MOVING TOWARDS A VISION OF EQUITABLE COMPUTER SCIENCE:

Results of a Landscape Survey of PreK-12 CS Teachers in the United States

December 2022

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KAPOR CENTER CSTA AIICE ALLIANCE FOR IDENTITY INCLUSIVE COMPUTING EDUCATION

EXECUTIVE SUMMARY

Given technology's significant role in society, our educational systems must ensure that all students have access to a robust and rigorous computer science education to prepare them to participate in the global economy and to contribute to a more equitable tech-driven future. As such, computer science (CS) teachers are critical to the efforts to expand access and equity in CS education. In our first national study published in 2021, we examined the landscape of PreK-12 CS teachers in the United States. In this 2022 follow-up study, we sought a more detailed and nuanced understanding of teachers' experiences and perceptions of achieving equity in K-12 CS education.

Demographics

In contrast to the diversity of the U.S. PreK-12 student body, the majority of CS teachers identified as white (68%), women (56%), and non-disabled (91%), and were currently teaching predominantly in high income (50%) and less racially diverse (71%) schools.

Findings

Teacher Support

33% of CS teachers are the **only CS teachers at their schools.**

40% of teachers in lower income schools were the **sole CS teacher at their school** in comparison to 29% of teachers in higher income schools.

Teacher Agency to Drive Equitable Computer Science

81% of teachers felt that they had influenced the **growth of CS within their school/ district.**

74% of teachers felt confident in their ability to **promote CS equity in their schools.**

56% of teachers felt confident in their ability to **promote CS equity at the district-level.**

44% of teachers felt confident in their ability to **promote CS equity at the state-level.**

"Implement CS classes at the elementary level — we need students engaged early on, by the time they reach high school and college, they already feel they don't belong or can't succeed."

–CS TEACHER FROM VIRGINIA

Use of Identity-Inclusive Computing

71%
of CS teachers seek out PD opportunities to **develop their skills in building equitable and inclusive classrooms.**

Less than **50%**
of teachers cover **identity-inclusive course material.**

35%
of teachers lacked confidence in using **culturally-relevant pedagogy to support student learning.**

69%
of teachers felt that **issues related to oppression (e.g., racism, sexism, ableism, and other inequities) should be covered in CS classrooms.**

70%
of teachers with greater experience in CS were confident in using **culturally-relevant pedagogy to support student learning** in comparison to 59% of teachers with less experience in CS.

65%
of white CS teachers were confident using culturally-relevant pedagogy to support student learning, as compared to 75% of Black, Latine, Native, and Native Hawaiian/Pacific Islander teachers.

Teachers' Needs for Classroom Success

86%
of teachers believe CS should **be as important as math or English/Language Arts.**

85%
believe CS should **be a graduation requirement.**

Teachers saw a need to address the **lack of academic priority for CS as a way to promote equity at the school-, district-, and state-levels.**

Recommendations

1. ***Recruit, retain, and diversify the pool of CS teachers.*** There are not enough CS teachers to meet the needs across schools, particularly for those serving marginalized communities. Exacerbating the issue is the large number of teacher vacancies due to the pandemic and teachers planning to leave the profession. Moreover, CS teachers are predominantly white, despite the growing diversity of PreK-12 students. To fill CS teaching positions, diversify the CS teaching population, and retain CS teachers, building communities of practice and creating incentive structures towards salaries and PD will be essential.

2. ***Prioritize CS as a core subject with universal participation throughout PreK-12 education.*** Just over half of the nation's high schools offer CS courses, but only a small fraction of students participate. CS is less common in younger grades, and there are wide disparities in participation. Yet, the workforce of the future demands it be foundational for college and career readiness. All students must learn computer science. Moreover, if students are expected to develop mastery in computing content, CS instruction must start in elementary and extend through high school. CS should be treated like other core subjects, including similar funding, resource allocation, instructional time, and prioritization among graduation requirements.

3. ***Invest in ongoing training for CS teachers.*** Continuous learning is critical to effective teaching. As schools struggle with budget cuts and even greater competing demands on teachers' schedules, leaders must commit to prioritizing ongoing PD and coaching as a necessity. Expanding access to free or low-cost training will ensure teachers stay up-to-date on educational research and further develop their teaching practices, which is especially important given the proportion of CS teachers who are early in their careers.

4. ***Provide curriculum, resources, and training that are aligned with identity-inclusive topics and approaches.*** Culturally-relevant classroom resources improve the outcomes of students underrepresented in CS; and yet, data showed that teachers lacked the confidence in developing equitable CS classroom experiences. Teacher preparation and PD programs must not only focus on developing CS content knowledge and skills, but also equip teachers to utilize inclusive teaching practices. Using an effective framework for teacher training models that strengthen their competencies in identity-inclusive student engagement strategies will be integral to building equitable computer education experiences for all students.

5. ***Connect CS teachers to collaborative communities.*** Because many CS teachers are the only teachers of the subject at their respective schools, common collaboration structures such as departments often do not exist, creating a greater need for collaborative learning outside of the school in regional communities. These supports and learning structures are particularly crucial for early-career teachers, elementary school teachers, and those teaching in marginalized communities.

INTRODUCTION

There have been long-standing and significant investments in programs and initiatives to expand access to PreK-12 computer science (CS) education across the nation over the past decade. As a result, access to CS courses within PreK-12 schools has significantly increased, and more students are taking CS courses than ever before. However, significant gaps in access and equity remain. Currently, just 53% of U.S. high schools offer at least one CS course, and just 5.6% of all high school students are enrolled in a CS course. Students from marginalized identities (e.g., Black, Latine, Native, low income, LGBTQ+, disabled, girls, and non-binary) continue to be excluded from computer science education. Black, Latine, and Native students and students from low-income schools are less likely to have access to CS courses, and are underrepresented among foundational and Advanced Placement courses. Given technology's significant role in influencing broader society, from shaping the workforce of the future, to proliferating mis/disinformation and hate speech across social media, to expanding the use of flawed algorithms in decision-making across such areas as financial lending, criminal justice, and hiring, it is imperative to ensure all students have access to computer science education and move beyond *just* access to equip students to challenge the status quo. As such, trained, competent CS teachers — i.e., those who can successfully integrate discussions about the social impacts of technology with teaching technical skills — will be instrumental.

In the first national landscape study of CS teachers published in 2021, we examined the backgrounds of PreK-12 CS teachers in the United States. In this follow-up study, we sought a more nuanced understanding of teachers' perceptions of how to move towards a vision of equitable CS. This report draws on a national sample of PreK-12 CS teachers to examine their views of both their professional development (PD) needs and institutional changes required to transform CS classrooms to be identity-inclusive[1]. As such, we will explore teachers' perceptions of: 1) existing levels of support to carry out equitable CS, 2) their sense of agency in promoting equity in CS, 3) their current practices and confidence in integrating identity-inclusive practices, and 4) their recommendations for the CS education field to more effectively promote equitable CS.

A Vision of Equitable Computer Science

Equitable CS* classrooms include:

- Valuing student agency and voice
- Including community voice
- Equipping teachers and schools with resources and trainings to deliver quality instruction
- Supporting all students to disrupt racism, inequity, and other systemic barriers

To ensure that historically-marginalized students:

- Receive opportunity and access to quality CS education
- Experience success in CS classrooms
- Are affirmed and cared for in CS classrooms

1 Identity-inclusive computing is "how identity (i.e., race, ethnicity, gender, sexuality, ability, socioeconomic status, and their intersections) impacts and is impacted by computing." The Alliance for Identity Inclusive Computing Education (AIICE) is working to transform K-16 computing education through evidence-based interventions that create more equitable and inclusive learning environments. Strategies target people, policies, and practices that directly impact the entry, retention, and course/degree completion rates of high-school and undergraduate students from groups that are historically underrepresented in computing.

