# Ramping Up to CS for All: Broadening Participation Through Equity-Focused Leadership

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***Abstract*—Despite the commitment of educators, policymakers and industry leaders, the goal of broadening participation in CS to students who have been historically underrepresented and excluded remains elusive. Drawing on in-depth interviews with 41 administrators and teachers across 20 elementary, middle and high schools in a New York City, a large urban district with a CS for All initiative, we build on prior work by examining how normative, political and technical barriers vary across schools offering CS through different implementation models. We also examine promising equity-focused leadership strategies aimed at overcoming these barriers.**

***Keywords—Equity, Computer Science for All, K-12 Instruction, Broadening Participation, Leadership***

## I. Introduction

Despite the concerted efforts of educators, policymakers and industry leaders, broadening participation in CS to *all* students remains elusive. In 2021, only 5 percent of high school students in the United States were enrolled in a foundational CS course [1]. Further, there are large, persistent disparities in who takes CS, with historically marginalized students—such as Black, Latinx, low-income students and girls—facing systematic barriers to participation [2]. In order to better understand these barriers and how equity-focused leadership might overcome them, our paper examines the implementation of a CS for All initiative in New York City, a large, urban district wrestling with bringing participation to scale. Our work illuminates the perspectives and experiences of school leaders and teachers who are tasked with implementing CS instruction.

## II. Literature and Theoretical Framework

We ground our work in the prior research on CS implementation challenges that delineates between normative, structural and political barriers [3],[4]. Normative barriers refer to commonly held attitudes and assumptions that might shape how much CS is valued or prioritized by school staff, or lead to biased beliefs regarding which students belong in CS classrooms to the exclusion of students from marginalized backgrounds (e.g., Black and Latinx students, girls, or students with disabilities). Structural barriers refer to capacity constraints–such as lack of time or trained teachers–that limit a school's ability to broaden CS participation. Finally political barriers refer to how district and state policies or a lack of support from district leaders might hinder CS implementation.

Our paper also examines the different strategies schools might employ to overcome implementation barriers, paying particular attention to distributed and equitable leadership practice. We draw on Spillane's distributed leadership framework, where leadership refers to practices—or "activities tied to the core work of the organization"—that are designed to "influence the motivation, knowledge, affect, or practices of other organizational members" [5]. In this definition of leadership, multiple people can take on leadership roles in an school—such as teachers—and not just those who are formally designated as leaders–like principals. We also draw on Ishimaru and Galloway's [6] framework for equitable leadership practice, which has been used in other studies of broadening CS participation in schools and districts [4]. Among other things, their framework articulates how school leaders enact a vision for equity, change school culture to become more equitable, reallocate resources, engage in continuous self-reflection, and use their institutional and cultural power to be allies to marginalized students and families.

## III. Study Context

New York City is one of several large school districts in the United States with a CS for All initiative. The initiative aims to provide a meaningful CS experience–one that develops computational thinking, problem-solving, creativity, and critical thinking skills–to every student, at least once in each grade band (K-2, 3-5, 6-8, 9-12). The initiative is particularly focused on ensuring that students who are disproportionately underrepresented in CS education and careers learn computer science. While the district has made some progress in broadening participation—with over 90 percent of schools offering at least some CS in 2021—less than a fifth of schools were reaching all students under the initiative's definition [7].

Currently, there are two predominant CS implementation models in the district. Elementary schools generally offer CS through *integrated instructional units* where at least 11 hours of CS instruction–focusing on student-driven topics and culminating with a project–is integrated into units across different subject areas (e.g. science or math). Typically, these

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units are taught by a dedicated STEM cluster teacher (e.g., a teacher who teaches multiple classes of students across grade levels like a technology teacher) or a classroom teacher. High schools generally offer CS through *stand-alone courses*. These courses are grounded in research-based curricula and provide students with opportunities to develop computational concepts and practices based on their personal passions. Schools offering stand-alone courses can provide multiple pathways depending on what works best for their school—including half- and full-year courses ranging from introductory to advanced AP offerings. Middle schools implement CS using a combination of both models.

