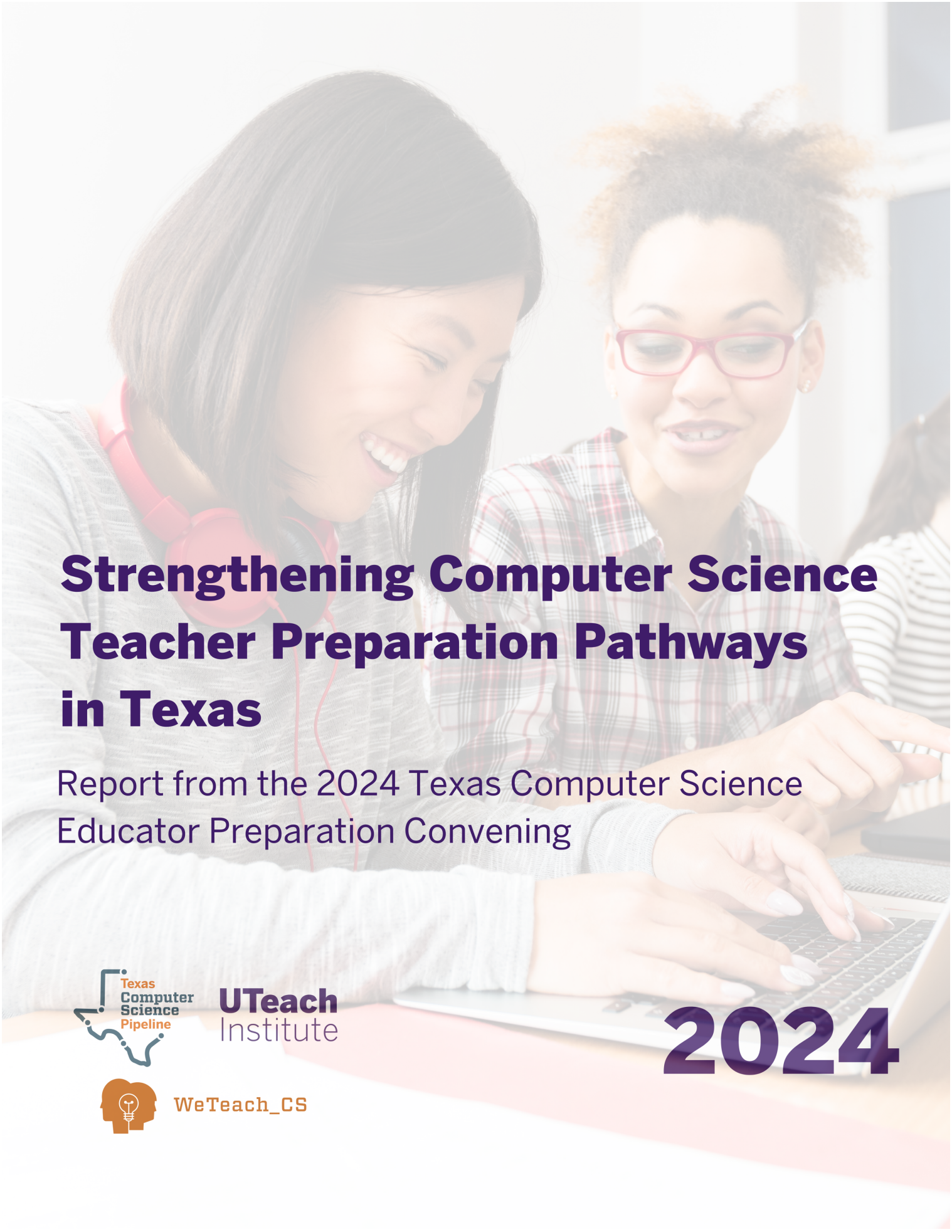

Strengthening Computer Science Teacher Preparation Pathways in Texas

Report from the 2024 Texas Computer Science Educator Preparation Convening

Texas Computer Science Pipeline

UTeach Institute

WeTeach_CS

2024

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Executive Summary

Computer science (CS) education is essential for preparing students for an increasingly technical workforce. Nationally, there is a growing consensus for the need to integrate CS and computational thinking into K–12 education. To ensure that Texas remains competitive, it must expand access to high-quality CS education for more students. Currently, there is an alarming shortage of qualified CS teachers to support expanded access to CS coursework for K–12 students.