DEMOGRAPHICS OF RESPONDENTS

To examine the perspectives and experiences of CS teachers spanning various educational and professional backgrounds as well as school contexts, data were collected from 2,238 PreK-12 CS teachers from across all 50 states, in addition to Washington, D.C. and Puerto Rico.[2] The following sections describe their backgrounds and contexts.

School Profiles

The majority of respondents taught in public schools (82%), with 25% serving elementary grades, 35% serving middle school, and 58% serving high school (Figure 1).[3] In alignment with data revealing gaps of CS course access to schools serving lower income and racially diverse student bodies, survey respondents predominantly taught in higher income schools and schools with a lower proportion of Black, Latine, Native, and Native Hawaiian/Pacific Islander students (Figure 2). As COVID-19 restrictions have largely been lifted, the majority of teachers reported returning to in-person instruction (71%); however, almost a quarter still reported teaching in hybrid mode (22%; Figure 3).

Figure 1. Percent of CS teachers, by types of schools and grades

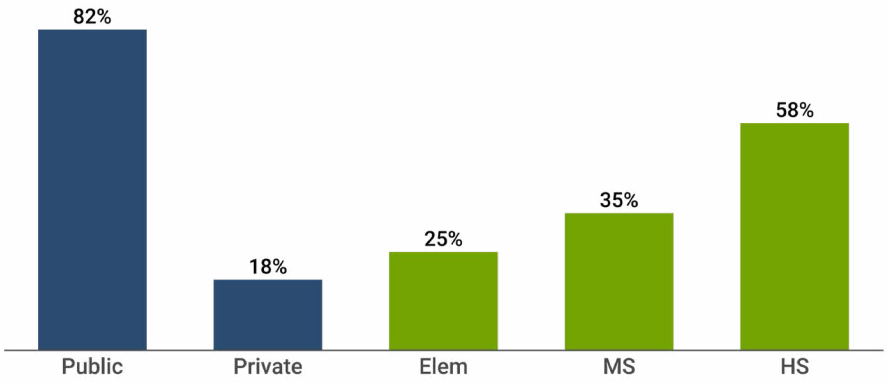
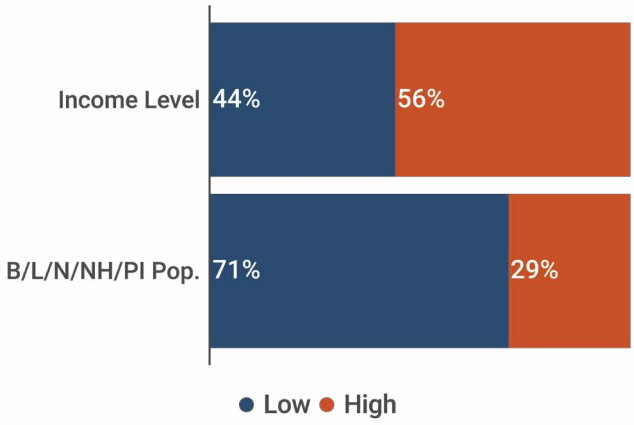


Figure 2. Percent of CS teachers, by school community profiles (income and B/L/N/NH/PI* student population)

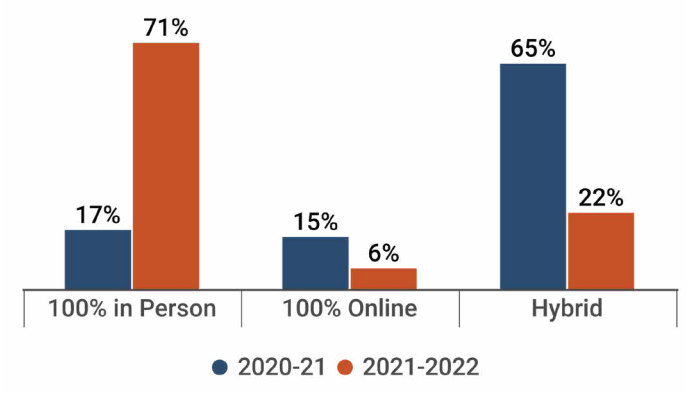


* Note: First letters of historically-excluded groups are used in charts to denote Black, Latine, Native, and Native Hawaiian and Pacific Islanders due to space constraints. Figure 3. School Modality, 2020-2022.

2 Respondent data can be explored in depth on the CS Teacher Report website: https://landscape.csteachers.org.
3 Does not sum to 100%, as multiple options were allowed.

DEMOGRAPHICS OF RESPONDENTS

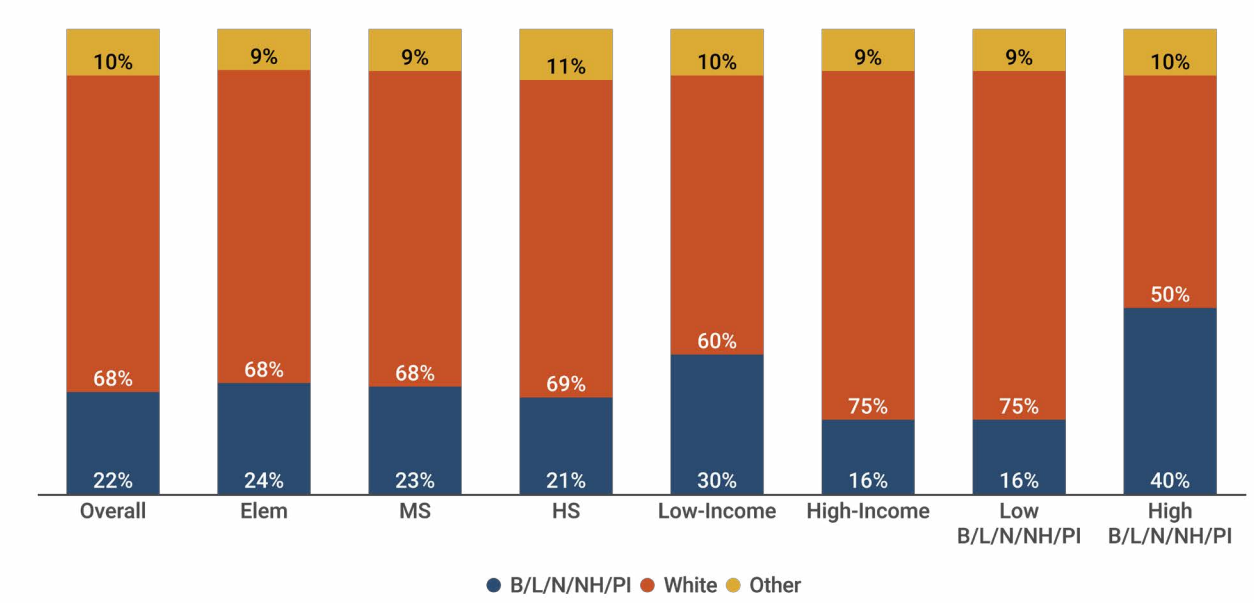
Figure 3. School Modality, 2020-2022



Teacher Profiles

Black, Latine, Native, and Native Hawaiian/Pacific Islander teachers were represented at higher rates at lower income and more racially-diverse schools. However, the racial demographics of CS teachers in this survey reflected a majority (68%) white workforce across varying school contexts (Figure 4). CS teachers do not reflect the demographics of the shifting racial landscape of the national student population.

