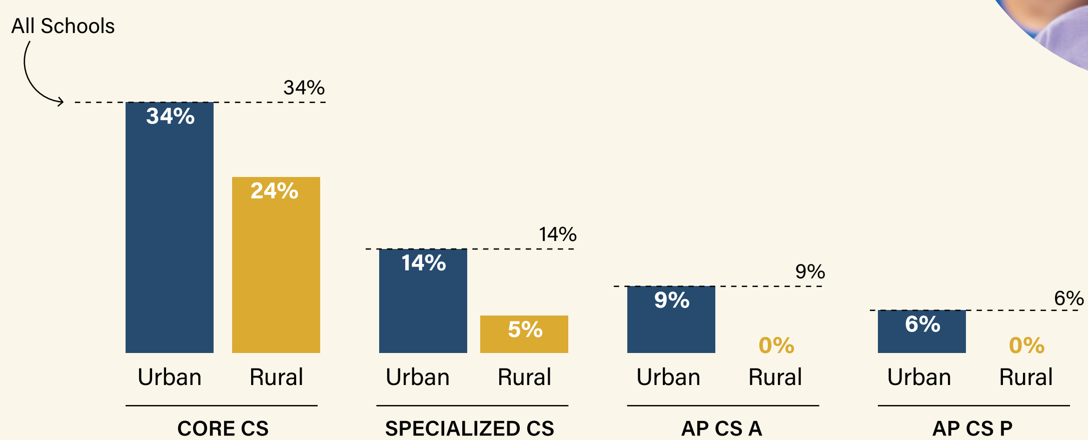
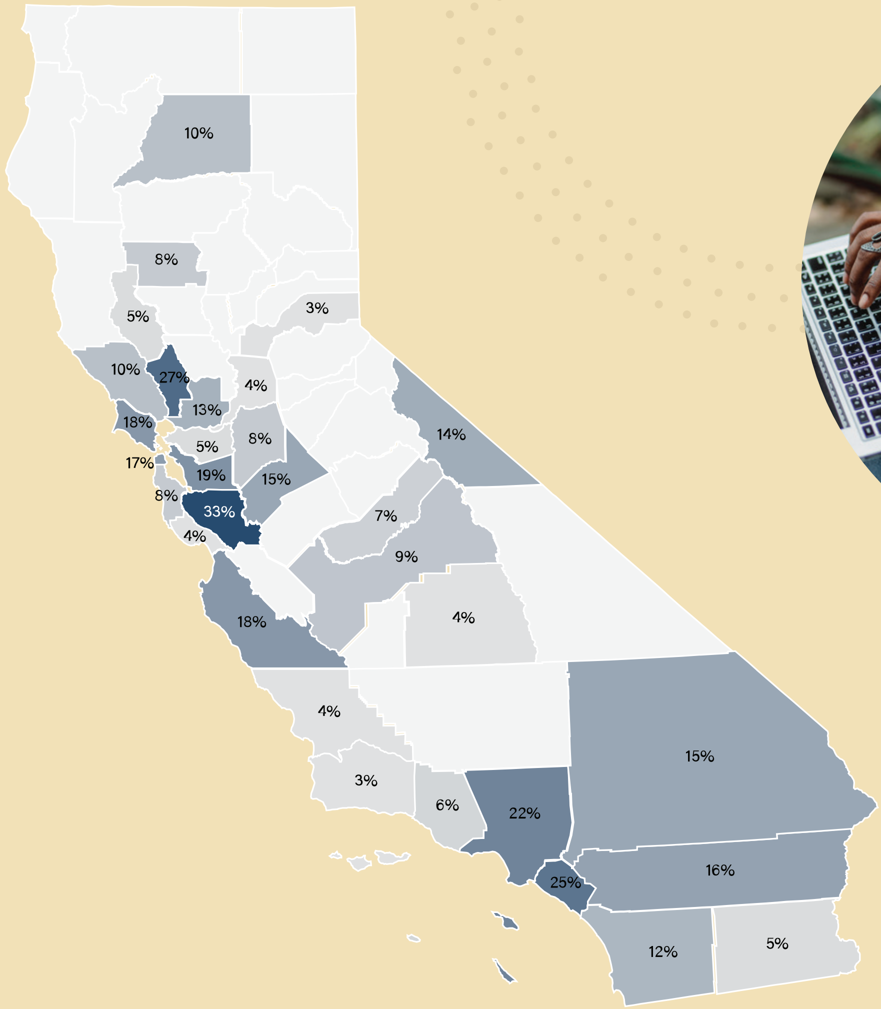


Figure 8. % of High Schools Offering AP CS, by County[5]



[5] Alpine county does not have any high schools, thus, does not have a number representation. All other counties with high schools, but no AP CS offerings in the 2018-2019 academic year were also left blank.