The Texas Computer Science Pipeline Initiative aims to improve access, participation, and experiences in K–12 CS education through professional development, infrastructure support, and accountability measures.

In Fall 2024, a convening was held at the Texas Advanced Computing Center (TACC) to address the challenges and opportunities in preservice computer science teacher preparation. The event brought together stakeholders from 18 Texas institutions of higher education, including education and computer science faculty and educator preparation program administrators, along with representatives from the Texas Higher Education Coordinating Board (THECB) and the Texas Education Agency (TEA).

Fall 2024 stakeholders convening.

Stakeholders identified the following challenges to strengthening the preservice computer science teacher pipeline and proposed solutions to these challenges.

Challenges Identified

- **Recruitment, Funding, and Incentives:** Difficulty in attracting CS majors to teaching due to salary differentials, lack of incentives, and apprehension about incurring additional education debt.
- **Policy Barriers and Gaps:** Misalignment of certification requirements with CS degree content and lack of statewide accountability measures.
- **IHE Programmatic Challenges:** Limited resources for CS-specific teaching materials and inflexible degree plans.

- **K–12 Capacity Issues:** Few incentives for districts to employ CS-certified teachers and challenges in placing preservice students for field experiences.

Recommendations

- **Establishing Statewide Priorities and Governance:** Develop a strategic plan for preparing Texans for the technological workforce, specify necessary funding, and create part-time CS teaching positions to expand K–12 capacity.
- **Revisiting Certification Requirements:** Streamline CS teacher certification to align with undergraduate curricula and explore dual subject certifications like a 6–12 math/CS certificate.
- **Supporting Preservice Pathways:** Encourage collaboration between education and CS faculty to create degree plans that combine CS and teacher preparation and reduce barriers.
- **Providing Financial Support:** Increase teacher pay and offer scholarships, stipends, and loan forgiveness to attract more candidates to CS teaching.
- **Increasing Public Awareness:** Launch a marketing campaign to highlight the importance of digital literacy and CS education, develop industry-education partnerships, and provide targeted professional development.