Figure 4. Teacher race/ethnicity, by school contexts*



* Note: Sum may not be 100% due to rounding.

DEMOGRAPHICS OF RESPONDENTS

Nine percent of respondents reported having a disability or chronic condition (Figure 5). Fifty-four percent of respondents identified as women; women were overrepresented and men underrepresented among the CS teaching workforce in high schools, low income schools, and schools with greater proportions of low-income and Black, Latine, Native, and Native Hawaiian and Pacific Islander students (Figure 6).

Figure 5. Teacher disability status

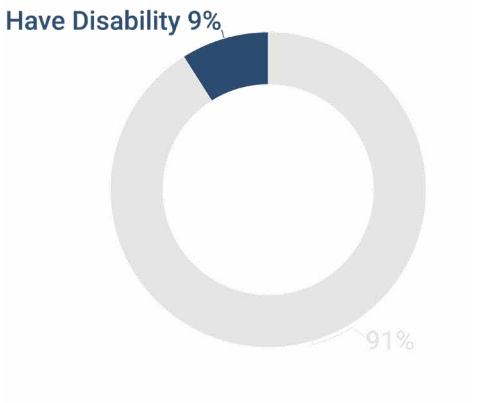
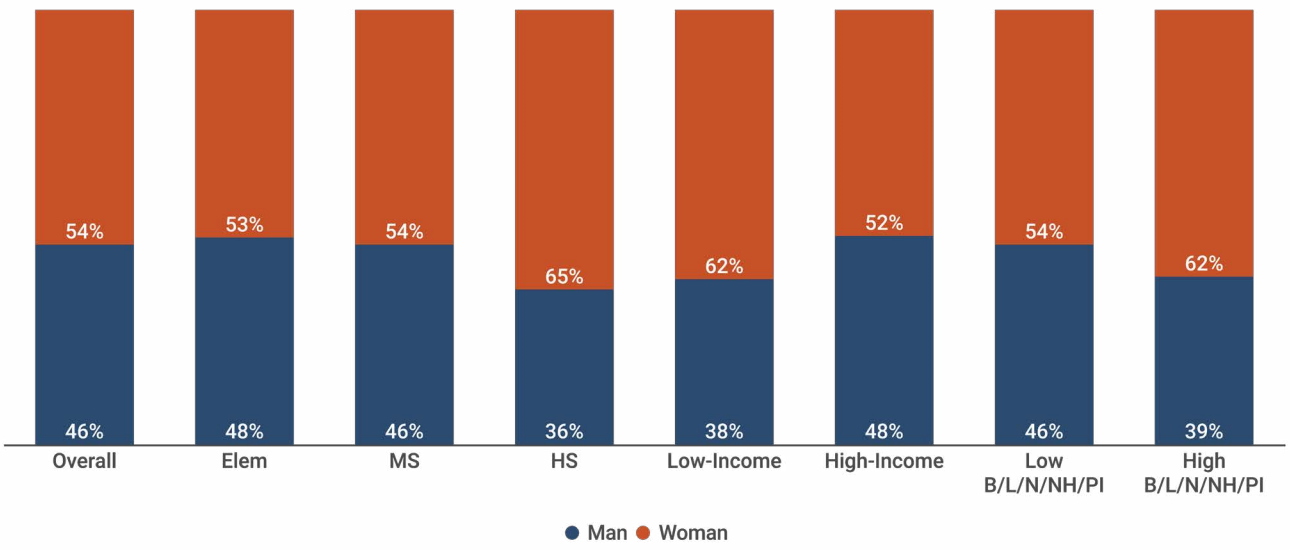


Figure 6. Teacher gender[4], by school contexts*



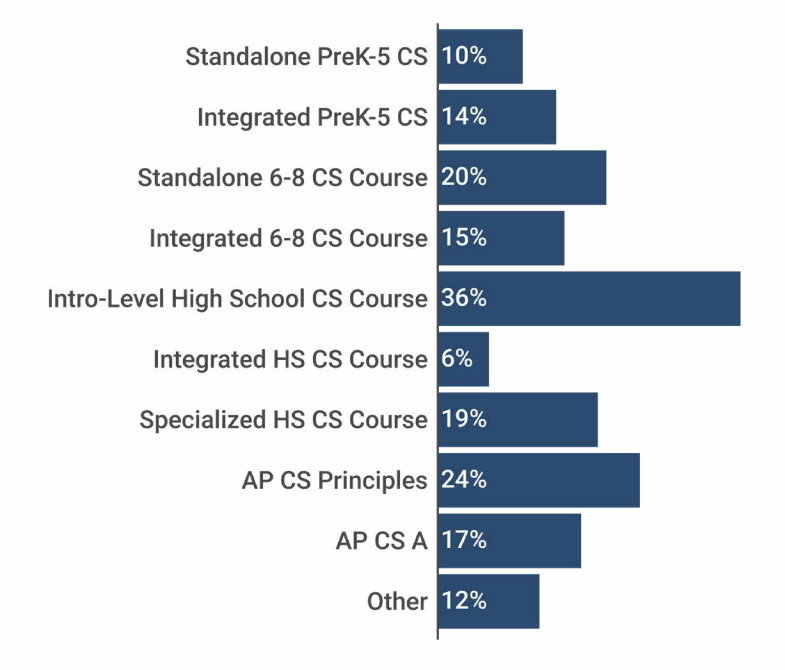
* Note: Sum may not be 100% due to rounding.

4 Less than 1% of respondents identified as non-binary.

DEMOGRAPHICS OF RESPONDENTS

Consistent with findings that elementary school students are traditionally introduced to CS in integrated settings, 51% of elementary school teachers identified teaching an integrated course (i.e., a course where CS is integrated with other subjects). Middle school teachers taught more standalone CS courses than integrated courses (54% vs. 40%, respectively). Of the high school teachers, 61% taught an introductory course, 32% taught a specialized course, 41% taught AP CS Principles, and 30% taught AP CS A; 55% of high school teachers taught a CS course designated as Career Technical Education (CTE). Figure 7 highlights the representation of course types taught by respondents. Almost half of respondents from elementary schools taught mandatory CS instruction, while 29% of respondents from middle schools and 33% of respondents from high schools taught mandatory instruction.

