



# CATCHing CS Equity: Counselors, Administrators, and Teachers Collaborating Holistically

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## ABSTRACT

Improving equity in K-12 Computer Science (CS) education benefits from the collaboration of classroom teachers, school counselors, and school leaders. This paper presents the outcomes of a pilot program that brought together cross-functional teams consisting of CS teachers, school counselors, and administrators. Over the course of a year, these teams attended monthly, equity-focused workshops, leveraging pre-existing materials from affordable, high-quality, research-based programs. The use of these resources demonstrated benefits of sequencing and synthesizing existing programs. Evidence from surveys and interviews shows that the workshops promoted learning and fostered collaboration between the cross-functional teams that would not have happened otherwise. Participants were motivated by the program, and they generated ideas that turned into actionable projects to promote CS education equity in their schools. While the initiative was well received, areas for improvement were identified, particularly, in school recruitment, workshop structure, and evaluation. This pilot initiative demonstrates that equity-centered programs comprised of cross-functional teams can help achieve systemic improvement of CS education equity.

## CCS CONCEPTS

• **Computer and Education**; • **Computers and Society**;

## KEYWORDS

Computer Science Education, Equity, cross-functional teams, Teachers, Counselors, Administrator

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## 1 INTRODUCTION

In the spring of 2021, the Black Student Union of Arlington High School hosted two guest speakers: the high school computer science (CS) teacher and the school counselor responsible for class selection and advising. The two educators had a mission: they wanted to hear directly from the Black students about ideas for building a more inclusive CS program. Reflecting on the meeting afterward, the CS teacher recalled that a common reaction among students was "Wow, that course sounds really great. I didn't know that it existed." It was a defining moment for the counselor and the CS educator; a moment when the educators realized "The students that we were trying to reach didn't know we existed."

This anecdote demonstrates the challenges faced by numerous schools when trying to create computer science programs that reflect the diversity of their student population.

### 1.1 Lack of Equity in CS Education

Lack of equity is a persistent and well-documented concern in CS education. The proportion of students from historically marginalized groups in CS does not come close to matching the proportion of these students in the general population either nationally or in most local school systems [15].

Stereotypes concerning who is – and who is not – interested in CS are remarkably pervasive. These stereotypes take hold among children as early as the beginning of elementary school [14], and are persistent and powerful influences on students' interest in CS. These factors contribute to a stark lack of representation of women and other historically marginalized people in CS courses and in the computing industry.

### 1.2 Challenges in Building Equity in CS Education

While efforts to expand CS education abound, equity is not always centered as a crucial goal. Too often, schools focus on increasing the number of students in CS programs without considering equitable representation and experiences in the programs. Even in attempts to build equitable CS programs, the focus often remains confined to the individual classroom level. DeLyser et al (2020)[5] asserts that CS expansion often relies on each individual teacher's enthusiasm. Achieving long-term equitable growth in CS education requires a comprehensive approach that encompasses curriculum, standards,

staffing, and vision, especially as CS evolves from an elective for a few to a subject accessible to a broader student demographic.

Given the decentralized nature of schools in the United States, growing equitable CS programs can be facilitated by state departments of education, but the work must be done primarily at the school and district level [4]. CS Education Equity programs are more likely to succeed when teachers, administrators, and counselors work together [9]. There is a need for concerted efforts to recruit and retain more underrepresented students in CS and ensure that they are successful in their courses. At the school level, counselors are often gatekeepers to course enrollment. The support of counselors has been identified as a key component of implementing a CS program [2]). Similarly, administrators normally shape decisions about which classes will be offered and how many students will be accommodated, so administrative support is needed for CS programs to be successful [13].

### 1.3 Approaches to addressing CS Equity

Many frameworks and programs have worked to ameliorate these challenges in centering equity in the growth of CS education. One common feature across these efforts is that they typically target one type of educator. For instance, ACM, Code.org, and CSTA came together to develop a K-12 Computer Science Framework with aligned standards for CS teachers. This work aims to ensure equitable access to CS education, fostering a diverse pipeline of future computer scientists and technologically literate citizens [12]. The CSforALL Script Workshop supports administrators in building CS programs, with an equity-first model. The National Center for Women in IT has a program called Counselors for Computing that enlists school counselors in the work of broadening participation in computer science [12].