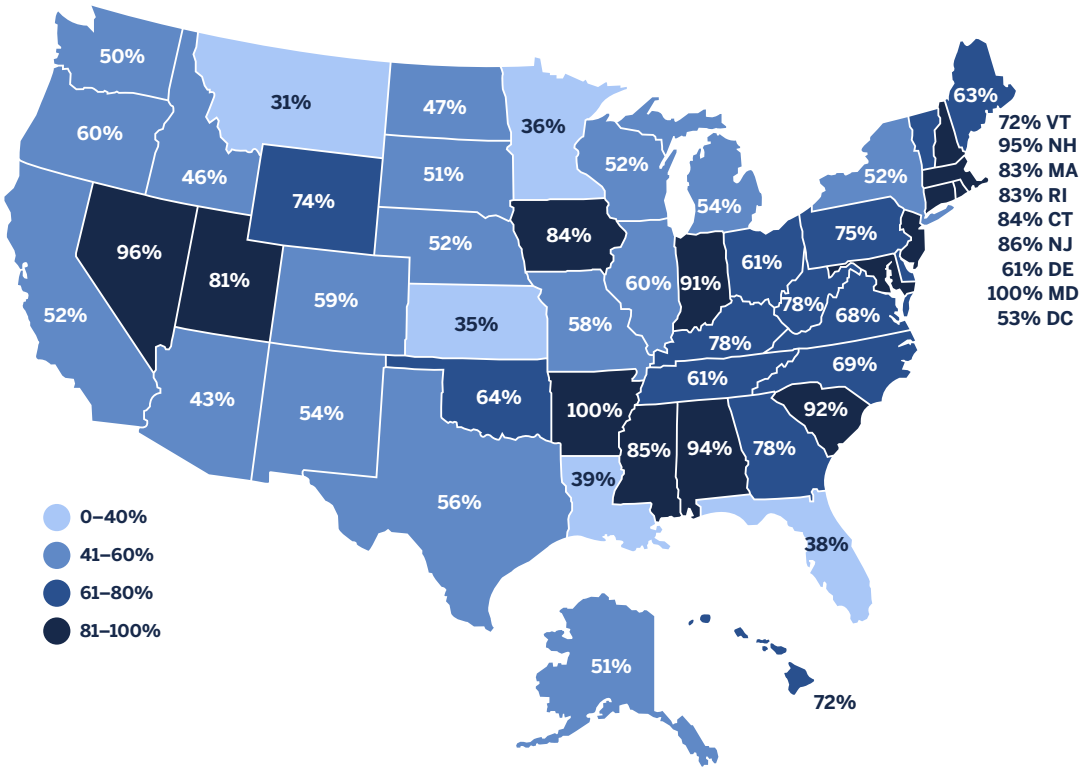
Background

State of Computer Science Education Nationwide

The 2024 *State of Computer Science Education* report (Code.org et al., 2024a) provides a comprehensive overview of the current landscape of computer science education across the U.S. and in each of the 50 states.

Code.org reports that — despite research showing that taking just one computer science course in high school can boost earnings by 8% — nationwide, only 60% of public high schools offer a foundational CS course (see Figure 1) and just 6.4% of high school students enroll in these courses annually. An annual teacher attrition rate of 8% further limits student access to and engagement with CS courses. More educators need comprehensive preparation to teach CS effectively and equitably. Code.org recommends that certification programs be innovative and flexible and recognize prior teaching experience. And it is important to note that training in-service teachers alone (a recent trend) is insufficient to meet the needs of K–12 students. It is crucial to bring in new CS teachers through preservice preparation programs (Code.org et al., 2024a).

Figure 1. Percent of High Schools Offering Foundational CS Courses by State in 2023–2024



Data for Figure 1 come from State of Computer Science Education *(Code.org et al., 2024a).*

Code.org (2024) offers 10 policy recommendations aimed at making computer science a foundational part of state education systems:

1. Create a state plan for K–12 computer science.
2. Define computer science and establish standards for K–12 computer science.
3. Allocate funding for rigorous computer science teacher professional learning.
4. Implement clear certification pathways for computer science teachers at elementary and secondary levels.
5. Create programs at institutions of higher education to encourage all preservice teachers to gain exposure to computer science.
6. Establish dedicated computer science positions in a state education agency.
7. Require that all schools offer computer science with appropriate implementation timelines.
8. Allow computer science to count toward a core graduation requirement.
9. Allow computer science to satisfy an admission requirement at higher education institutions.
10. Require that all students take computer science to earn a high school diploma.

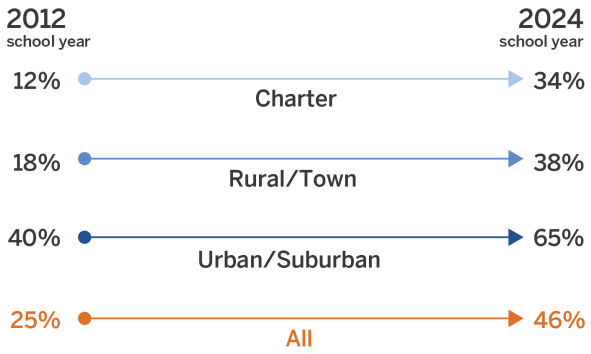
State of Computer Science Education in Texas

Recently, the Texas state legislature allocated $12 million to state education agencies for professional development in computer science education over the next two years (Texas Legislature, 2024). According to Code.org (Code.org et al., 2024b), Texas is succeeding in six of their 10 recommended policy indicators. However, Texas could strengthen CS education outcomes by developing a state plan, creating a statewide CS education leadership position, establishing a CS requirement for graduation, and strengthening preservice teacher preparation.