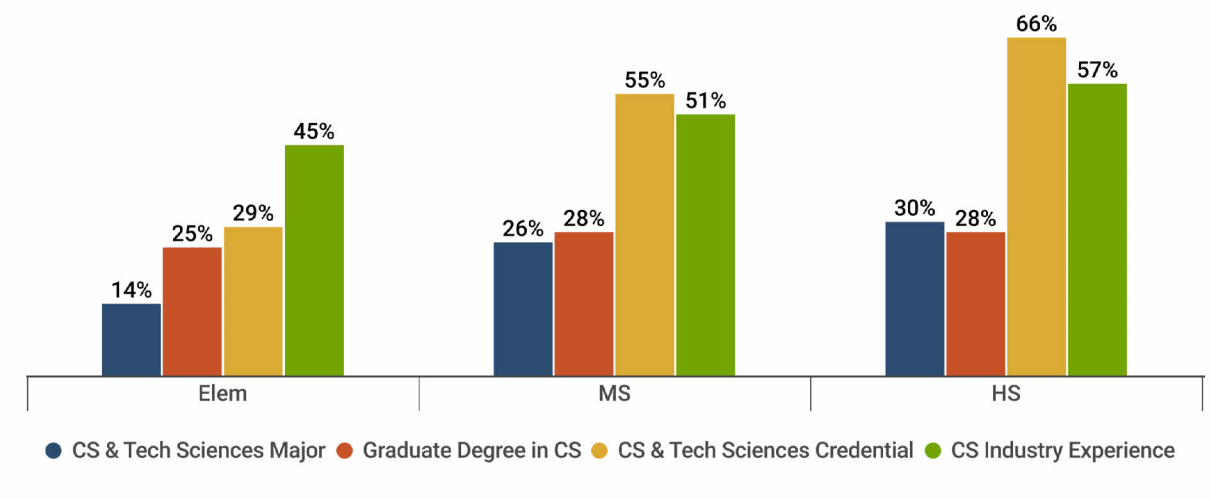
Figure 7. Courses taught by teachers



DEMOGRAPHICS OF RESPONDENTS

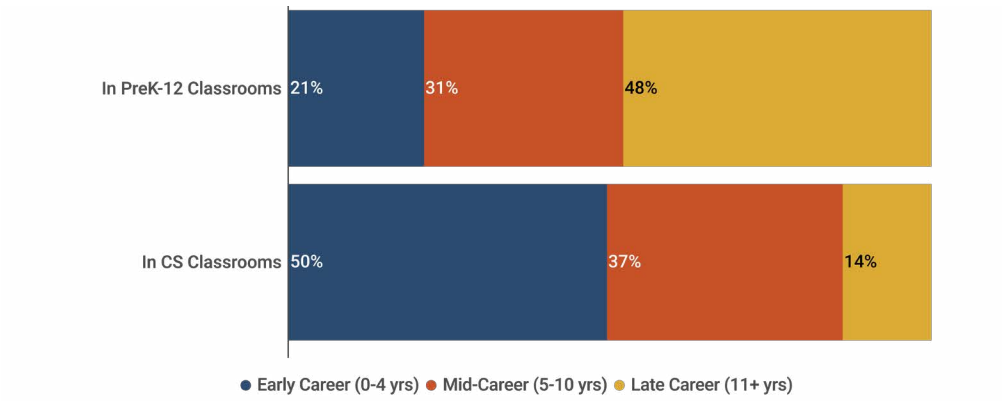
Approximately one-quarter (26%) of respondents declared an undergraduate major in CS or other technical sciences[5], a similar percentage had a graduate degree in CS (27%), and slightly more than half of respondents had a credential in CS or other technical sciences (55%). Only half of respondents had some industry experience (51%). Those teaching high school were 2.1 times more likely than elementary school teachers to declare a major or hold a credential in CS or technical sciences (Figure 8).

Figure 8. Teacher CS degrees, credentials, and industry experience, by grade level



Respondents identified having a larger proportion of their teaching and classroom experience happen in general PreK-12 classrooms rather than specifically within CS courses. Forty-eight percent of respondents were late career teachers (i.e., 11 or more years of classroom experience). Yet, only 28% of these late career teachers had an equivalent number of years in CS classrooms. In fact, half of all respondents were early career CS teachers (i.e., fewer than five years of experience in CS classrooms; Figure 9).

Figure 9. Teacher classroom experiences*



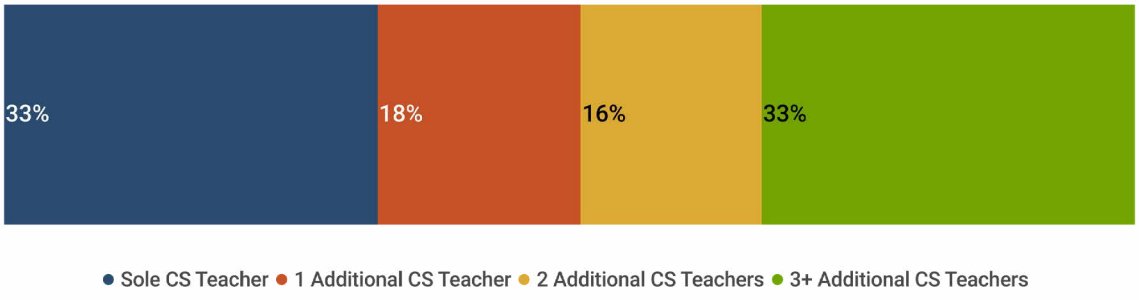
* Note: Sum may not be 100% due to rounding.

5 Computer and Technical Sciences degrees include: Computer Science, Information & Communications Technology; Information Technology, Engineering, Networking, Cybersecurity.

Teacher Support

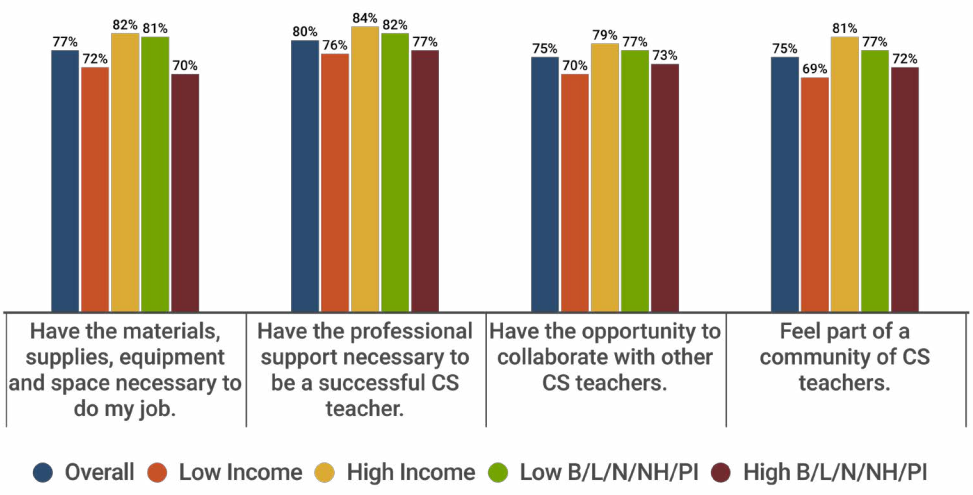
Strong work environments marked by collaboration among teachers, administration support for teachers, and time and resource allocation towards PD allow for stronger gains in teacher effectiveness. Teachers of most subjects have school-based colleagues with whom they can easily and frequently collaborate, but this is far less common in CS, where CS teachers are more isolated. Figure 10 highlights that one-third of respondents are the sole CS teachers within their schools, one-third have one to two additional teachers, and the final one-third have three or more additional teachers. Teachers in lower income schools were more likely than teachers in higher income schools to be the sole CS teacher (40% versus 29%, respectively), indicating fewer opportunities for CS teachers in lower income schools to collaborate within their schools to build subject matter expertise. These data highlight a greater need to improve the support CS teachers receive within their school contexts.