Who participates in computer science across California high schools?

While CS is offered in 42% of California's high schools, just 5% of the 1.93M high school students in California were enrolled in any type of CS course in 2018-19. Since the 2016-17 academic year, the state has only seen a two percentage point increase in the number of high schools offering CS and the number of students enrolled in these courses.[6] When examining race/ethnicity and gender differences in CS course enrollment, the data reveal considerable underrepresentation among girls and students of color. Despite comprising 49% of the student body in California, girls only represent 30% of students enrolled in CS courses (see Figure 9). Further, Black, Latinx, Indigenous, and Pacific Islander students are underrepresented in CS courses relative to their representation in the high school population (51% compared with 63% of HS enrollment; Figure 10).

Figure 9. Overall CS Enrollment, by Gender

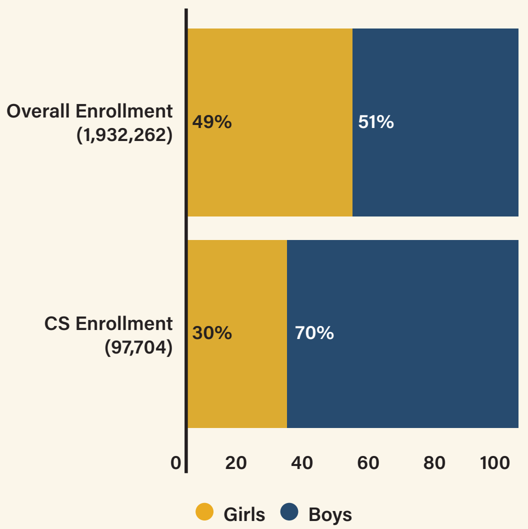
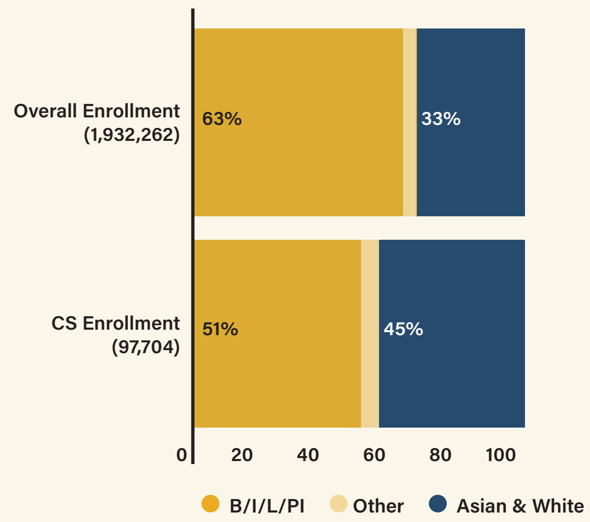