In Texas, while all high schools are required to offer computer science courses (Texas Administrative Code, Title 19, Part 2), in 2022–2023 only 46% of high schools offered CS courses and only 5% of students enrolled in a CS course at their school.

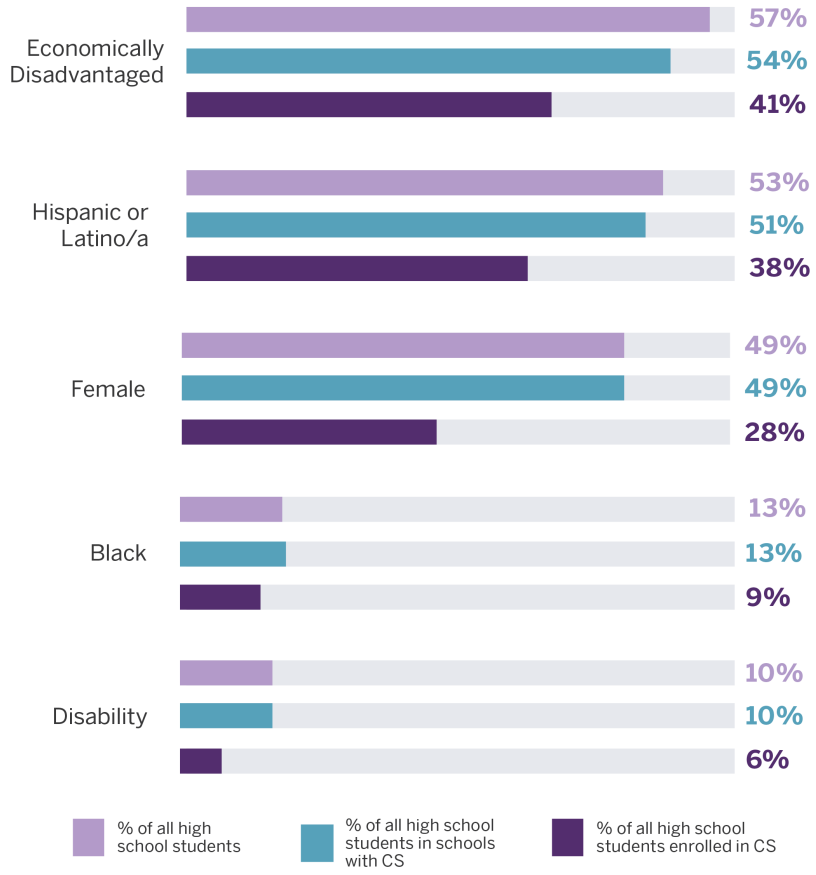
Student access to CS courses in Texas is also uneven. CS course offerings are more likely in urban/suburban schools (65%) compared with rural schools (38%) and charter schools (34%). See Figure 2). Participation in CS coursework is also lower than the average for economically disadvantaged students (41%), Hispanic (38%) and Black (9%) students, and for female (9%) and disabled (6%) students (Texas Advanced Computing Center, 2024). (See Figure 3.)

Figure 2. Percent of High Schools Offering CS in Texas



Data for Figure 2 come from Explore Texas computer science education data: EPIC dashboard 3.0.*(Texas Advanced Computing Center, 2024).*

Figure 3. Percent of High School Students Enrolled in CS in Texas (2022–2023)