Figure 10. CS teacher community within schools



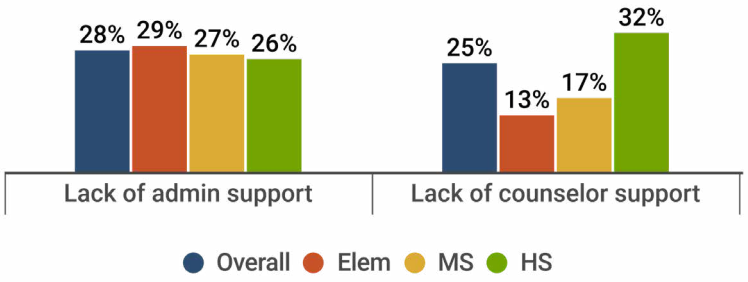
Teachers from higher income schools and those from schools with a lower proportion of Black, Latine, Native, and Native Hawaiian/Pacific Islander students were more likely to feel supported. Those teachers were more likely to report having the physical resources, professional support, and CS teacher peer support to do their jobs effectively. Figure 11 highlights the inequitable levels of support CS teachers receive in lower income and more racially diverse schools.

Figure 11. Level of support received by CS teachers



When staff across the district *collectively* prioritize educational initiatives for their students, there is a higher likelihood of sustaining efforts. In particular, it is necessary to garner the buy-in of administrators and counselors. Administrators have tremendous influence in shaping academic priorities and communicating with families, and counselors determine course placements and influence students' exploration of postsecondary college and career options. Unfortunately, administrator and counselor buy-in to equitable CS was not a universal experience for CS teachers, with 28% identifying a lack of administrator support as a major challenge to CS education and 25% identifying a lack of counselor support as a major challenge. While these numbers did not vary by schools serving higher or lower income communities or higher or lower proportions of Black, Latine, Native, or Native Hawaiian/Pacific Islander students, Figure 12 identifies the greater challenge posed by lack of counselor support for high school teachers as opposed to middle or elementary school teachers.

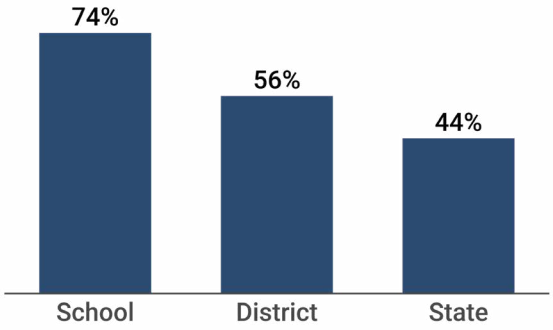
Figure 12. Major challenges to gaining support for CS education



Teacher Agency to Drive Equitable Computer Science

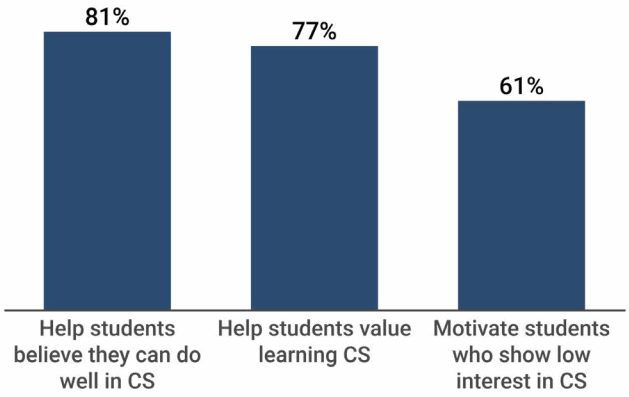
Teachers overwhelmingly (81%) felt that they had influenced the growth of CS within their school/district. However, it is insufficient to attend only to growth without attending to whether that growth has benefitted only certain subsets of students. As those who work closest with PreK-12 students, teachers play an essential role in advocating for and implementing equitable CS education. Yet, teachers reported a lack of confidence in playing this role beyond their schools. Seventy-four percent of respondents felt confident about promoting CS equity in their schools, but only 56% of teachers felt confident in their ability to promote CS equity at the district-level and even fewer (44%) felt confident in their ability to promote CS equity at the state-level (Figure 13).

Figure 13. Teachers' confidence in promoting equitable CS at the school-, district-, and state-levels



When asked about agency within their classrooms, over 90% of teachers felt that they had control over how they taught CS. Furthermore, data indicated teachers were confident in using this agency over their classroom to shift students' mindsets about CS. Many of the respondents felt that they can help students believe they can do well in CS (81%) and value learning CS (77%). However, fewer teachers (61%) felt that they could motivate their students who showed lower interest in CS. See Figure 14.

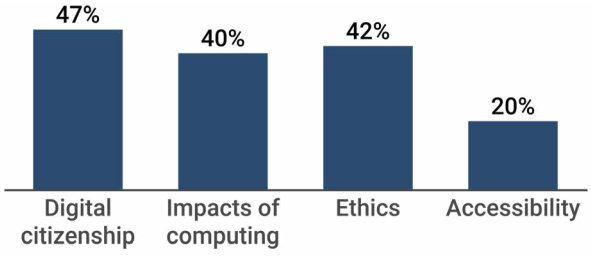
Figure 14. Teachers' sense of agency in shifting students' CS perceptions



Teachers' Use of Identity-Inclusive Pedagogy

While 71% of CS teachers are eager to seek out PD opportunities to develop their skills in building equitable and inclusive classrooms, they continue to identify challenges with creating inclusive learning environments. In the current CS classroom, less than half of teachers cover identity-inclusive course material. Only 47% of CS teachers cover digital citizenship, 42% cover ethics of computing, 40% cover the impacts of computing, and a mere 20% cover topics of accessibility[6] (Figure 15). Lack of universal access to identity-inclusive computing experiences coupled with teachers' own beliefs of what types of content belong in computing classrooms often deter students from pursuing and persisting in the field.

Figure 15. Teachers' current coverage of key identity-inclusive content in their classrooms



6 This finding at the PreK-12 level is similar to data about postsecondary coverage of accessibility content.

Prior research has shown that using equity-focused pedagogies in CS classrooms can positively influence student outcomes. Yet, CS teachers' responses showcase a greater need to support teachers in shifting their classroom practices. Not only do teachers identify a need to build their confidence in motivating students to engage in CS and a need to incorporate more identity-inclusive topics, but more than one-third (35%) of teachers lacked confidence in using culturally-relevant pedagogy to support student learning (Figure 16). Notably, only 64% of white CS teachers were confident using culturally-relevant pedagogy to support student learning in comparison to 75% of Black, Latine, Native, and Native Hawaiian/Pacific Islander teachers. Similarly, a greater number of teachers with more experience in CS (70%) were confident in using culturally-relevant pedagogy to support student learning than those with less experience in CS (59%). Moreover, only 69% of teachers felt that issues related to oppression (e.g., racism, sexism, ableism, and other inequities) should be covered in CS classrooms (Figure 17).