Additionally, the initiative aims to scale up the number of teachers prepared to provide CS instruction by offering a variety of professional development (PD) opportunities, focused on exposing teachers to new programs and pedagogies. Crucial to our paper's focus on equitable and distributed leadership practice, these include workshops that support administrators and teachers in 1) developing CS school teams that help their school community understand what CS is, its importance, and how to implement it, and 2) strategic planning around school-wide CS implementation, increasing participation among underrepresented student groups, and ensuring that CS instruction is culturally relevant and responsive.

## IV. Positionality Statement

As qualitative researchers adhering to the epistemological assumptions of a social constructivist/interpretivist paradigm, we actively worked to assess how our own positions and experiences might contribute to interpretations of people's lived experiences. As such, we present our findings with explicit articulations of our positionalities. All of us belong to groups historically underrepresented in CS, and are committed to increasing the inclusion of students from marginalized backgrounds in the field. The first author is an Black woman from the west coast of the United States, the second and third authors are an Afro-Latinx man and a Middle-Eastern woman from the Northeastern United States. All of us have K-12 classroom teaching experience, with the second author having taught computer science for at least two years. Additionally, all of us have contributed to various computer science K-12 program evaluations. We worked as a team having regular discussions to ensure our study was guided by the collective insights that our backgrounds and experiences provided, and that any biases and assumptions coming from those experiences were addressed.

## V. Data Sources and Methods

This study used a qualitative approach to data collection and analysis to investigate the following questions: (1) What do teachers and administrators see as the major technical, normative, and political barriers to broadening student CS participation in a large urban district with a CS for All initiative? (2) What do they see as promising leadership strategies for overcoming these barriers? (3) How does this vary between schools following integrated and stand-alone implementation models?

### A. *Sample*

We used a purposeful sampling methodology to recruit 18 administrators (e.g., principals or assistant principals overseeing CS) and 23 CS teachers from 20 schools that offered CS instruction in our focal district. The schools in our sample served student bodies that were predominantly Black and Latinx and had higher than average economic need. We sampled schools with different levels of CS participation–schools that were meeting or close to meeting the initiative's goal of broadening participation to all students, and schools that were offering some CS, but had stagnated in their progress. We also sampled schools with different CS implementation models–of the 20 schools in our sample, all eight of the elementary schools and one middle school followed the integrated implementation model and all nine of the high schools and two middle schools followed the stand-alone model.

### B. *Data Sources*

We conducted interviews with school administrators and CS teachers over Zoom (due to pandemic restriction on in-person site visits) between 2019 and 2022. For the majority of schools (85%), we were able to interview one administrator and one CS teacher and in 15% we interviewed two teachers. Interviews lasted between 45-60 minutes and were guided by a semi-structured protocol that asked participants to discuss their CS educational vision, instructional practices, and PD. Interviewees were also asked to reflect on the history of their schools' CS programming, the facilitators and barriers to increasing student CS participation, and sustainability.

### C. *Analytic Approach*

Our main analytic method followed Creswell's [8] data analysis spiral which allowed for a fluid yet systemic approach to analyzing qualitative data. First, the qualitative data was reviewed via a thorough iterative coding process, where segments of text were labeled with codes assigning symbolic meaning to the descriptive information [9]. We coded the interview transcripts using Dedoose, a computer-assisted qualitative data analysis software program.

We developed codes both deductively–drawing upon prior research and inductively–allowing codes to emerge organically from the data. The inductive coding and analysis allowed us to be attentive to concepts and relationships that surfaced as we reviewed the data. After coding, we created an excel matrix organized by participants and the summaries of their interview data by code, allowing us to distill common themes and consider dis-confirmatory cases. We took steps to enhance the credibility of our analysis, including triangulating interview data across teachers and administrators from the same school, and establishing inter-rater reliability across coders.

## VI. Findings

### A. *Implementation Barriers for Integrated and Stand-Alone Schools*

Across all of our interviews, teachers and school leaders noted persistent challenges that hindered their ability to offer CS instruction to all of their students. We found that these barriers had normative, structural and political dimensions that often overlapped–although they manifested differently by school implementation model.

