# Equity in the Who, How and What of Computer Science Education: K12 School District Conceptualizations of Equity in 'CS for All' Initiatives

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***Abstract*—Equity is arguably an agreed upon value within the Computer Science education (CSed) community, and perhaps even more so within efforts to universalize access to CSed within K12 settings through emerging 'CS for All' initiatives. However, stakeholders often mean different things when referring to equity, with important implications for what CS teaching and learning looks like in schools. In this paper, we explore the question of how K12 school district actors' conceptualizations of equity manifest within their planning and implementation of district-wide CSed initiatives. Based on a research-practice partnership aimed at supporting and researching district-wide CSed initiatives, data presented - interviews with district faculty, district planning documents, meeting transcripts and field observations - were drawn from five participating school districts as they made decisions and enacted activities over 11 months in areas including vision-setting, curriculum, professional development, leadership efforts and use of formative data about implementation. Analyzing these data through equity frameworks found in CSed literature, we highlight three distinct but interconnected ways that district actors conceptualized equity within their CSed initiatives: (1) equity in *who* Computer Science is for, (2) equity in *how* Computer Science is taught, and (3) equity in *what* Computer Science is taught. Data show that these varied conceptualizations resulted in different kinds of decisions about CSed in districts. We discuss the implications of these findings in terms of their relevance to equity-oriented CS education researchers, and what lessons they hold for policy-makers and education leaders engaged in their own efforts to support equitable computer science education.**

***Index Terms*—Equity, district decision making, policy implementation, K12 CSed, CS for All**

## I. Introduction

Equity is arguably an agreed upon value within the Computer Science education (CSed) community, and perhaps even more so within efforts to universalize access to CSed within K12 settings through emerging 'CS for All' initiatives. However, stakeholders often mean different things when referring to equity, with important implications for what CS teaching and learning looks like in schools. For example, equity understood as equal treatment of all students, the definition offered in the landmark education case Brown vs. Board of Education [1], may have overlaps with an understanding of equity as the righting of historical social injustices, but these nuanced differences can easily manifest distinct educational approaches and policies. How equity is conceptualized matters when the rubber hits the road of educational practice. In what are still quite nascent efforts to bring computer science into K12 schools, it's important to understand how varied understandings of equity might play out on the ground. In doing so, the field may be able to better consider where and how certain dimensions of equity are being effectively met by current efforts, and where improvement is still needed.

Researchers, practitioners and policymakers focused on K12 computer science education voice a number of equity-related themes. Foremost are those of broadening participation [2] and goals of making computer science accessible for all [3]–[5], the former focusing on addressing issues of underrepresented groups in the STEM workforce, and the latter centering on ensuring universal access to CSed more generally. Related to these are pedagogically-focused discussions of what equitable teaching and learning look like for various groups, such as pedagogies appropriate for those with disabilities, women, ESL students, or black and brown communities [6]–[11]. Finally, broader societal acknowledgement of the role of technology platforms themselves as linked to production of social inequities has led some advocates to call for computer science curricula that actively teach about the social impacts of computing [12], [13]).

But what do these ideas mean on the ground, in key contexts - K12 school districts - that are currently attempting to institutionalize CS education? In this paper, we explore the question of how K12 school district actors' conceptualizations of equity manifest within their planning and implementation of district-wide CSed initiatives. Data presented was collected as part of a research practice partnership [14] focused on supporting district-wide CSed initiatives, and includes qualitative data - interviews with district faculty, meeting transcripts, district planning documents and field observations of planning

978-1-7281-0821-6/19/$31.00 ©2019 IEEE

meetings - drawn from five participating school districts. Data focused on capturing the deliberations, decisions and activities that district teams and broader faculty within associated districts engaged in around a number of areas related to developing comprehensive computer science initiatives for their schools - leadership efforts, vision-setting, curriculum and materials, professional learning and development and utilization of improvement data to inform decision-making.