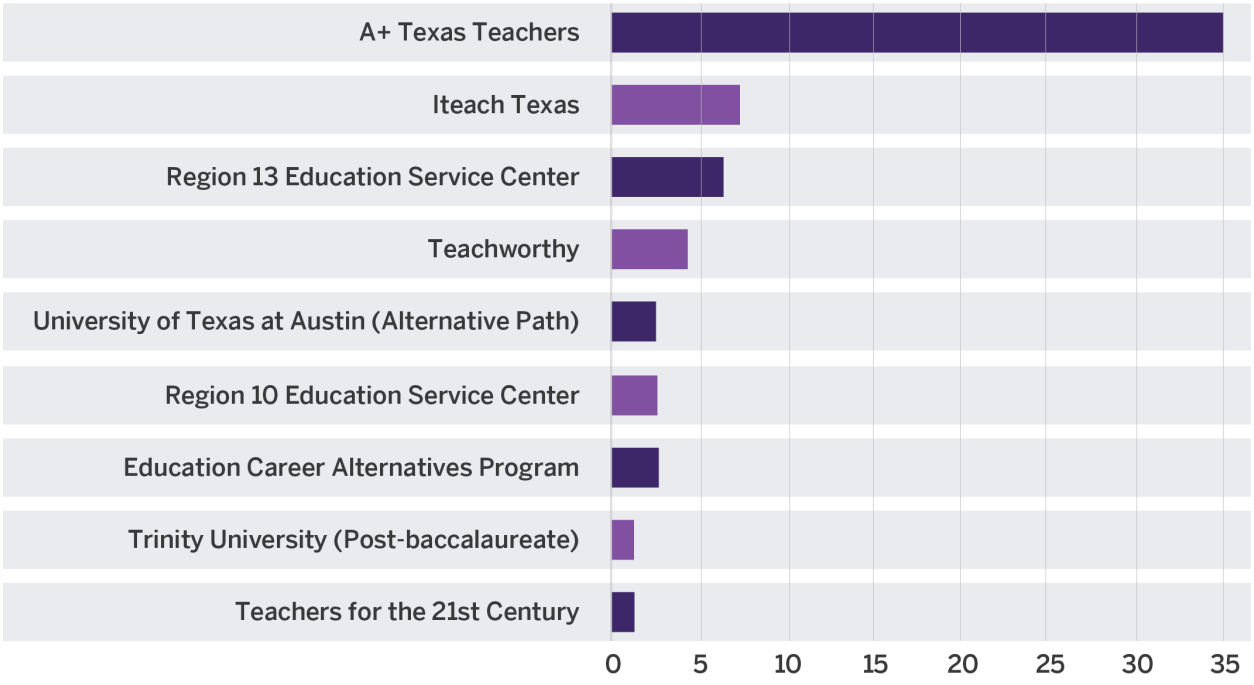
Data for Figure 3 come from come from Explore Texas computer science education data: EPIC dashboard 3.0.*(Texas Advanced Computing Center, 2024).*

Computer Science Teacher Production in Texas

Fifty-eight percent of Texas high schools employ at least one CS-certified teacher (Texas Advanced Computing Center, 2024). With more than 8,100 high schools across the state, a conservative estimate would call for approximately 3,000 new CS-certified teachers in order to expand access to CS coursework for students to all high schools. For the 2021–2022 academic year, the most recent year for which data are available, just 60 initial computer science teaching certificates were awarded (Texas Education Agency, 2023).

It's worth noting that only two Institutions of Higher Education (IHEs) in Texas, — The University of Texas at Austin and Trinity University — produced certified computer science teachers that year. In Texas, teachers prepared by universities produce greater student learning gains and are retained at higher rates than non-university prepared teachers (Marder et al., 2022). Despite this higher quality, production of university-prepared teachers in STEM across the state has declined by more than 40% over the past decade. Figure 4 shows that the vast majority of CS teachers are being certified through for-profit, alternative pathways.