Figure 16. Teacher confidence in identity-inclusive pedagogy

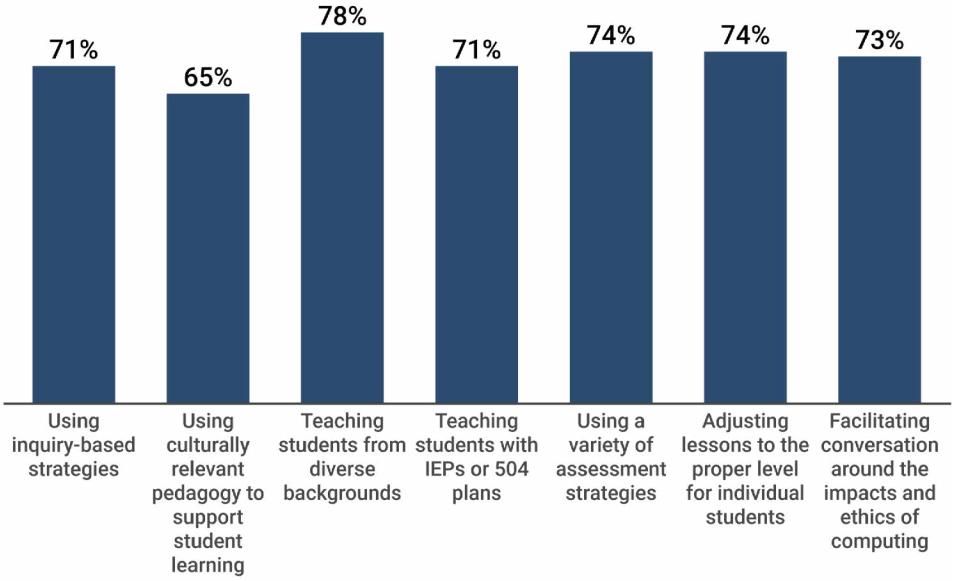
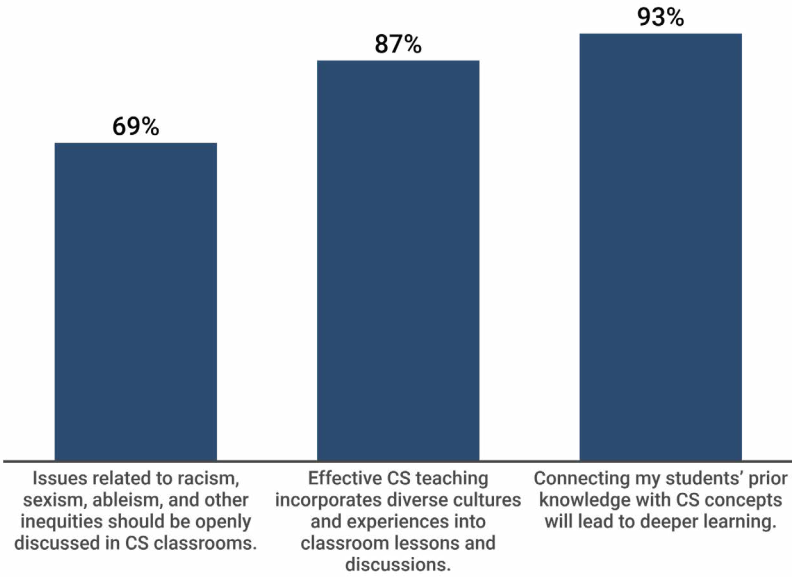


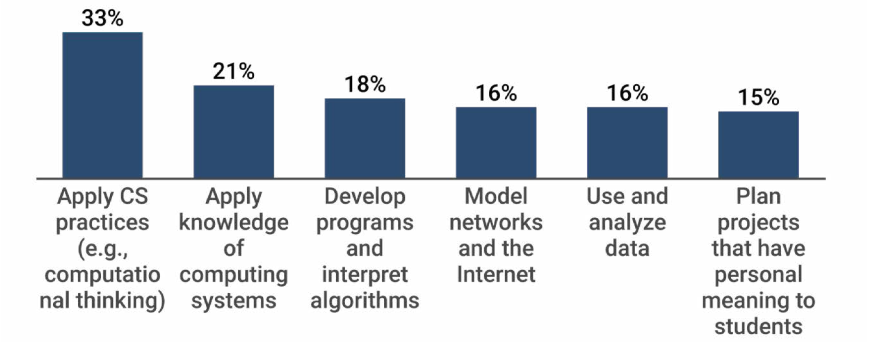
Figure 17. Teacher perceptions of effective identity-inclusive pedagogy



Teachers' Needs for Classroom Success

CS teachers will require a multitude of supports to ensure classroom success. For teachers, learning opportunities for CS content was a leading need for PD, particularly as it relates to the application of knowledge. Figure 18 highlights the top PD needs identified by teachers.

Figure 18. Teacher-identified professional development needs



"[I need] more access to professional development — our school district has a very limited budget, and I am only able to participate in funded conferences and events."

–CS TEACHER FROM MICHIGAN

FINDINGS

Currently, 86% of teachers believe CS should be as important as math or English/Language Arts and 85% believe CS should be a graduation requirement (Figure 20), but identified the lack of academic priority as a major challenge to instruction (Figure 19). In addition, addressing the lack of academic priority posed to CS was a top recommendation that teachers identified when asked what policies needed to be in place to promote equity at the school-, district-, and state-levels. Teachers identified a need for CS to be an academic requirement, as it then allows for expanding resource allocation towards the subject matter. Specifically, teachers identified that a CS mandate could open up funding for PD opportunities, classroom resources, and appropriate pay.

Figure 19. Top challenges identified by teachers in teaching CS

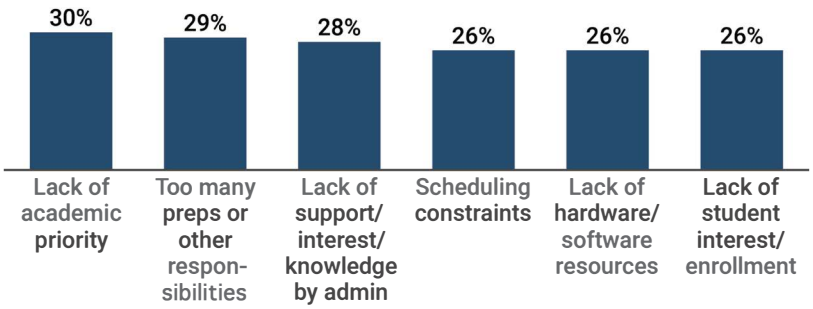
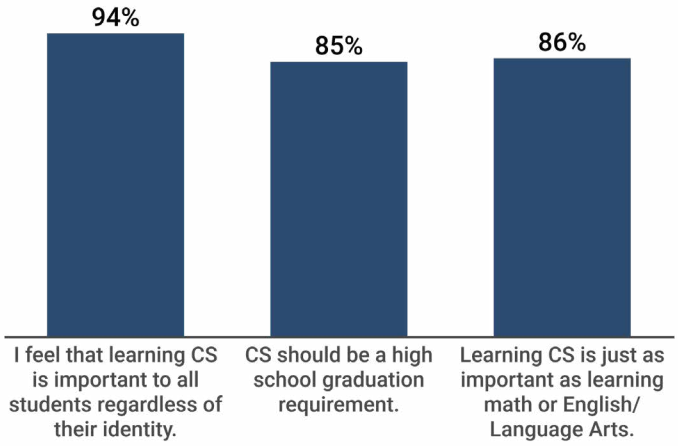


Figure 20. Teacher perceptions of the importance of CS in PreK-12 education



RECOMMENDATIONS

This report surfaces the need to prioritize several key actions by teachers, administrators, and policymakers to ensure a prepared CS teacher workforce. To succeed, teachers need access to CS teacher peer support, physical resources, and the professional support and development necessary to do their jobs effectively. Drawing upon these data, this report concludes with the following set of recommendations to support teachers and, ultimately, to advance a vision for equitable CS.

Recommendation #1: Recruit, retain, and diversify the pool of CS teachers.