Analyzing these data through existing equity frameworks found in CS literature noted above, our findings speak to three distinct but interconnected ways that district actors conceptualized equity within their CSed initiatives: (1) equity in *who* Computer Science is for, (2) equity in *how* Computer Science is taught, and (3) equity in *what* Computer Science is taught. Data show that these varied conceptualizations resulted in different kinds of decisions about what CSed would look like in their districts. We discuss the implications of these findings in terms of their relevance to equity-oriented CS education researchers, and what lessons they hold for policy-makers and education leaders engaged in their own efforts to support equitable computer science education.

## II. Equity in the Context of K12 Computer Science Education

In K12 computer science education there are a variety of equity-oriented discourses, each emphasizing different goals and relationships to the notion of equity. In this section, we highlight some of the most prominent, with an aim to establish that there is not a single, agreed upon understanding of equitable computer science education, and therefore a variety of equity-related goals that might be pursued by districts attempting to bring computer science to their schools.

Perhaps the most prominent notion of equity in CS education is encapsulated in the 'for all' moniker that's been linked to the broader movement to establish universal access to CS learning experiences [3]–[5]. 'For all' has been used both as a naming convention as well as 'rallying cry' of various local and national initiatives and organizations dedicated to expanding access to CSed within K12 contexts (e.g. CS4TX, CS for All Teachers, CS4All NYC), acting a shorthand for the goal of establishing equity in access for all learners regardless of their backgrounds in terms of gender, race, ability, socioeconomic status, and other factors.

Related to this is the frame of 'broadening participation', adopted as the primary equity-orientation of the National Science Foundation [2], which focuses on addressing the lack of under-represented groups within STEM careers and industries including women, minorities and persons with disabilities. In centering on issues of under-representation specifically, the broadening participation frame still focuses on issues of access, but can be seen as somewhat distinct from the 'for all' frame in that it actively highlights and acknowledges historical and contemporary realities of exclusion of particular groups from participation in computing culture.

For others concerned with access, having under-represented groups participate in CSed focuses less on the problem of a lack of diversity within computing industries in-and-of itself, and more on issues of economic inequality [15], [16]. Essentially, this perspective sees well-paying jobs in computing as ladders of economic opportunity for low-income groups specifically, which often, though not always, are the same groups that are underrepresented in computing professions. This focus on the relationship between computing, equity and jobs emphasizes economic mobility rather than representation, viewing computing careers as a mechanism for poverty alleviation for non-dominant populations.

Equity orientations focused on access to CS learning are linked to those concerned with questions of appropriate pedagogies for particular groups. For example, advocates of accessibility for students with special needs in computer science education [6], [17] do not simply argue that diverse learners should be present in CS classes, but that these classes, and associated instructional technologies, must be taught and designed in ways that are inclusive; grounded in principles of universal design for learning [18]. Similarly, those focused on teaching black and brown students, ESL students and those from indigenous communities see equitable CS education as requiring shifts in teaching to methods that are culturally and linguistically relevant, responsive and sustaining [7]–[11]. These viewpoints see that *how* CS is taught is inextricably linked to *who* has access to it.

Finally, preparing students to understand the social impacts of computing represents an equity-oriented view of computer science education learning goals. This conception of equity focuses on learners themselves grappling with varied forms of social inequality and ethics issues associated with computing technologies and platforms such as those related to bias, privacy, labor exploitation or erosion of democracy [13]. For example, the K12 Computer Science Framework includes as one of five central conceptual areas one related social impacts of computing, highlighting learning goals such as "An informed and responsible person should understand the social implications of the digital world, including equity and access to computing." and "design and use of computing technologies and artifacts can improve, worsen, or maintain inequitable access to information and opportunities" [12]. It also highlights as a central practice "fostering an inclusive computing culture", which includes "address[ing] bias in interactions, product design, and development methods". Such concerns around ethics and social impacts acknowledge the emergent realities of, for example, bias in algorithms [19], [20] and adverse effects of networked technologies on democracy and civil society [21], [22].

## III. School Districts as Contexts for Policy Implementation in Computer Science Education

The differing notions of equity noted above might seem somewhat abstract, even philosophical. But we see importance in taking such differences seriously in the context of the larger project of bringing computer science education into K12 schools, since bringing to CSed to scale can mean that slightly different understandings around equity might

have cascading effects within large, distributed and complex institutional systems that school districts represent.