Lack of buy-in–both from teachers, who were tasked with incorporating CS into lessons and units, and from administrators, who had the authority to set school-wide priorities–was a major normative barrier in many of the integrated model schools we studied. Buy-in suffered in part because many administrators and teachers did not initially understand what CS instruction entailed (e.g., a focus on building critical computational skills as opposed to using computers for typing lessons) and its potential to support student learning across different subject areas. This lack of understanding discouraged teachers from incorporating it into their instruction, because it felt to them like extra work with dubious returns. One school leader remarked how pervasive this sentiment was among teachers in the early years of his school's CS program, stating "*We had to [convince teachers] that it isn't just another thing you have to do–it's a better way of engaging children in the content and curriculum.*" Without understanding the importance and value of CS, teachers had little incentive to devote precious time to implementation.

Insufficient time to design lessons that fit into the scope and sequencing of other required curriculum remained a persistent structural barrier for integrated model schools, even when administrators and teachers were bought-in to offering CS. As noted by a CS teacher from a school that was struggling to broaden its CS participation, "*There are so many demands of a classroom teacher that to ask them to do this as well is hard. Trying to find creative ways to [fit CS in]—all that takes time*." Teachers and administrators pointed to other priorities that took precedence over CS–such as covering material for core subject areas that was tested in state exams. Thus, the lack of district accountability metrics for CS achievement was a political barrier that exacerbated normative and structural barriers, motivating schools to deprioritize CS. As noted by a school leader, "[CS] *is not part of the measures of accountability for schools. You don't do the things that people tell you are important, but the things that they show you are important*." He went on to say that if computational skills showed up on state exams, schools would treat CS instruction as a higher priority.

Most of the stand-alone model schools we studied tried to broaden participation and make access more equitable by exposing all students to CS opportunities, and then letting students decide if they wanted to pursue them. As one principal described, "*Equity is really about exposure and then choice. If you have exposure, and students are able to see themselves in CS and possibly opt in? That to me is what equity looks like*." However, none of the stand-alone model schools that only offered CS as an elective reached all of their students. As participation depended on student access and choice there were many normative barriers. Students' decisions to take CS were constrained by assumptions and beliefs on the part of both staff and students–including how welcome students felt in CS classrooms, or whether teachers or guidance counselors believed that only students with prior academic preparation (such as passing Algebra I) were ready to enroll. When presented with choices or faced with barriers to access, many students ultimately opted to take other electives instead of CS.

Moreover, for stand-alone schools, several capacity issues emerged as important structural barriers to even offering sufficient CS courses for all students to have access. First, school leaders noted that they struggled to hire enough teachers prepared to teach CS. Despite the expansion in PD opportunities afforded by the initiative and the fact that teaching CS does not yet require official state certification, they still reported that teaching CS in high school required specialized content knowledge that not all teachers possessed—particularly when it came to exposure to advanced programming languages. Second, even when there were sufficient teachers prepared to teach CS, those teachers were also needed to teach other core subjects that were graduation requirements, limiting how many sections of CS they could offer. At one high school, the assistant principal for math and CS explained, "*Math education takes a higher priority than computer science. While computer science is important to me, and it was my principal's idea to bring computer science into the school, it's not top priority*." Consequently, the fact that CS is not a graduation requirement became a political barrier, as schools were more likely to de-prioritize it when they had to make tough decisions about what courses to offer.

*B. Promising Leadership Strategies*

For schools following both the integrated and stand-alone implementation models, ensuring that leadership was distributed across multiple staff members–including administrators and teachers–was crucial in ramping up participation. While the impetus to offer CS was spearheaded by a "champion" teacher or administrator in all of the schools we studied, schools with sustained, high participation rates had a team that led CS implementation. As noted by a CS teacher from one such elementary school, "*You need a handful of people who can drive this work–enough people to make a team. You can't do this alone. It can't be the administrator just saying, 'Do it.'*" School staff pointed to PD opportunities offered by the district–which in part encouraged schools to create CS teams to lead implementation efforts—as key in building their leadership capacity.