Figure 10. Overall CS Enrollment, by Race/Ethnicity

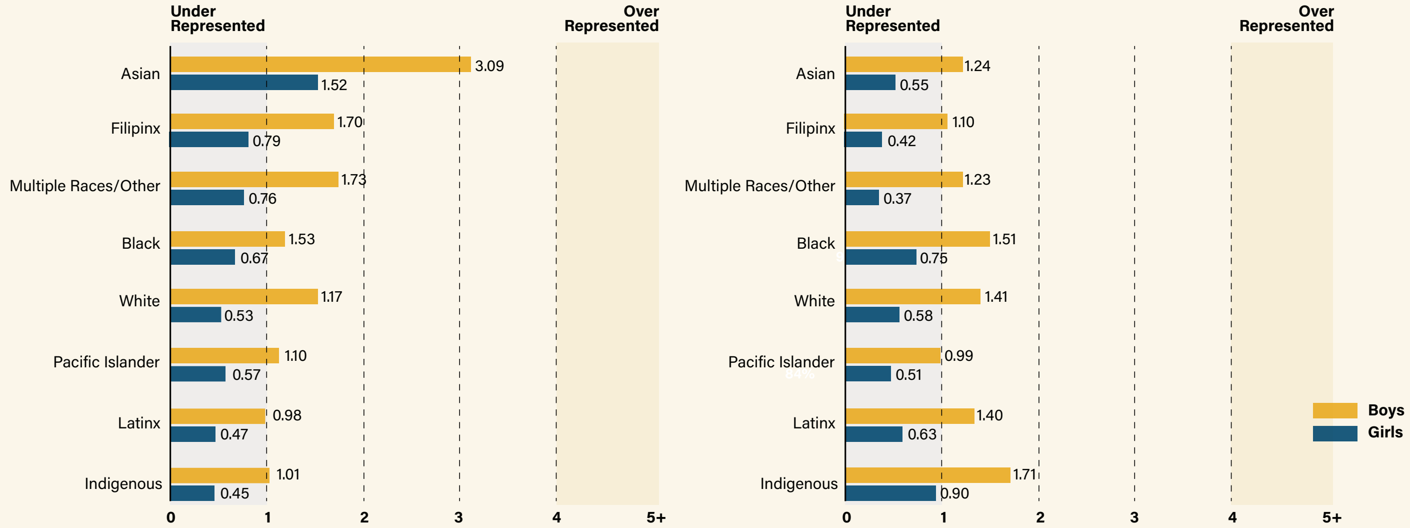


Enrollment in core and specialized computer science courses

Overall enrollment numbers show that only 3% of all high school students are enrolled in core CS courses, and only 1% of are enrolled in specialized CS courses. Moreover, when looking at enrollment trends across courses by race/ethnicity and gender, girls of every race/ethnicity (aside from Asian girls), are underrepresented in core CS courses. Data on boys' enrollment show underrepresentation among Latinx boys in core CS and among Pacific Islander boys in specialized CS. See Figure 11.

[6] A detailed view of CS enrollment by course type, race/ethnicity, gender, county, district, and school can be found at www.csforca.org.

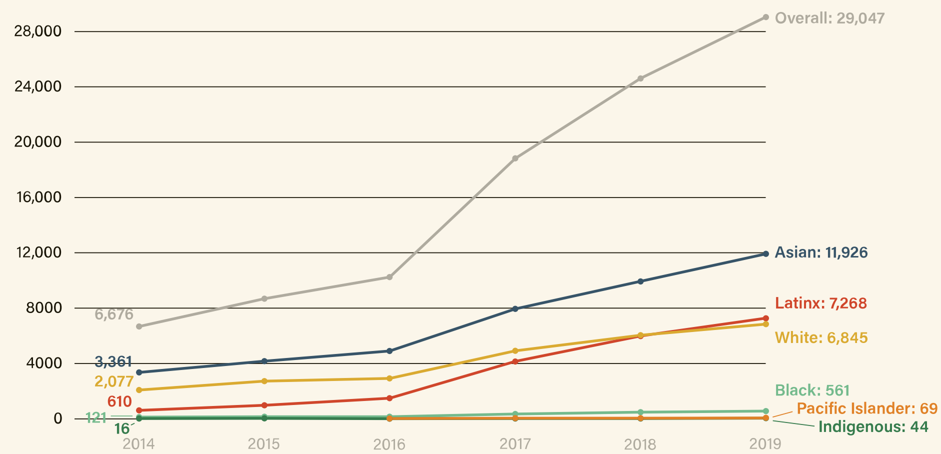
Figure 11. Enrollment Representation of Gender by Race/Ethnicity and CS Course Type: Core CS (left) vs. Specialized CS (right)