Within the policy context of the United States, districts are a critical unit of change. Education reform has historically been largely decentralized in this country, with both state and local district-level actors playing a large role in determining the shape of education systems. Districts specifically play central roles in deciding questions of curriculum and assessment, graduation requirements, and professional development, among other things. And while some scholars and promoters of universal computer science education have noted that understanding policy implementation will be key to achieving their goals [23], [24], there are few studies that aim to understand the relationship between policy implementation and issues of equity (see [25], [26] for emerging work in this area), and none that look at how district actors' views concerning equity play out within decision-making about instruction.

This study draws on conceptual tools from a larger literature on policy implementation within districts concerned with how decisions are made and how they contribute to, or detract from, the development of coherent instructional systems [27]–[29]. This framework focuses on the importance of looking across many elements of instructional systems - including guiding vision, learning goals, guiding pedagogies, curriculum, professional development, leadership practices and organizational routines - in order to create alignment across these elements. For example, this view of instructional coherence holds that professional development opportunities should build teaching capacity in ways that align with the guiding pedagogy of a district, selected curricula should align with learning goals, and organizational routines should support the process of coordinating and aligning such elements of an instructional system.

In the context of understanding issues of equity, frameworks that aim to understand policy implementation in districts are useful in that they expand the view from solely looking at classroom contexts, aiming to understand the broader organizational systems that classrooms and teachers are situated in. Additionally, the particular framework of instructional systems coherence focuses on understanding linkages between broad goals and values held by actors within a system and how they are manifest in decision-making about various aspects of an instructional system that mediate equity.

In this paper, we aim to explicitly center on decision-making about instructional systems around CS education within districts, and in particular look at decisions that focus on issues of equity, as seen through the various orientations towards equity laid out in the prior section.

## IV. Methods, Data Sources and Analytic Approach

This paper is based on data collected as part of a research practice partnership (RPP) [14] focused on supporting K12 district level computer science initiative planning and implementation. The RPP includes a research team along with a partner non-profit organization that supports CS education nationally. Together, the project supported sixteen district teams across urban, suburban and rural districts in a geographically diverse region of the mid-Atlantic United States. Districts were supported in efforts to design coherent CS implementation plans that addressed issues of curriculum, leadership, professional learning, vision-setting and data-informed decision-making around CS education in their contexts. They were provided with planning frameworks, work time, financial reimbursement for portions of team planning time and consultation with the RPP team. District teams were convened during a series of strategic planning workshops between January 2018 and January 2019, and a subset participated in virtual cross-district and one-on-one calls with the RPP team. In these contexts, district teams engaged in planning around their initiatives, shared ongoing work with one another, gave and received feedback on proposed implementation strategies, and worked with the RPP team to develop approaches for collecting and analyzing district improvement data. Each district team ranged from six to twelve members, and districts were selected along a number attributes, including their size, the demographic makeup of their students, their CSed offerings coming into the project, and their desire to participate in the RPP. All were relatively small districts, with the smallest serving under 1,000 students and the largest serving just over 5,000.

Data collection with districts included initial applications and interviews with district leaders, principals and faculty to understand incoming contexts, field-notes and district created artifacts from RPP-led workshops where teams developed implementation plans, and transcripts of conversations from a wide variety of meetings between the RPP and district teams that took place throughout the project. Altogether, data collected on district planning and decision-making encompassed over one hundred pages of written notes, approximately 20 hours of recorded meetings and interviews, an additional 130 hours of meetings with recorded field notes, and dozens of district created documents related to their CSed initiatives including team meeting notes, internal guidance documents around their initiatives' goals and underlying values, budget plans, proposals for external funding, data collection plans, and information that district teams gathered for planning purposes about current CS activities in their schools. We include data related to five focal districts in this analysis, using pseudonyms for each.