The integrated model schools with the highest CS participation rates developed dedicated CS instructional teams that fostered distributed leadership across administrators and teachers. The teams supported classroom teachers through creating and sharing lesson and unit plans incorporating CS, and facilitating in-school professional learning opportunities that centered on demystifying CS integration. This cultivated buy-in among teachers as they learned how CS could support learning in other subject areas. As noted by one school principal, "*It was important to not just hear from me, but to hear from their colleagues about the importance of CS, and what growth they see from the children learning it*." Moreover, the CS teams alleviated some of the structural barriers that the teachers faced by setting aside common planning time and relieving them of the burden of creating lessons and unit plans on their own.

The stand-alone model schools with the highest CS participation rates also had school implementation teams with administrators and teachers. Their work began with envisioning how CS could tie into the school's curricular offerings to become a core part of the programming. For schools that did not already have a school-wide technology or STEM focus, this took some creativity. As an example, a high school with a musical theater theme began to offer courses in sound production and video editing. The implementation team also tackled capacity barriers by being attentive to which teachers might have the potential to teach CS–both when hiring new staff and when assessing the skill set of current staff, to determine who might be trained by the district initiative. Finally, once there was sufficient capacity in course offerings, the schools with high participation made CS mandatory for students to take. As another principal noted, "*if you want all students to take CS and not self-select, then you have to build a structure to support it*." However, this often entailed making difficult trade-offs about what electives were most important to offer to students.

## VII. Discussion

Our findings suggest that while it is useful to examine the normative, structural and political dimensions of barriers to implementation, it is also productive to understand how these barriers intersect with one another. In particular, we found that addressing normative barriers–such as a lack of buy-in among staff–was dependent on mitigating structural barriers that limited a school's capacity to offer CS. School staff were more likely to buy-in to offering CS if there was a feasible way (in terms of time and resources) to do so. In turn, both normative and structural barriers are impacted by political barriers—particularly whether schools are held accountable for offering and having students learn CS, which influenced the extent to which schools were motivated to offer CS.

Our findings also point to the need for the CS education field to explore how barriers to broadening CS participation vary by how the schools offer CS instruction. Much of the literature has focused on barriers to broadening participation in middle and high schools [2], [10]–which generally offer CS through a stand-alone implementation model. As integrated models become more prevalent as a strategy to increase CS participation, the field must also explore the barriers associated with implementing CS under these models. Integrating CS into required courses, such as math or science, could potentially remove some of the capacity limitations faced by stand-alone schools—such as not having enough teachers or time in students' schedules. Moreover, when taking CS is a requirement, it eliminates normative barriers to participation—such as assumptions that only select students are equipped to learn CS. However, our work underscores they are still capacity issues in terms of time and curricular planning that can make integrating CS into other courses challenging.

Finally our findings point to the importance of leadership in broadening school participation. It is notable that school teachers and administrators had the most power to address normative barriers, through influencing their schools' cultures so that broadening equitable CS participation was valued as a priority among staff. While some leaders made headway in tackling structural barriers—particularly in reshaping instructional practices to incorporate more CS, or envisioning ways to fit CS into school curricular offerings–they had less power to tackle many of the structural barriers that limited schools' capacity to offer CS (e.g., the need to cover curriculum that was mandated by the state through testing/graduation requirements.) This warrants further exploration into what equitable leadership strategies and policies are needed at the district and even state level to broaden CS participation.

## VIII. Limitations

Although we strove to include participants that were representative of schools with different levels of CS participation, our purposeful sampling strategy and sample of 41 interviews means that our conclusions may not be generalizable. A further limitation is that we did not include schools offering no CS in our sample.

## IX. Future Directions

We have several data collection efforts and analyses underway that will build upon and augment the research presented in this paper. First, we are conducting descriptive and inferential statistical analyses of district administrative records to examine how the characteristics of schools that have made more progress towards the initiative's goals compare to those lagging in participation. In addition, we are fielding a survey to school administrators and teachers across the district to understand how implementation barriers—which cannot be examined in depth through analyzing administrative records alone—might vary. Finally, we are conducting interviews with staff in district schools that have yet to offer any computer science to round out our sample of qualitative data. We hope that this additional mixed-methods research will produce findings that are more generalizable across the district, and support the initiative in its ongoing work to bring CS participation to scale.


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