There is good research evidence [3],[6] about the efficacy of these programs. As we considered the next level of work for CS education, we wondered how we might sequence these individual programs together into a comprehensive experience for a cross-functional school community.

### 1.4 Research Question

How can the integration of diverse educational programs, such as the ones described above, be effectively utilized within a cross-functional collaborative environment to create an impactful approach to the enhancement of equity in Computer Science Education?

## 2 DESIGNING THE PROGRAM

Our goal in this ongoing research is to improve equity in high school CS programs by bringing together cross-functional teams that consist of CS teachers, school counselors, and administrators. The cohort consisted of facilitators and teams from three schools during a pilot year which featured monthly, virtual workshops. These workshops drew on professional learning curricula from established, research-based programs. In the workshops, educators worked together with each other in school-based teams, with facilitators, and with educators from other districts.

We report here on the program goals, our recruitment process, monthly professional development meetings, practitioner design projects, and evaluation of the first school year of the program.

Three main findings emerged from our study. First, educators expressed the remarkable value in setting aside time to work together in teams with colleagues in other roles in their schools. Second, participating in an equity-focused program provided a unique and valuable opportunity for teams to learn from one another and to work towards building CS equity in schools. Third, the utilization of existing, curriculum-agnostic tools in professional learning efforts proved beneficial, as it saved resources and added credibility to the program. The feedback we received on specific areas for improvement will be incorporated into future efforts to enhance the growth of the program.

### 2.1 Program Goals

The goal of the series of workshops was to advance educators' capacity and ability to advance equity in computer science education. Our definition of equity in the context of computer science is informed by the CAPE framework (Capacity for, Access to, Participation in, and Experience of equitable CS education) [18]. This framework argues that creating an equitable system of CS education that ensures fairness and inclusivity for all students goes beyond representation in CS coursework to address the entire ecosystem of CS education. This includes developing the capacity to offer inclusive CS instruction, providing equitable access to CS courses and programs, promoting active and meaningful participation of underrepresented groups, and fostering equitable experiences in CS learning.

By addressing the root causes of under-representation and implementing the principles of the CAPE framework, we strive to build a computer science education landscape that embraces diversity, inclusion, and equal opportunities for all students. Therefore, our goals in targeting different layers of inequity are informed by the understanding that achieving equity in CS education requires a multifaceted approach. We recognize that inequities can manifest differently across districts. Thus, the program aimed to empower school educators to address the specific challenges and opportunities within their school to create meaningful and sustainable change toward equitable CS education which targeted capacity building, expanding access, promoting successful participation, and equitable classroom experiences.

Flapan et. al.[6] documented one of the few programs that has adopted such comprehensive multi-stakeholder approach to building equity in CS. This program implemented a week-long regional professional development learning program in California, bringing together cross-functional teams of teachers, counselors, and administrators. The study highlights that bringing together these cross-functional teams was beneficial for expanding equity. Without denying the importance of issues related to classroom instruction, they conclude that a systems approach – incorporating school- and district-level policies and stakeholders – is necessary to accomplish the goal of CS for all. Expanding upon the work of Flapan et al., this project seeks to advance existing frameworks and programs by establishing a collaborative program that engages counselors, administrators and teachers.

## 2.2 Recruiting for the Program

To establish an equity-focused collaborative cohort, we worked with CSforMA (the Massachusetts computer science education hub) and the Massachusetts Association of School Superintendents (M.A.S.S.). CSforMA is dedicated to ensuring that all K-12 students have access to high-quality computer science coursework and can succeed in it. M.A.S.S. strives to provide high-quality education to every student in the public education system. With recommendations from these collaborators, project personnel worked to recruit up to six high schools to participate in a pilot project. Given the challenges of schools in that year, with the return to fully in-person learning following the significant disruption of the COVID-19 pandemic, we were able to recruit only three public high schools for our project.