Figure 4. Computer Science Teachers Certified by Texas Educator Preparation Programs (2021–2022)



Data for Figure 4 come from the Texas Public Education Information Resource *(Texas Education Agency, 2023).*

These data make it clear that Texas faces a significant challenge in cultivating a robust, sustainable pipeline of qualified computer science educators. The critical shortage underscores an urgent need for innovative and coordinated strategies that can bridge the gap between the increasing demand for technology skills in the workforce and the current state of teacher preparation. Teachers are critical to a robust CS workforce pipeline. In a recent study of students across the state of Maryland, researchers showed that taking just one high school CS course increased the likelihood of declaring a CS major by 10% and of receiving a CS degree by 5% (Liu et al., 2024). Considering current and projected growth in demand for computing skills and occupations (Muro & Liu, 2023; U.S. Bureau of Labor Statistics, 2024), if Texas fails to address this deficit of high-quality CS teachers, the state risks falling short of its educational and economic goals.

Texas Computer Science Pipeline Initiative

The **Texas Computer Science Pipeline initiative** (TX CSP) is focused on building educator, institutional, and systemic capacity to improve access to, participation in, and experiences of K–12 computer science education (CSEd) for all Texas students. Funded by the Texas Legislature during the 88th session, the initiative is allocated $5,000,000 annually for 2024 and 2025 and is administered by the WeTeach_CS program in partnership with the Texas Higher Education Coordinating Board (THECB).

TX CSP Components

- **Building K–12 Computer Science Educator Capacity:** Through professional development, stipends, and other supports, TX CSP fosters sustainable educator growth.
- **Enhancing CSEd Infrastructure and Support:** TX CSP provides the infrastructure and support systems for comprehensive computer science education.
- **Evaluating, Researching, and Tracking Statewide Goals:** TX CSP holds itself accountable by providing clear goals and up-to-date progress reports on the state of CSEd.

Educator Preparation Stakeholder Convening

One of the objectives of TX CSP is to strengthen preservice preparation of CS teachers in Texas. The UTeach Institute and the Texas Advanced Computing Center's WeTeach_CS program, both at The University of Texas at Austin, partnered to facilitate a statewide working group focused on this issue.

As an initial step, a late fall 2024 convening was held at the Texas Advanced Computing Center and brought together stakeholders from 18 Texas institutions of higher education representing educator preparation programs and computer science departments. They were joined by representatives of the Texas Higher Education Coordinating Board and the Texas Education Agency. The focus of the convening was to identify challenges in the current preservice CS teacher pipeline, explore and propose potential solutions, and make recommendations for next steps. Additionally, initial steps were made to form a community of practice to support ongoing collaboration on possible solutions and next steps.

Challenges and Opportunities for Strengthening Preservice Computer Science Teacher Preparation

Stakeholders identified challenges that were grouped into four categories: recruitment, funding, and incentives; policy barriers and gaps; higher education programmatic challenges; and K–12 capacity issues. These are detailed below.

Recruitment, Funding, and Incentives

Challenges

The group identified several key challenges in getting undergraduate CS majors interested in and incentivized to pursue teaching. One issue is the salary differential between industry jobs and teaching roles, which presumably makes teaching less attractive to students. Participants also highlighted that STEM faculty often don't see teaching as a valuable career and may discourage students from pursuing CS teaching certification.

Additional challenges exist around funding and incentives to make exploring and pursuing teaching certification attractive to more undergraduate students. Recruiting any STEM major to teaching right now is challenging. CS presents possibly the greatest challenge, given the competition with industry. And the prospect of taking on additional education debt or extending time at the university in order to become a teacher only discourages student interest in many teaching pathways.

Opportunities

Additional teacher pay for high-shortage areas like CS could go a long way toward incentivizing students to consider teaching as a career. Additional funding could be used to develop targeted recruitment materials and support recruitment activities. Funds are also needed to incentivize more students to explore and pursue teaching. In particular, funds are needed to provide direct student financial support in the form of tuition reimbursement for exploratory/introductory teaching courses and scholarships or loan forgiveness. Financial support during the student teaching semester is especially important.

Positioning and marketing the earning of a CS teaching credential as an additional career option for CS majors, as opposed to requiring students to change their major, is another approach to increasing student interest and motivation to pursue teaching.

It may also be necessary to dispel misconceptions about the teaching workforce. A first step would be to collect data from CS majors on their interest in and concerns around pursuing teaching as a possible career choice.