Enrollment in advanced placement computer science courses

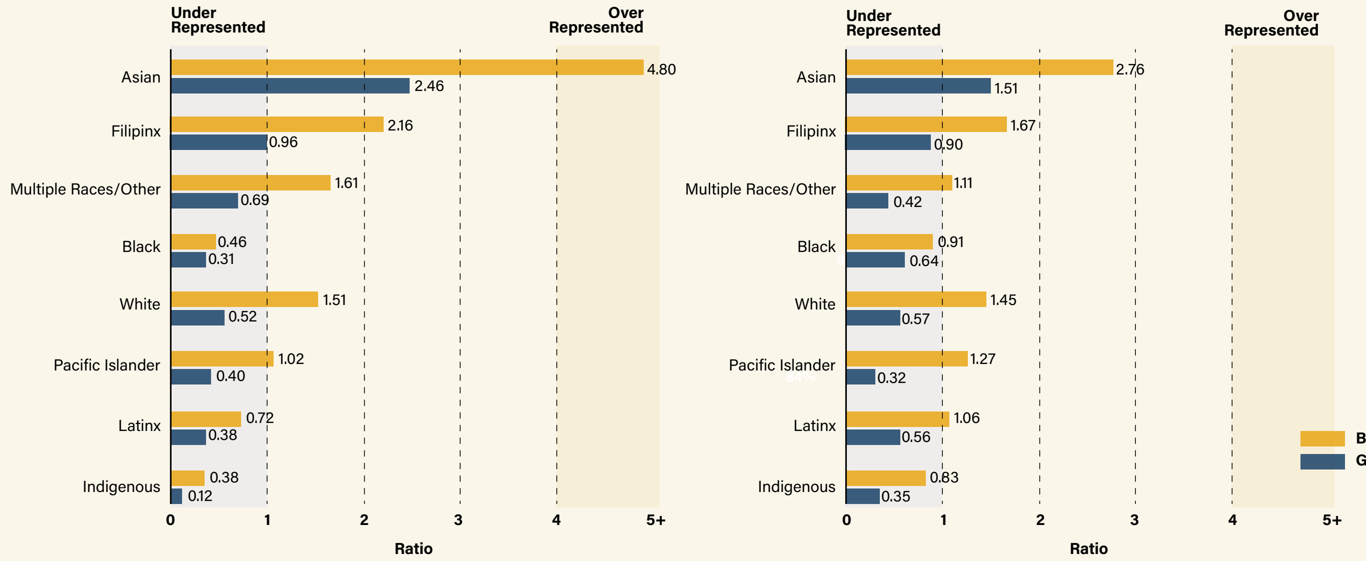
Across the state of California, nearly 30,000 high school students (2%) participated in an Advanced Placement CS course in 2018-19, nearly a fivefold increase since 2014 (Figure 12). Despite the overall growth in AP CS participation, and a significant increase in the number of Latinx and Asian students taking AP CS, Black, Indigenous, and Pacific Islander students have had continually low participation rates over the past six years.

Figure 12. AP CS (A+P) Participation by Race/Ethnicity, 2014-2019



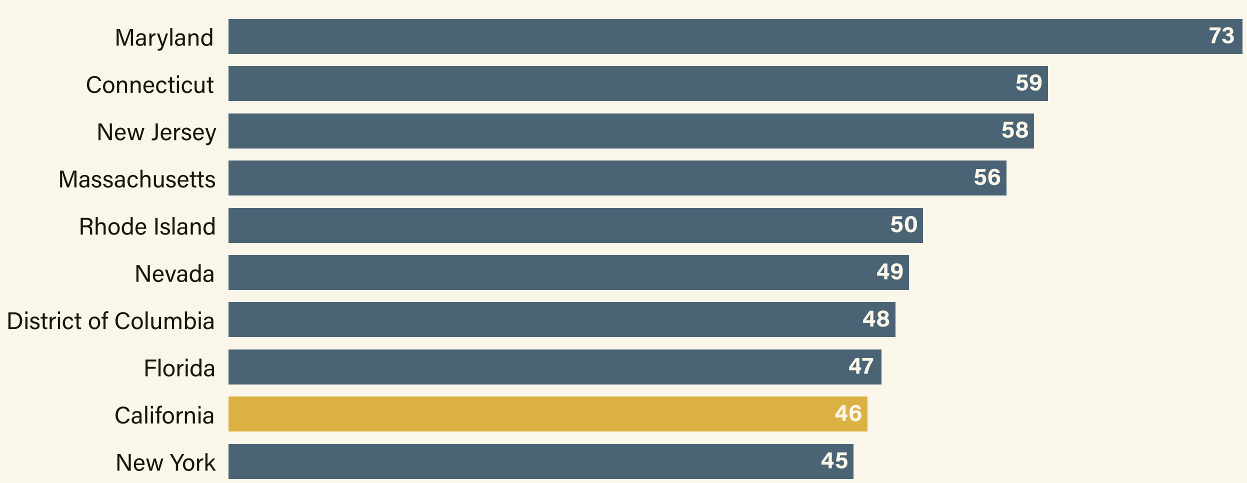
Despite overall growth, the state continues to struggle with underrepresentation in AP CS Principles and AP CS A among Black, Indigenous, Latinx, and Pacific Islander students and girls. In AP CS A, Black, Latinx, and Indigenous boys are underrepresented, as are girls from all racial/ethnic backgrounds (with the exception of Asian girls). In AP CS Principles, a course developed to intentionally broaden participation, there has been increased participation of Black, Indigenous, Latinx, and Pacific Islander students and girls taking this course since its inception in 2016. Yet, Black and Indigenous boys and girls from all racial/ethnic backgrounds remain underrepresented and additional efforts are needed to broaden participation. See Figure 13.