The three participating schools are located in suburban districts within a 25-mile radius of Boston. In Massachusetts, 57% of computer science (CS) students are white [17]. However, the participating school districts had different percentages of white CS students: 57%, 74%, and 78% respectively. The CS student population in Massachusetts is predominantly male, with around 69% being male. Participating districts had varying percentages of male CS students: 88%, 77%, and 65% respectively. Each district consisted of a single high school with student populations of approximately 1000, 1500, and 1700 respectively.

Both school and CS enrollment data from the Massachusetts Department of Elementary and Secondary Education (MA DESE) underscore this pronounced disparity, both within individual schools and across the state and nation. Asian and White students show a trend of higher CS enrollment, while African American, Hispanic, and Native American students consistently exhibit lower CS enrollment percentages across the three participating school districts, as well as in the state and nationwide [11]. These disparities highlight the imperative for focused efforts aimed at achieving diverse and equitable participation in CS education.

## 2.3 Program Design

After recruiting districts in the early part of the 2021 - 2022 school year, monthly workshops launched in November 2021. These virtual meetings had two main focuses: delivering professional learning on equitable CS and creating a collaborative space to facilitate reflection and brainstorming for the participating school districts. Each of these aspects contributed to the overarching goal of promoting the design and implementation of programs to enhance equity in the schools' CS initiatives.

Existing research shows the efficacy of certain programs developed specifically for CS teachers, counselors, and administrators [6]. This approach offers other advantages including cost and time savings, quality assurance and scalability. Hence, the program was designed based on the following research proven resources:

- (1) The Strategic CSforALL Planning Tool for School Districts (SCRIPT) self-assessment rubric, designed for district-wide teams [5]). Conducted over two sessions, this workshop guided school teams through a series of visioning, self-assessment, and goal-setting exercises to create or expand upon a computer science education implementation plan for their students.

- (2) A workshop provided by the National Center for Women & Information Technology's Counselors for Computing (C4C) program [1]. This resource facilitated discussions on various dimensions of identity, such as gender, sexuality, race, ethnicity, disability, and neurodiversity. The focus was on equipping educators with the tools to foster inclusive learning environments and promote dialogue around these topics.
- (3) Teacher Moments Scenarios: Teacher Moments is a platform for administering digital clinical simulations. To address the experiential aspect of CS education equity, educators interacted with simulated CS-focused scenarios through the Teacher Moments platform. These scenarios presented challenging contexts where educators made choices, enabling them to practice and engage in discussions about equitable teaching practices
- (4) The CAPE framework [8], which served as a lens for examining and planning for equity in CS.
- (5) Final Project Design: The remaining workshops were dedicated to planning, collaborating on, and launching the final project design. Educators were tasked with creating an artifact (e.g., a tool, intervention, presentation) that would enhance equity in their school's CS program. These sessions provided a platform for educators to apply their learning and develop practical solutions

In addition to attending the workshops, educator teams met between workshops to prepare for meetings and develop their final design projects. These professional learning materials and programs were designed to be flexible, accommodating multiple districts with various CS curricula. The focus was on equity, and the workshops covered a range of topics, as outlined in Table 1.

This comprehensive approach involved assembling a cross-functional team of CS teachers, school counselors and administrators, in collaborative workshops, using established resources and research. The program design facilitated theoretical understanding of equity and equipped participants with various practical tools, principles and guidelines to advance equity in their CS programs.

## 3 METHODOLOGY

In this study, part of a researcher practitioner partnership (RPP), we collaborated with the schools who participated in the program to understand how the existing frameworks embedded in the design of the workshops enhanced the intentional efforts of counselors, teachers, and administrators towards promoting CS equity. A crucial aspect we examined was the effectiveness of having these stakeholders in a collaborative program. Our objectives in studying the outcome of this program align with Porter's (2022) perspective on assessments, which emphasizes shifting the purpose solely from measuring the program's success to deepening our understanding of how the program worked and for whom it was effective [16]. In our study, in addition to impacts in participating school districts we were also interested in any growth among participating educators.

### 3.1 Data and Measures

To ensure comprehensive and reliable assessment, we used a mixed methods approach, leveraging different approaches to obtain a broader perspective and enhance the credibility of findings [10].