Close collaboration between education and computer science departments is necessary to co-develop program approaches and recruitment activities that encourage faculty with CS expertise to support CS teaching options and expose CS majors to educational outreach opportunities, advising, and positive messaging around choosing teaching as a rewarding career choice.

Policy Barriers and Gaps

Challenges

While Texas requires all high schools to offer computer science coursework, a lack of accountability measures has resulted in poor compliance across the state. This incomplete approach to ensuring access for students results in a patchwork of demand for CS teachers that can inhibit full-throated efforts to increase production — producing a chicken-and-egg problem of sorts. There is also no statewide plan to expand student access to CS across the state.

On the other hand, computer science teacher certification requirements pose a different set of challenges that can make it difficult for university-based education preparation providers (EPPs) to prepare CS teachers. Many of the content requirements for CS teaching certification simply do not align with the content of the CS degrees that students earn, creating a situation where a CS degree holder is deemed unqualified to teach CS in Texas without additional content preparation. Currently, EPPs must create new coursework to address these K–12 content topics if they wish to certify CS teachers.

Finally, there is insufficient awareness generally across the state about the importance of technical literacy and the critical role that CS education will play in being able to compete for the economic and workforce opportunities of today and the future.

Opportunities

While the Texas Administrative Code's Required Curriculum (Texas Administrative Code, Title 19, Part 2) states that every high school must offer at least one computer science course, there is no accountability associated with meeting this requirement. If schools were required to demonstrate that students have access to and are enrolled in a CS course as part of the state accountability system, administrators would prioritize hiring of CS faculty and offering of courses.

Efforts to continuously educate Texas citizens and policymakers on the benefits afforded by strong technical knowledge and access to CS education are necessary to address current policy gaps. A statewide strategic plan could establish targets for improved access and attainment of technical knowledge and skills, and providing a roadmap for student achievement in these areas could address workforce needs across the state.

A statewide plan could also set the stage for enhanced policies to ensure more students get access to computer science coursework, like a CS graduation requirement, and early exposure to CS in elementary schools. A plan is also needed to lay out the case for increased financial investments across the state.

An immediate opportunity exists to revisit CS teacher certification requirements to make it easier for CS majors to also become certified CS teachers. Another policy consideration would be to develop new combined certifications, such as a math/CS certification. This could potentially interest more students who might be pursuing other teaching certifications to consider also preparing to teach CS. It would also provide schools with fully certified teachers in two high-need fields. A similar approach was developed when high school programs of study in engineering were introduced (Texas Education Agency, 2024). A combined mathematics/physical sciences/engineering teacher certification was developed by Texas rather than a stand-alone engineering certification. This combined certificate was more attractive to a wide variety of undergraduate majors and was also more marketable, since most first year teachers don't start teaching exclusively engineering classes when a program is being built in a school.

Higher Education Programmatic Challenges

Challenges

Challenges faced by university-based educator preparation programs include limited resources for creating CS-specific teaching materials and a dearth of CS content knowledge among faculty. Furthermore, when it comes to recruiting CS majors to consider teaching, many CS degree plans are overloaded and inflexible, leaving little room for teacher preparation courses. There is also an issue of economy of scale. If an institution has low enrollment in its CS pathway, it is difficult to justify investing in hiring specialized faculty, developing curriculum, tools, and materials for these programs.

Opportunities

Close collaboration between education and computer science faculty to co-develop viable teacher preparation pathways will be key to overcoming barriers to recruiting and preparing CS and other STEM majors to teach CS. Developing the CS content knowledge of current education faculty who prepare teachers is also needed. New CS degree plans could be created that combine CS core curriculum with flexible minor options, including teaching. IHEs should also explore CS certification options that fit various degrees in fields like information technology, data science, or dual certifications such as math and CS.

Institutions should also explore developing alternative certification pathways geared toward career changers and degree holders to expand their reach beyond the undergraduate student population. Collaboration across institution can address the economy of scale issue. By developing consensus courses that any student pursuing CS certification should take and sharing course materials with other EPPs across the state, programs can optimize resources and ensure consistency across preparation programs.