The focal question we aim to address in this paper is: How do school district actors' conceptualizations of equity manifest within their planning and implementation of K12, district-wide computer science education initiatives? In order to answer this question, three members of the research team first coded qualitative data using a coding scheme developed based on an existing theoretical framework around district decision-making and instructional systems [28], [29]. One aspect of the codebook focused on decision-making processes and enacted activities (e.g. a goal being set, a potential activity proposed, an action being carried out, etc.) and another focused on what aspect of the instructional system a decision or activity related to (e.g. leadership, curriculum and instructional materials, professional learning, etc.). Throughout, we also coded for

any instances that either implicitly or explicitly focused on addressing equity concerns. In a second round of analysis, we returned to these data that specifically focused on equity and further analyzed them through existing definitions of equitable computer science education, including the noted frames of broadening participation [2], reaching all students [3]–[5], culturally and linguistically responsive computing pedagogies [7]–[11], addressing special needs students [6], ethics and social impacts in computer science education [12], [13], and addressing economic inequality through supporting access to technical professions [15], [16]. We aimed to surface data on both explicit instances of district participants or teams including rationales or values related to various conceptualizations of equity in CS education, and then also direct actions and activities that linked to and could be understood as reflective of those values.

## V. Findings

In looking across the plans and implementation activities in the districts we studied, along with the rationales provided for these decisions, our analysis showed three broad and interrelated ways of conceptualizing equity within district-level computer science education initiatives: (1) equity in *who* computer science is for, (2) equity in *how* computer science is taught, and (3) equity in *what* computer science is taught.

### A. Equity in who Computer Science is for

Aligning with prevalent rationales of bringing computer science to all K12 students, one conception of equity evident in the data centered on addressing equity issues around who is taught computer science. In Warren Central School District (WCSD), the idea of equitable participation was present in their initial application to participate in the partnership, where they noted that an important existing district goal is student equity. The application stated this as an intention for their forthcoming CSed initiative, stating that "creating assured experiences for all students, regardless of their teacher, socioeconomic status, native language or disability status is a high priority."

Similarly, Greenwood Unified School District (GUSD), in their district mission and vision for their CSed initiative stated that "Every GUSD student across race, class, gender, language, and ability level, will creatively and critically engage in representing and solving problems using computational and systems thinking." Finally, during one of the project's cross-district community calls, an assistant superintendent from Springfield Central School District (SCSD), shared the following about internal district discussions around the development of their CSed initiative:

> "We looked at the equity part of this, which was a huge part of our process. We do want all the students to be involved in this. So, we want our special ed students and especially in some cases, both genders, girls and boys being involved and taking advantage of those kinds of things."
>
> *-Juan, SCSD assistant superintendent, cross-district call May 10th, 2018*

Across these three examples, we see conceptions of equity that focus largely on who has access to CSed, both through the lens of universal access (as WCSD stated, "assured experiences for all students") that align with the broader 'for all' frame, and then also specifically noting sub-groups that have been traditionally underrepresented along lines of gender, race, socioeconomic status, language, and special needs, aligning with a 'broadening participation' frame.

While all of the above represent what might be considered fairly straightforward commitments to equitable learning, it is important to look with more specificity at how districts aimed to mobilize these equity commitments around who is accessing computer science within the context of the decisions they made in their implementations.

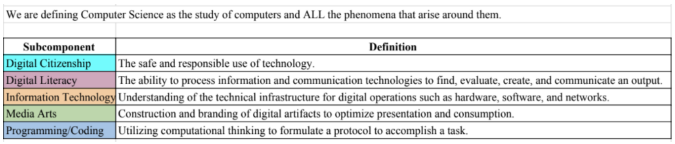
At one of the strategic planning workshops facilitated by the RPP team, one activity focused on helping participants link their rationales around CSed to implications for how they planned to carry out implementation in their districts. In this activity, a teacher and assistant superintendent from WCSD worked with one rationale for CSed they had come up with during the activity, that CSed "cultivates equal opportunities for all students in a K12 setting and in the post-secondary world". In coming up with implications of this rationale for their initiative, Warren Central School District listed the following activities in a planning document created on January 23, 2018:

- "[Create] assured experiences at each grade level k-9
- Track enrollment metrics
- Active promotion of CS opportunities to underrepresented groups
- Eliminate or minimize prerequisites
- Limiting scheduling barriers
- Intentional cultivating of the mindset of staff that all can and should participate in CSed"

All of the above represent various ideas that WCSD leadership and faculty considered as important for reaching their goal of equitable CSed access to all students, though the picture of how they aimed to translate this commitment into practice came into sharpest relief later in their initiative's development as they worked to define their initiative's specific learning objectives in the Spring of 2018.