**Table 1: Workshops Overview**

Month	Focus	Goal
November	Program Launch. Introduction of CAPE framework.	Community building, starting to form a benchmark, forming a common framework for discussion.
December	Strategic CSforALL Resource & Implementation Planning Tool (SCRIPT), Part One	District self-assessment and goal-setting
January	SCRIPT, Part Two	District self-assessment and goal-setting
February	Counselors for Computing (C4C) Videos that Spark Conversations	Tap into the cross-functional potential of the program by focusing on the role of counselors
March	Equitable Teaching Practices	Provide a practice and reflection space for equity-involved classroom challenges
April	Project Design, Part 1	Transform acquired insights into actions for school program development
May	Project Design, Part 2	Transform acquired insights into actions for school program development
June	Project Showcase	Community building and idea sharing

Thus, we combined exit surveys with individual conversations and the evaluation of the final projects presented by the educators at the end of the program.

- (1) Exit Surveys: Each participating educator completed an exit ticket after each monthly meeting. These surveys provided an opportunity for the educators to reflect on their experiences, share their feedback and suggestions for improvement.
- (2) Individual Qualitative Interviews: We conducted interviews with each of the educators that participated at the beginning and at the end of the school year. These interviews served to provide nuanced insights into their experiences and growth throughout the program.
- (3) Final Project Presentation: We reviewed the workshop products and final projects from each participating school. These artifacts served as tangible evidence of educators' growth and provided insights into their implementation of CS equity principles and practices.

### 3.2 Data Analysis

To investigate the use of diverse educational programs within a cross-functional program for enhancing equity in Computer Science Education, we analyzed the data sets noted above. A thematic analysis on the exit surveys allowed us to identify recurring themes related to their engagement level and the perceived program's effectiveness. Through the content analysis of the individual interviews, we gained insights into the specific challenges of the different educators within their unique roles in the school community. By systematically reviewing the artifacts that they produced, we were able to review the extent to which the program translated into practical solutions and initiatives within each educator's school environment. We also observed exchanges between educators from different domains (such as teachers and counselors), which further informed our analysis of the value of multi-stakeholder professional learning.

## 4 FINDINGS

Our analysis illuminated three key findings. First, educators reported that working together in a school-based, cross-functional team was valuable. They were given authority to step out of business as usual and use their multiple, coordinated perspectives to work toward equity in ways they would not have been able to alone. Second, educators reported a preference for collaborating with other schools. Third, using curriculum-agnostic, pre-existing materials allowed the workshops to move faster and more economically than building our own materials would have. Our findings echo previous research showing that administrators find value in equity-focused, example-based, discussion-oriented workshops that incorporate networking opportunities [7].

### 4.1 Benefits of Cross-Functional Teams

The anecdote from the beginning of this paper, in which the Black Student Union at Arlington High hosted two guest speakers, the high school computer science (CS) teacher and the school counselor, emphasizes the significance of cross-functional collaboration. The success of this meeting was a result of the combined expertise, roles, and contacts of various stakeholders, including the math & CS director, counselor, and teacher. Together, they facilitated a direct conversation with the Black students that generated new ideas for building a more inclusive CS program. Other educators who participated in the collaborative workshops expressed that they valued the opportunity to partner with other educators in different roles, as it allowed them to compare efforts, exchange ideas, and receive the much needed support from other educators working towards equity in computer science (CS) education.

For instance, one superintendent was invited to have a team participate in the pilot program. Eager to promote equity, the superintendent signed up and delegated leadership of this effort to the newly hired STEM Coordinator who was less than a month into his role. The STEM coordinator was similarly eager to increase equity in CS, but was unsure about their ability to recruit team members. The computer science teacher was willing to participate,

but was not sure what would be possible. Finding a school counselor who would devote precious time during the return to school in the midst of the global COVID pandemic was challenging. But the STEM coordinator's recruitment was successful: the CS teacher, a school counselor, and the STEM coordinator set aside time to participate. Each member was dedicated to the efforts to build equity and representation. After a school year of professional learning, their group was changed. The scheduled time together had transformed them into a true team with a common goal. Each reported that though they had been uncertain at first, allocating time in the midst of a difficult year gave them a much needed boost, keeping them moving forward rather than just being reactive. In response to what they learned through interaction with other school teams, they created a video for classroom TV announcements to recruit students, especially ones underrepresented in CS.