K–12 Capacity Issues

Challenges

School districts have few incentives to employ CS-certified teachers, creating uncertainty around the demand for ramping up preservice recruitment and preparation. These issues are exacerbated when K–12 districts find themselves struggling to staff mathematics or other required STEM courses. They may resort to eliminating CS course offerings and reassigning teachers to other subjects, especially high-stakes test subjects like mathematics. Even given the currently low numbers of preservice CS teaching candidates, programs are challenged by limited access to fully certified CS teachers in K–12 districts for field placements and mentoring.

Opportunities

Many of the opportunities already discussed, like policy changes to bolster accountability and require CS coursework, would provide K–12 schools and districts with incentives to increase capacity to serve many more students in CS courses. Information and education efforts discussed earlier would also contribute significantly to creating demand for expanded access to CS courses. In particular, educating school leaders and administrators on the need to develop digital and technical literacy, as well as provide CS coursework for students, is needed.

Schools and districts could potentially staff more CS courses if they offered part-time positions. Part-time work opportunities could appeal to a wide range of current or retired industry professionals who would like to get involved in supporting CS education efforts.

Recommendations and Next Steps

Texas is falling behind other states at a pivotal moment in computer science education. Insights gathered from 17 institutions of higher education and other key stakeholders point to the need for strategic, systemic approaches to expanding computer science access and achievement in Texas schools.

Preparing more CS teachers is a critical piece of the puzzle. We offer the following recommendations for increasing highly qualified, certified CS teachers through the expansion of university-based preservice pathways:

- **Establish statewide CS education priorities and governance:** Develop a statewide strategic plan that lays out a vision for preparing Texans for the current and future technological workforce. Specify the funding necessary to successfully achieve targets and outcomes. Encourage the creation of part-time CS teaching positions to expand immediate capacity of K–12 schools to offer CS to more students.
- **Revisit CS teacher certification requirements:** Streamline CS teacher certification requirements to better align content requirements with undergraduate core CS curriculum. Explore the development of new dual subject certifications, including a 6–12 math/CS certificate.
- **Support the development and expansion of preservice CS teacher preparation pathways at Texas institutions of higher education:** Encourage and support collaboration between education and computer science faculty to devise four-year degree plans that combine CS and related technical majors with teacher preparation coursework. Develop a CS disciplinary culture that values and honors teaching as a career choice through ongoing cross-disciplinary faculty partnership and collaboration, identification and nurturing of CS education champions, and targeted engagement with accurate data and information about the teacher workforce. Actively work to reduce barriers to participation in teacher credentialing pathways for CS and other STEM or technical majors.

- **Provide financial support and incentives to recruit more candidates to CS teaching:** Increase teacher pay or provide salary supplements, especially for the hardest-to-staff subjects and schools, to attract more Texans to teaching careers. Provide funding in the form of scholarships, stipends, and loan forgiveness to encourage undergraduates to pursue CS teaching.
- **Increase public awareness about the benefits of computer science education:** Launch a comprehensive marketing and outreach campaign that focuses on the importance of digital literacy and technology skills and promotes the role that computer science education plays in accessing economic opportunities. Develop industry-education partnership programs and high school internship opportunities to increase exposure to CS opportunities. Provide targeted professional development to both K–12 administrators and higher education faculty.

Conclusion

The challenges facing computer science education in Texas are complex but not insurmountable. The recommendations in this report offer initial considerations for transforming CS education from an ad hoc, anemic effort to a robust, strategic statewide effort.

Success will require intentional and ongoing collaboration between K–12 schools, higher education institutions, state agencies, and industry. Ultimately, a cohesive statewide approach that simultaneously addresses teacher preparation, certification, funding, K–12 capacity, and public awareness will put Texas on a path to becoming a national leader in preparing students for the technological challenges and workforce of today and for the future.

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