Figure 13. Enrollment Representation of Gender by Race/Ethnicity in AP CS A (left) vs. AP CS P (right)



California continues to be one of the leading states in the number of AP CS test takers per 10,000 students increasing from 39 AP CS test takers in 2018 to 46 AP CS test takers in 2019 (see Figure 14). Despite this growth, California dropped in ranking from 2018, going from sixth to ninth in the number of AP CS test takers. This decline in ranking was due to a significant growth in AP CS test takers in Rhode Island (increasing from 38 to 50 per 10,000 students), Nevada (increasing from 19 to 49 per 10,000 students), and Florida (increasing from 38 to 47 per 10,000 students).

Figure 14. Top 10 State Rankings in AP CS Test Takers Per 10,000 K-12 Students (2019)



Enrollment trends across CS course types indicate that in addition to addressing the lack of access to CS courses, educators and policymakers must also address the current challenges of equity in student recruitment, participation, and persistence.

Among those who enroll in computer science, are students successfully developing computational competencies?

Beyond participation and enrollment in CS courses, it is critical to understand the extent to which students are successfully developing computational competencies. The College Board's Advanced Placement CS exams are one standardized indicator of course performance. In 2019, the overall passage rates for the AP CS A and AP CS P exams were 73%, an increase from 71% in 2018.

Concerningly, these rates of increase are driven primarily by Asian and white students taking the courses. Data broken down by gender and race/ethnicity show that Black, Indigenous, and Latinx students are far less likely to pass the exams, particularly for those identifying as girls. In AP CS principles, over 80% of Asian and White students passed the exam, compared to roughly 50% of Black and Latinx students. Notably, Latinx girls were the least likely to pass the exams, with only 30% passing the AP CS A exam and 49% passing the AP CS P exam. See Figures 15 and 16.

Figure 15. AP CS A Passage Rates by Gender and Race/Ethnicity[7]

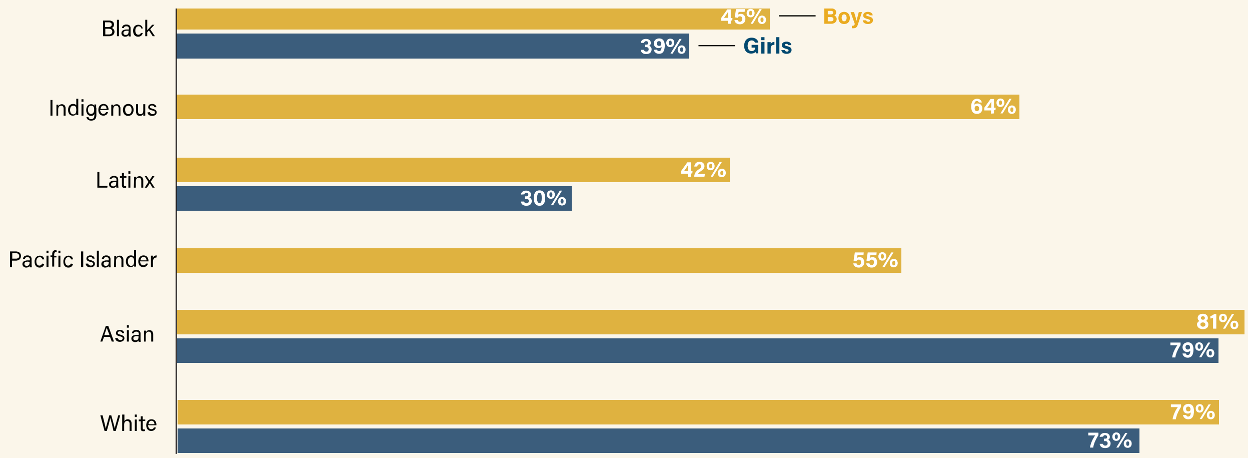
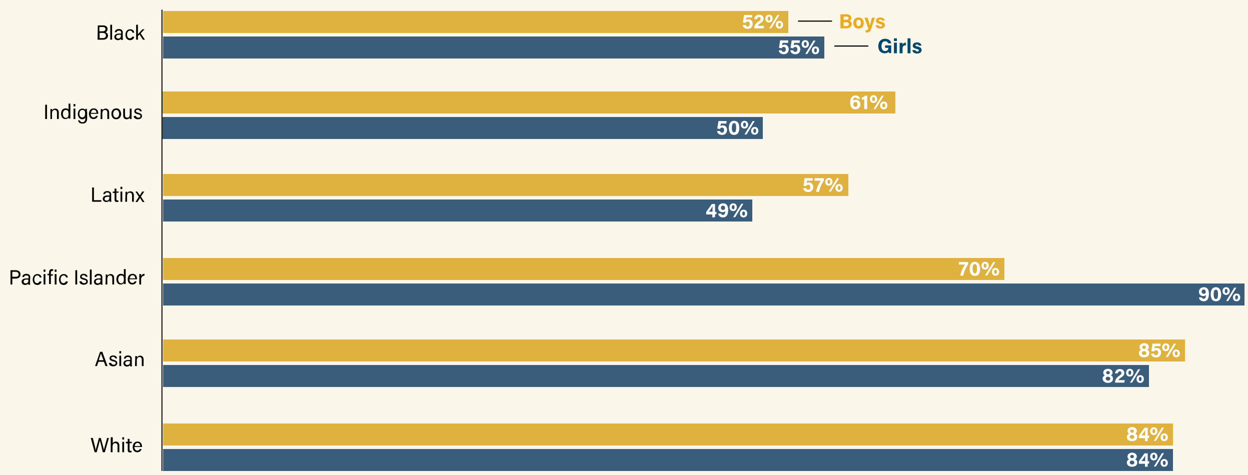