#### 4.2 Benefits of promoting Computer Science equity in a collaborative program

A main activity of this program was the establishment of monthly workshops composed of school-based, cross-functional teams, to promote equity in CS and secondarily, to address the isolation often experienced by CS educators. We hypothesized that providing a platform for CS educators, counselors and administrators to interact with their counterparts from other schools would yield valuable growth and learning opportunities. Monthly, virtual workshops were the primary activities of the program.

Participating educators considered the program to be a success. They expressed appreciation for the designated time to focus on CS equity and the opportunity to speak with like-minded peers. As one participant noted after a workshop: "it just got my mind racing about the possibilities and hopefully we can keep having these discussions. I now know who to contact to steal ideas from." One district indicated that this program "help[ed] us to have conversations about underrepresented students."

The workshops helped the educators identify simple, easily implementable ways to make their current CS courses more welcoming to a broad array of students. For example, one workshop featured a presentation by Ira Fay, a professor from Hampshire College, which showcased how small, easy to implement changes, such as renaming a course, could significantly increase the participation of historically marginalized students in CS available at GDC Vault. Inspired by this example, some educators immediately revised their course title and descriptions. Educators also explored moving CS courses and topics to other departments (such as business) which were perceived as more attractive to a range of students.

According to a report by the Computer Science Teachers Association (CSTA), one in three CS teachers is the sole CS instructor on their campus [9]. This meant that the program was perceived as particularly important to CS instructors' ability to collaborate on, and advance ideas for improving equity. The inclusion of cross-functional teams received support from school administrations, enabling the availability of substitute teachers during workshops (although it should be noted that the difficult realities of the pandemic and labor shortages during the 2021-2022 school year meant that, in at least one instance, a substitute was simply not available).

Despite the significant disruptions caused by the pandemic in 2021-2022, we were able to recruit schools to participate in the program. This suggests the value that educators placed on equity-focused learning, as confirmed by their feedback provided during end-of-year interviews. A number of educators acknowledged that although the commitment required by the program sometimes seemed daunting, they were ready to make it work by scheduling time for it and participating, because they found immense value in it. For example, one participant noted that the most useful part of the program was that it "forced" their team to schedule time to meet and enabled them to focus on the issue of CS equity.

#### 4.3 Benefits of Curriculum-Agnostic, Pre-Existing Materials

An important finding from our observational study was that the use of professional learning materials that are (1) curriculum agnostic, (2) pre-existing, and (3) high-quality offers significant benefits. As a result of focusing on CS courses in general, and not particular/specific CS curriculum, it was possible for everyone to participate, avoiding the formation of isolated groups based on particular curriculum. Using pre-existing materials helped to conserve project resources and expedited implementation. Educators benefited from the use of evidence-based, vetted tools, while the facilitation team could devote its time to individualized assistance required by the districts.

The four tools used in the workshops helped educators develop and refine their approach to equity. Specifically, SCRIPT rubrics were used by district teams to assess the current status of their CS programs. Working through the SCRIPT rubrics allowed educators to reflect on the current status of their programs with equity as a focus and to explore possible improvements. The granularity of the SCRIPT rubrics made it possible for educators to analyze specific strengths and barriers to improving equity in their districts. For example, one team noted that while their superintendent was supportive of CS, the superintendent's leadership style encouraged principals to make as many decisions as possible. This posed a challenge as some of the district's principals were not fully supportive of the efforts necessary to achieve CS for all.

The Counselors for Computing workshop was particularly useful for participating counselors as it bridged the gap between their domain and CS education. Of the three groups represented, collectively, school counselors had the fewest previous opportunities to work on issues related to CS education in general, and equity in CS education in particular. This workshop provided an opportunity for the counselors to become more familiar with CS education. As one participant put it, counselors were "hungry for knowledge" about how to help the students they advise be prepared for technology careers, especially those learners who are not from the demographics stereotypically thought to be good at CS or other STEM subjects.