> "[We need] salary commensurate with responsibilities, professional development for subject specific knowledge/training, and hiring more qualified teachers. There is such a shortage of good CS teachers."
>
> –CS TEACHER FROM GEORGIA

> "There are not enough teachers in the field reflective of this population. Reflection of self is critical for students to listen, pay attention, and relate to the subject matter. People believe in others that look like them as a means to achieve and excel in life in all areas."
>
> –CS TEACHER FROM INDIANA

There are not enough CS teachers to meet the needs across schools, particularly for those serving marginalized communities. Exacerbating the issue is the large number of teacher vacancies due to the pandemic and teachers planning to leave the profession. Moreover, CS teachers are predominantly white, despite the growing diversity of PreK-12 students. To fill CS teaching positions, diversify the CS teaching population, and retain CS teachers, building communities of practice and creating incentive structures towards salaries and PD will be essential.

Take action:

Teachers:

- Join affinity groups to collaborate with, build community for, and support teachers of shared identity.
- Invite teachers to learn how to begin teaching CS by participating in PD.

Administrators:

- Provide stipends for hard-to-staff positions.
- Compensate teachers for their participation in ongoing PD.

Policymakers:

- Develop incentive structures to recruit, retain, and diversify the pool of CS teachers, such as loan forgiveness and stipends for hard-to-staff positions.
- Develop programs to train and pay for in-service teachers to gain certifications or endorsements to teach CS.
- Build pathways to specifically attract and prepare more Black, Latine, Native, and Native Hawaiian/Pacific Islander teachers.
- Invest in comprehensive pre-service CS teacher education programs. See examples and guidance for creating programs at schools of education.

Curriculum / PD Providers:

- Offer opportunities to earn graduate credit for PD completion, to support teachers in increasing their step on salary schedules.

Recommendation #2: Prioritize CS as a core subject with universal participation throughout PreK-12 education.

"[We need to make] CS a graduation requirement. Right now the students have so many "core" classes and only have a limited amount of "electives" they can take. They do not have much CS experience coming into high school so many of them lack the knowledge or exposure to CS, which makes it challenging for them to really want to take CS compared to other subjects they already enjoy."

—CS TEACHER FROM CALIFORNIA

"Implement CS classes at the elementary level — we need students engaged early on, by the time they reach high school and college, they already feel they don't belong or can't succeed."

—CS TEACHER FROM VIRGINIA

RECOMMENDATIONS

Just over half of the nation's high schools offer CS courses, but only a small fraction of students participate. CS is less common in younger grades, and there are wide disparities in participation. Yet, the workforce of the future demands it be foundational for college and career readiness. All students must learn CS. Moreover, if students are expected to develop mastery in computing content, CS instruction must start in elementary, extend through high school, and receive the funding and resource allocation appropriate for core subjects.

Take action:

***Teachers**:*

- Examine trends in the access to and participation in CS at your school/district, and advocate to disrupt inequities and increase diversity in elective CS classes.
- Invite your administrators to learn more about CS and join PD.
- Develop community support by sharing information about CS and its importance with students' families.

***Administrators**:*

- Learn about effective and equitable CS instruction.
- Examine trends in the access to and participation in CS at your school/district, and make plans to disrupt inequities (e.g., improving English learners' access to CS).
- Support teachers and counselors with effective and equitable recruitment into elective courses. Share targeted resources for counselors.
- Connect with other administrators across the school district to build a coherent pathway across grades PreK-12.

Policymakers:

- Create requirements to ensure universal participation in CS beginning in elementary grades and continuing through high school (e.g., required course or integrated experience per grade band, high school graduation requirement).
- Create accessibility requirements in the procurement of software, digital tools, and curricula, to ensure that students with disabilities can access the content. See an example law from Maryland.
- Provide funding to districts and schools to support CS implementation.
- Collect and publicly report disaggregated data on student participation in CS instruction at all school levels.

Curriculum / PD Providers:

- Create PD programs for administrators, counselors, paraeducators, and other school-based personnel to learn more about PreK-12 CS instruction and how to support it.

Recommendation #3: Invest in ongoing training for CS teachers.

"Don't think you can scrimp on personnel and their training and ongoing support as this is 10X more important than any hardware or software you buy."

—CS TEACHER FROM SOUTH CAROLINA

"[I need] more professional development. Computer science is constantly changing and improving but I haven't been trained again after my initial training. I would also like to learn more to teach my students more and be able to change up the curriculum a bit from year to year."

—CS TEACHER FROM MISSOURI

Continuous learning is critical to effective teaching. As schools struggle with budget cuts and even greater competing demands on teachers' schedules, leaders must commit to prioritizing ongoing PD as a necessity. Expanding access to free or low-cost training will ensure teachers stay updated on educational research and further develop their teaching practices, which is especially important given the proportion of CS teachers who are early in their careers.

Take action:

Teachers:

- Reflect on areas of growth aligned to CSTA Standards for CS Teachers. Then, find and participate in PD aligned to these priorities. For example, find quality PD programs, complete online PD courses, attend the CSTA Annual Conference, and join virtual summits or webinars.

Administrators:

- Allocate funding to PD for your CS teachers, and compensate them for participation (e.g., allow them to participate during contract hours or pay extended hours).
- Provide structures for ongoing, job-embedded teacher development like coaching.

Policymakers:

- Allocate funding to both initial **and ongoing** PD that is aligned to the CSTA Standards for CS Teachers. See models for funding professional learning.

Curriculum / PD Providers:

- Develop more ongoing PD programs, focused on a variety of topics and skills that teachers want to develop and aligned to the CSTA Standards for CS Teachers.
- Ensure programs are accessible to teachers with disabilities.

Recommendation #4: Provide curriculum, resources, and training that are aligned with identity-inclusive topics and approaches.

> "[We need] materials that support more diverse learning needs and cultural interests that map with diversity of student voice."
>
> —CS TEACHER FROM WASHINGTON

> "I need more ways to teach students with visual impairments. I also need more ways to teach students with learning disabilities."
>
> —CS TEACHER FROM MASSACHUSETTS

Despite the success of engaging underrepresented students in CS with more culturally-relevant material, data showed that teachers lacked the confidence in developing equitable CS classroom experiences. Teacher preparation and professional development programs must not only focus on developing knowledge and skills in CS content, but also equip them to use inclusive teaching practices. Using an effective framework for teacher training models that strengthen their competencies in identity-inclusive student engagement strategies will be integral to building equitable computer education experiences for all students.

Take action:

Teachers:

- Evaluate your CS curricula for cultural responsiveness, accessibility, and inclusion of identity-inclusive content (e.g., ethics, impacts of computing); and work to fill in gaps.
- Learn more about culturally responsive-sustaining CS education, and participate in PD to develop your knowledge of equity and inclusive teaching practices. For example, join this Identity Inclusion for K-12 CS Educators online PD course and AiiCE events.

Administrators:

- Evaluate and select curricula that are cultural responsive, accessible, and include identity-inclusive content (e.g., ethics, impacts of computing, accessibility).
- Allocate funding for training, curriculum, resources to implement identity-inclusive topics and approaches.

Policymakers:

- Adopt standards or endorse coursework that includes identity-inclusive topics (e.g., ethics, impacts of computing, accessibility).
- Include identity-inclusive computing content and practices in certification and endorsement programs.

Curriculum / PD Providers:

- Develop curriculum, resources, and training that support culturally responsive-sustaining CS education.
- Reflect on how your PD programs align with tenets of identity-inclusive computing.
- Ensure your curriculum and related software are accessible to teachers and students with disabilities.