Figure 16. AP CS P Passage Rates by Gender and Race/Ethnicity



Enrollment disparities in CS suggest that policy considerations not only need to address issues of access to CS courses, but must also address the current challenges of equity in student recruitment, participation, persistence, and performance.

[7] Sufficient numbers (i.e., greater than 5) were not met for the College Board to report on the AP CS A exam scores of Indigenous and Pacific Islander girls.

What policies should California implement to increase equity in access, enrollment, and success?

In the past several years, California has made steady progress towards statewide policy change leading to implementation of CS education. The development of K-12 CS content standards (2016), the adoption of a strategic implementation plan (2019), making CS count towards University of California/California State University A-G requirements (2104, 2019) have all demonstrated the commitment of California's state leaders to CS education. In 2021, Governor Newsom continued support by allocating funding for teacher professional development and certification and a statewide CS education coordinator. While California has made progress towards broadening participation in CS, additional policy strategies mandating schools offer CS and investing in preservice education have been implemented in states like Nevada and Rhode Island, leading to rapid growth in student enrollment. See Appendix 2.

Given California's role as the largest state in the nation with the largest technology economy, California must implement comprehensive and strategic statewide policies to provide access to computing for all of California's students, close racial, gender, geographic, and socioeconomic gaps in computing participation, and prepare Californians for the future technology-driven economy.

California can demonstrate a bold commitment to preparing its students for the future through the adoption of the following set of policies:

1. Develop Incentive Structures to Recruit, Prepare, Retain, and Diversify the Pool of Computer Science Educators

To ensure all of California's students have equitable access to rigorous CS education, we must invest in the development of a robust pipeline of CS educators prepared to provide high-quality CS instruction. Incentive structures such as student loan forgiveness to fill, retain, and diversify CS positions in lower income, racially diverse, and rural areas can assist in increasing access to computing education. Furthermore, as greater demands and time constraints are placed on educators, incentives must include not just financial commitments from the district and state, but there must also be commitments to allocate time during the school day towards educators' desire to access ongoing teacher development, coaching, and professional learning communities.

2. Build Comprehensive Pre-Service and In-Service Teacher Education and Training Programs Aligned to an Equity-Focused Computing Education Framework

Despite the growing diversity of the U.S. K-12 student body, girls and Black, Indigenous, Latinx, and Pacific Islander students remain vastly underrepresented in computing education. In order to enable CS educators to engage and support systemically excluded students in the classroom, teacher training models must include an effective framework that strengthens their competencies in computing content knowledge as well as culturally-responsive student engagement strategies. Incentives for schools of education to build pre-service and in-service teacher preparation programs through an equity-lens will ensure CS teachers are equipped to build computing education experiences for all students.

3. Engage Strategic Partners to Better Align K-12 Learning Goals with California's Computer Science Strategic Plan to Ensure Student Preparedness for a Technology-Driven Future

As the tech industry continues to expand, policymakers, educators, industry professionals, and the community must share the responsibility to equip students for our future. By collectively identifying the needs of California's future workforce and communities, developing developmentally-appropriate learning goals that align to those needs, aligning goals with the state's CS strategic plan, and carving out clear pathways into industry for students who meet pathway standards, schools can cultivate more interest from students to enter computing fields while ensuring they are prepared to meet workforce needs. Furthermore, policies to incentivize industry professionals to partner with K-12 institutions to develop experiential learning opportunities will enable greater growth in building effective pipelines to computing careers.

4. Integrate Computational Competencies and Learning Goals Across Subject Areas and in High School Graduation Requirements to Engage All Learners

Schools must move beyond CS education being confined solely to classrooms dedicated to CS content. As technology continues to undergird all sectors and content areas, schools need to integrate computational competencies across disciplines and K-12 learning goals. Simultaneously, CS must be considered a core requirement for high school graduation and postsecondary entry to incentivize greater numbers of students to participate.