The CAPE framework was presented in the workshops and used throughout the year as an analytical tool. CAPE, an acronym for capacity, access, participation, and experience, is a framework which posits that building equity in CS education requires capacity for CS programs, access to these programs, participation in CS, and positive experiences in the programs. It recognizes that achieving equity is more than merely achieving demographic representation

in CS programs. As one of the educators noted: “I hadn’t thought too much about the experience part . . . they’re only going to go on if they have a good experience.” Similarly, another educator commented in the exit interview that they “thought it was helpful to look at the barriers to entry as well as access points.”

Scenarios and simulations from Teacher Moments allowed educators to gain experience with potentially high-stress, realistic situations in the low-pressure and low-stakes environment of a digital simulation. These helped to raise reflective discussions amongst the educators about how to continue to work towards building more inclusive and equitable CS opportunities in their respective schools. A challenging aspect of improving equity is responding in the moment to statements and situations that perpetuate bias. Teacher Moments is a useful tool for helping educators practice responding to these situations; as one participant observed in their exit interview: “the questions were very real and very right on.” We found that the Teacher Moments scenarios were not only effective in educator self-reflection and practice, but also in providing a common set of experiences for discussion: because the educators had all worked through the same scenario, a subsequent discussion about equity in CS education was grounded in pragmatic examples and helped educators stay focused on the topic so that a rich discussion could ensue. One challenge of bringing together cross-functional teams and across-district communities of practice is that common ground may be lacking. However, the Teacher Moments scenarios served as a shared experience upon which to build a foundation for understanding equity.

## 5 LIMITATIONS

While this program yielded benefits, our analysis also revealed several key limitations and areas for improvement. First, it was difficult to recruit school districts with diverse populations. Districts with high diversity are often underserved districts which, in particular, may have lacked the time and resources to commit to the program. Future efforts will focus on how to engage a wider range of school districts, especially those serving marginalized groups. To engage these schools with fewer resources, we will test the efficacy of a front-loaded schedule, with onboarding happening during the summer and fewer and shorter meetings during the school year. Second, scheduling challenges posed barriers for some educators. Although the routine monthly meetings facilitated focus for many, others struggled to attend, as evidenced by teachers attempting to supervise classes during virtual sessions. Exploring ways to relieve scheduling difficulties, especially for teachers, could increase participation. One possible way to increase participation and attention during workshops is again to have in-person kickoff work during the summer and to follow this up with shorter, less frequent, and after-school meetings during the school year. Third, our approach to evaluation and feedback collection was limited. While educators’ feedback was overwhelmingly positive, more nuanced feedback is needed to understand what has worked and prioritize improvements. For example, at the time of writing, we do not have data to track demographics of student enrollment in computer science before and during schools’ participation in this program. We have anecdotal reports that female participation has increased, but do not have numbers to corroborate these reports. We are collecting

data now that will help observe trends in the diversity of CS classes in these schools and contribute to assessments of the efficacy of this program.

## 6 CONCLUSION

This experience report reflects only the first year of the initiative – a year that was particularly challenging due to the pandemic and district staffing shortfalls. The program will continue for at least three more years, with adjustments driven by feedback from the educators who participate. When asked what could be done to improve the program, first-year educators requested more time to meet with their counterparts from other districts. It was apparent that educators were deeply interested in what their counterparts were doing and were eager to implement ideas that had been successful in other schools for improving access and equity in CS education.

The most important accomplishments of the pilot year of the program included establishing the foundation for a strong collaborative program and the effectiveness of cross-functional teams in promoting equity in Computer Science. Educators benefited from learning through the experiences of other school districts, broadening their sense of agency for promoting equity.

Achieving systemic changes requires collaborative effort that involves all the stakeholders who play significant roles in shaping students’ choices and their overall experience within the educational system. This type of collaboration which requires brainstorming instructional approaches, student well-being, and decision-making processes, and more, was evident in our program. It was apparent that counselors can either exacerbate or ameliorate inequities in CS as they counsel students about their academic plans. When asked about what changes participation in the program brought to their thoughts, one counselor shared that, “prior to participating in the program, they were not even sure that [equity in CS] was really on my radar as an issue to look at or even be aware of.” Similarly, as CS educators make efforts to design classroom instruction with equity in mind, this can only be successful with adequate support and backing from the schools’ administration.

This program demonstrates that a collaborative program made up of cross-functional teams using existing, high-quality materials has promising impacts for building equity in high school CS.

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