Recommendation #5: Connect CS teachers to collaborative communities.

"Teachers need networks of teachers at their grade levels to share ideas and engage in relevant discussions. In elementary, most of the teachers teach CS in isolation or integrate it in the curriculum."

—CS TEACHER FROM CALIFORNIA

"I am the only person in my district that teaches computer science, so building a strong professional learning network would be beneficial. Having this group that you would feel comfortable asking questions and building knowledge with would be vital."

—CS TEACHER FROM NEBRASKA

Because many CS teachers are the only teachers of the subject at their respective schools, common collaboration structures such as departments often do not exist, creating a greater need for collaborative learning outside of the school in regional communities. These supports and learning structures are particularly crucial for early-career teachers, elementary school teachers, and those teaching in marginalized communities.

Take action:

Teachers:

- Become a member of CSTA, the world's largest CS department.
- Join one or more communities to learn from and alongside other CS teachers. For example, join your local CSTA Chapter and virtual communities and affinity groups.

Administrators:

- Create structures to support collaboration among CS teachers (e.g., professional learning communities). If CS teachers are isolated at their school sites, connect CS teachers across schools or allow them to participate in external communities (e.g., CSTA Chapters).

Curriculum / PD Providers:

- Join CSTA's PD Provider Summits for training, support, and community building.
- Join the Alliance for Identity Inclusive Computing Education.
- Encourage teachers to join CSTA and other communities of practice.

CONCLUSION

Despite continued efforts to promote PreK-12 CS education, we are far from our vision of equitable computer science. Disparities persist in who has access to and participates in CS instruction, predictably by aspects of student identities including race, gender, sexuality, ability, and socioeconomic status. The CS teaching workforce is not reflective of the student diversity, and many CS teachers lack the confidence and knowledge to build equitable classroom environments that allow all students to feel welcome, supported, and validated. Most do not teach critical computing content to understand how identity impacts and is impacted by computing. CS teachers are overworked, under-resourced, underappreciated, and face innumerable challenges, yet they are committed to their students' success.

We must transform our collective approach to counter these problems at a systems level and move towards a vision of providing equitable and inclusive CS learning environments for all students. This requires investment from teachers, administrators, policymakers, curricula and PD providers, families, communities, and industry partners. This report highlights the need to prioritize CS in schools in order to ensure strategic investments can be used to expand, diversify, and retain a qualified pool of CS teachers; provide curriculum, resources, and *ongoing* PD that are aligned with identity-inclusive topics and approaches; and develop communities of practice amongst CS teachers. We must collectively commit to expanding and better equipping the current CS teacher workforce before we can realize a technology ecosystem that is more just and reflective of society.

> "Students are required to take core classes, foreign languages and are encouraged to take AP classes in order to be prepared for and desirable to colleges; they should also be expected to take at least one year of computer science to develop 21st century skills. Teachers are required to promote these skills but if students (and teachers) are not properly trained to use them, students fall behind."
>
> —CS TEACHER FROM NORTH CAROLINA

APPENDIX

Appendix 1: Definitions

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.

Low B/L/N/NH/PI and High B/L/N/NH/PI Schools: While the term "underrepresented minority" or "URM" has often been used to reference the collective low participation rate among Black, Latinx, and Native people within STEM, this report has shifted to naming the totality of groups as "historically-marginalized groups" or "historically-excluded groups" to shift the lens to the systemic and historical exclusion these groups have faced, or to identify 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 reference groups. Schools with less than 50% and more than 50% proportion of Black, Latinx, Indigenous, and/or Native Hawaiian/Pacific Islander students were categorized under "low" and "high," respectively. These racial/ethnic groups are underrepresented in computing education, degree completion, and the tech workforce, relative to their percentage of the U.S. population.

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 0-50% FRPL and "low-income" was defined as 51-100% FRPL.

Appendix 2: Survey Methodology

An online survey was distributed May through July 2022. The Computer Science Teachers Association recruited PreK-12 computer science teachers nationwide through multiple channels including member & partner emails, blog posts, targeted social media, and newsletters. Teachers from all 50 states participated, with the first 3,000 participants given a $10 gift card as incentive.

The 84-item teacher survey contained seven sections: Teacher Demographics; School Demographics; Satisfaction with Computer Science Teaching; Instructional Practice; Cultural Competence; Satisfaction with Curriculum; Perceptions of Incorporating Culturally Relevant Pedagogy; and Professional Development.

Quantitative reporting was based on frequency analyses. Analyses on 4-point scaled items were based on the percentage of teachers who reported a 3 or 4. Qualitative analyses were conducted using MAXQDA software, by coding and sorting open-ended responses into numerical categories to produce frequency reports based on themes.

ABOUT US

The Alliance for Identity-Inclusive Computing Education (AiiCE) is a national cross-sector partnership that aims to disrupt the norms that currently exist in high-school and postsecondary computing education and to create equitable and inclusive environments for students and educators from groups that are historically underrepresented in computing based on identity (e.g., race, ethnicity, gender, sexuality, age, ability, and class).

The Computer Science Teachers Association (CSTA) is a membership organization that supports and promotes the effective and equitable teaching of computer science. Its mission is to empower, engage, and advocate for K-12 computer science teachers worldwide.

The Kapor Center aims to enhance diversity and inclusion in the technology and entrepreneurship ecosystem through increasing access to CS and STEM education, advancing diversity and inclusion in tech companies, and investing in community organizations, diverse entrepreneurs, and gap-closing social ventures.

Suggested Citation

Koshy, S., Twarek, B., Bashir, D., Glass, S., Goins, R., Cruz Novohatski, L., & Scott, A. (2022). Moving towards a vision of equitable computer science: Results of a landscape survey of PreK-12 CS teachers in the United States. Retrieved from: https://landscape.csteachers.org.

Acknowledgements

The authors would like to thank the other members of the AiiCE Research Constellation for their assistance in survey content development, including Dr. Valerie Barr, Dr. Brianna Blaser, Dr. Shaundra Daily, Lien Diaz, Dr. Joanna Goode, and Dr. A. Nicki Washington. Our deepest gratitude goes to the CSTA Policy Committee for their instrumental work on policy recommendations: Todd Beard, Cindi Chang, Daryl Detrick, Chris Dovi, Rudy Escobar, Alexandra Holter, Audra Kaplan, David Lockett, Kerri Murphy, Carla Neely, Sonal Patel, Henry Ramirez, Dominick Sanders, Lawrence Tanimoto, and Amber Williamson. The authors would like to express gratitude for the expertise provided by the following colleagues and collaborators: Jake Baskin, Jason Bohrer, Dr. Joshua Childs, Vanessa Jones, Gaby de Jongh, Dr. Tom McKlin, and Dr. Lijun Ni. We would also like to thank Stacy Jeziorowski, Paul Lim, and Minerva Matos-Garner for communications and marketing support and Candase Chambers, Alicia Nuñez, and Nicole Vasgerdsian for report design. Lastly, we would like to thank Rae Ward for her efforts on the report landing page.

This material is based upon work supported by the National Science Foundation under Grant No. 2118453. Any opinions, findings, and conclusions or recommendations expressed in this material are those of the authors and do not necessarily reflect the views of the National Science Foundation.

To learn more about taking action and explore the data, visit https://landscape.csteachers.org.

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