Conclusion

The rapid expansion of a technology-powered global economy requires California to continue making long-term, strategic efforts to remain competitive. While the most recent allocation of funding and resources towards computing education in the statewide budget indicates the state's commitment towards reformation efforts, the broader tech ecosystem's struggles with representation and the disparities in computing education highlighted in this report indicate that comprehensive solutions must address the structural problems leading to unequal access. And, policymakers play a pivotal role in ensuring California accelerates its efforts to equip all its students for the workforce of the future.

APPENDIX

Appendix 1: Definitions

AP Passage Rates: Passage rates in AP Computer Science are defined as the percentage of test-takers who scored a 3, 4, or 5 on the exam (Source: College Board, 2019).

Computing and Computer Science: Computing is a broad term defined by the Association for Computing Machinery as "any goal-oriented activity requiring, benefiting from, or creating computers… including five sub-disciplines of computer science, computer engineering, information systems, information technology and software engineering." Computer science is defined by the Association for Computing Machinery as the "study of computers and algorithmic processes, including their principles, their hardware and software designs, their implementation, and their impact on society." The terms computing and computer science are used interchangeably throughout this report.

Computer Science Course Categorizations: Computer science courses were categorized into three buckets in alignment with the California Computer Science Standards. These standards are based on CS core concepts and practices, aligned to the K-12 Computer Science Framework. The standards (built upon work done by the Computer Science Teachers Association) were developed by educators affiliated with the State Board of Education-appointed Computer Science Standards Advisory Committee.

Of the 60 high school standards associated with CS courses, 28 fall under the Algorithms and Programming concept. Thereby, if a CS course code had at least half of its instructional hours aligned with the 9-12 Algorithms and Programming concept, it was categorized as "Core" (with the exception of advanced placement courses). Course codes associated with this categorization included: Exploring Computer Science (2452), Computer Programming (2451), Computer Science (2453), International Baccalaureate (IB) Computer science (2465), Introduction to Systems Programming (8130), Intermediate Systems Programming (Concentrator; 8131), Advanced Systems Programming (Capstone; 8132); Introduction to Information and Communication Technologies (8100); Introduction to Web and Social Media Programming and Design (8133), Intermediate Web and Social Media Programming and Design (Concentrator; 8134), and Advanced Web and Social Media Programming and Design (Capstone; 8135).

If a CS course code was associated with a College Board-affiliated advanced placement course, it was categorized as "Advanced Placement." Course codes associated with this categorization included: AP Computer Science A (2470), AP CS AB (2471), and AP CS Principles (2472).

If a CS course fulfilled the standards of 9-12 specialty courses, which provides options for extending a CS pathway with content containing increased complexity and depth, it was categorized as "Specialized." Course codes associated with this categorization included: Introduction to Games and Simulation (8140), Introduction to Networking (8120), Introduction to Information Support Services (8110), Intermediate Games and Simulation (Concentrator; 8141), Advanced Games and Simulation (Capstone; 8142), Intermediate Networking (Concentrator; 8121), Advanced Networking (Capstone; 8122), Intermediate Information Support Services (Concentrator; 8111), and Advanced Information Support Services (Capstone; 8112).

Computer Science Enrollment Representation of Gender by Race/Ethnicity: Figures 11 and 13 represent the enrollment ratio of gender by race/ethnicity. The enrollment ratio is calculated using the number of students enrolled in each CS course representing each gender by race/ethnicity category divided by the number of total students enrolled in high schools representing each gender by race/ethnicity category. If this ratio falls below 1.0, the category is underrepresented in the CS course. If this ratio is 1.0, the category is represented equitably in the CS course. If this ratio falls above 1.0, the category is overrepresented in the CS course.

Low B/I/L/PI and High B/I/L/PI Schools: While the term "underrepresented minority" or "URM" has often been used to reference the collective low participation rate among Black, Latinx, and Indigenous people within STEM, this report has shifted to naming the specific groups explicitly to recognize their unique experiences, challenges, and needs within computer science education. With space restrictions in charts, the first letter of each racial/ethnic category was used to identify the racial/ethnic groups of reference. Adapting from the UCLA Civil Rights Project's work on racial segregation in schools, the categories used in this report include "Low B/I/L/PI" schools (0-50% of the school's student population is Black, Indigenous, Latinx, or Pacific Islander) and "High B/I/L/PI" schools (91-100% of the student population is Black, Indigenous, Latinx, or Pacific Islander). Categories were intentionally kept the same as the categories in an analysis of California's CS access and equity in 2016-17, in order to examine data over time. When comparing categories, "High B/I/L/PI"reflects the category with the greatest proportion (e.g., 91-100% B/I/L/PI), while "Low B/I/L/PI" reflects the category with the lowest proportion (1-50% B/I/L/PI).

Low-Income and High-Income Schools: The socioeconomic demographics of schools are determined by the percentage of the school's student population who qualify for Free/Reduced-Priced Lunch (FRPL; through federally-determined poverty guidelines) from the National School Lunch Program. "High-income" was defined as 0-25% FRPL and "low-income" was defined as 76-100% FRPL, consistent with the National Center for Education Statistics.

Percentage of B/I/L/PI and FRPL Schools Offering CS Courses: These analyses were calculated by dividing the number of high schools in each B/I/L/PI or FRPL category offering computer science courses (numerator), by the total number of high schools in each B/I/L/PI or FRPL category (denominator) to demonstrate the percentage of high schools in each category which offer computer science.

Percentage of B/I/L/PI students with Access to CS Courses: These analyses were calculated by summing the total number of Black, Indigenous, Latinx, and Pacific Islander high school students who attend a school that offers CS courses (numerator) by the total number of Black, Indigenous, Latinx, and Pacific Islander high school students attending high schools in California (denominator; defined above as any school serving grades 9th-12th).

State Ranking in AP CS Participation: AP participation rankings by state are calculated using the total number of students who took an AP CS A or AP CS P exam in 2019, divided by the number of K-12 students in the state. There are minor differences in the number of students taking the exam versus enrolling in the course, but the College Board only provides test-taking data publicly (Source: College Board, 2019).

Total Computer Science Course Enrollment: The total number of students (in grades 9th-12th) enrolled in CS courses is 97,699, including both Core CS, Specialized CS, and AP CS courses offered in 2018-19 and recorded in the CDE enrollment dataset. Enrollment is counted once in the Fall and enrollment totals are duplicated since one student can be enrolled in more than one CS course.

Total High School Enrollment: n=1,932,262. Includes all students in grades 9 through 12 across the 2.596 high schools included in the analysis. (Source: California Department of Education, Primary Enrollment, 2018-19).

Trends in Gaps to CS Courses by School FRPL and URM Demographics: Utilized the percentage of schools offering CS and AP CS courses by FRPL quartile recorded in the 2014-15, 2015-16, 2016-17, and 2018-19 CDE enrollment datasets. This comparison is intended to give a summary of where changes have occurred but cannot control for the changing demographics of schools since 2014 (e.g., the number of schools that fall into each category in 2014) (Sources: California Department of Education, CS enrollment (2014-15; 2015-16; 2016-17; 2018-19).

Urban/Rural Schools: Counties with less than 50% of the population living in rural areas are classified as urban; counties with greater than 50% living in rural areas are classified as rural (Census, 2010).

Appendix 2. K-12 Computer Science Policy Implementation Comparison between California, Florida, Nevada, and Rhode Island

	California	Florida	Nevada	Rhode Island
Create a K-12 CS state plan	X		X	X
Define CS and establishes standards	X	X	X	X
Allocate funding for teacher professional development and course support	X[8]	X	X	X
Implement certification pathways for CS teachers	X	X	X	X
Create programs at institutions of higher education to offer CS to preservice teachers			X	
Establish a dedicated CS supervisor in state and local education agencies	X[9]	X	X	X
Require all high schools to offer CS		X	X	X[10]
Allow CS to satisfy a core graduation credit	X	X	X	X
Allow CS to satisfy admission requirement at institutions of higher education	X		X	

ACKNOWLEDGEMENTS

The authors would like to express gratitude for all members of the CSforCA coalition who have been working collectively to improve access and equity in computer science in California. We are grateful for the expertise provided by a number of collaborators, including: Jared Amalong, Sam Berg, Liz Gauthier, Roxana Hadad, and Emily Oliva. We would also like to thank Nicole Vasgerdsian for the report design. Finally, we would like to acknowledge the National Science Foundation and Program Officer Fay Payton Cobb for providing support for this project under grant #1748316, and Mitch Kapor and Freada Kapor Klein for generous support of this project.

8 Funding for professional development was included in Governor Newsom's 2021 budget.

9 Funding to hire a CS supervisor was included in Governor Newsom's 2021 budget.

10 While Rhode Island high schools do not offer universal CS directly, CSforRI links CS providers with any schools interested in offering CS to their students free of cost.

KAPOR CENTER

CSforCA
COMPUTERSCIENCEFORCALIFORNIA