The definition of computer science learning goals within WCSD was unique - it was intentionally broad, and inclusive of different approaches to CSed, as well as some elements such as digital citizenship and media arts which have variable overlaps, depending on how they are enacted, with learning goals found in CSed guidance documents like the K12 CS Framework. The Warren team shared their definition with us in the context of a document they were using to conduct a curricular audit. (see Figure 1).

At the top of the document they included a broad definition of computer science - "the study of computers and ALL the phenomena that arise around them", one offered by noted computer scientist Herb Simon and shared with the participating



We are defining Computer Science as the study of computers and ALL the phenomena that arise around them.

| Subcomponent | Definition |
|---|---|
| Digital Citizenship | The safe and responsible use of technology. |
| Digital Literacy | The ability to process information and communication technologies to find, evaluate, create, and communicate an output. |
| Information Technology | Understanding of the technical infrastructure for digital operations such as hardware, software, and networks. |
| Media Arts | Construction and branding of digital artifacts to optimize presentation and consumption. |
| Programming/Coding | Utilizing computational thinking to formulate a protocol to accomplish a task. |

Fig. 1. A screenshot from Warren's curricular audit document, showcasing their five part definition of computer science learning goals.

districts in the context of one of the RPP's strategic planning meetings. Below that, they outline various 'subcomponents' and what would get taught in WCSD within the context of their computer science initiative, including "digital citizenship", "digital literacy", "information technology", "media arts" and "programming/coding".

In discussions about it, Warren's leadership framed the broad nature of their definition of CS as something that would support teacher buy-in, and, in- turn, support equitable learning opportunities for students. Molly, the district assistant superintendent, mentioned in an initial interview that Warren's newer teachers are largely open to teaching various forms of CSed - both direct computer science activities (for example, Hour of Code) as well as CS integration into existing curricula. However, she stated that older teachers see computer science as limited to coding, and therefore a new skill that they must learn themselves in order to teach, as well as a competing priority in their lesson plans. During a call with our research team, she explained Warrens broad operationalization of computer science within their curricular audit this way:

> "I think some teachers are very comfortable with [CSed] and with teaching any form of computer science and some arent, which could account for why students have different experiences depending on who the teacher is. Part of this audit, maybe its expanded beyond curriculum to instruction to say how much of your instruction currently has some form of computer science and what is your efficacy towards those skills, using those tools as a professional and implementing them into your curriculum instruction assessment."
> *-Molly, WCSD assistant superintendent, cross-district call, April, 18, 2018*

The move for broad definitions of CS is seen both as a possible way to secure greater teacher buy-in by highlighting integration points that do not require specialized coding skills or pushing out existing content, but is also a way to improve equity, since a broader definition means more places that it might sit in a curriculum - not just in stand-alone programming classes that fewer students in the district are exposed to. In this case there is an interdependence between several elements of the instructional system at play in a decision-making process: how CS learning goals are defined, teacher buy-in, what teachers need to know about CSed, and equitable access to CS learning opportunities. Through a definition of CS learning goals that was broader than coding, district leadership changed the requisite teacher knowledge and thus, in theory, faculty buy-in, which would then mean a greater possibility of an initiative to have CS instruction reach all students.

This example highlights how complex decision-making can be when the 'rubber hits the road' concerning a fairly straightforward and common conceptualization around equity in CSed - who gets access to computer science learning experiences. The equity goal around reaching all students rippled through a number of interrelated elements that were the focus within the planning and implementation process, so much so that it mediated that ways that district leadership defined what learning outcomes should be specified to guide the initiative's curricular approach and attendant professional learning efforts.

### *B. Equity in how Computer Science is Taught*

The second broad conceptualization of equity found in the data relates to how computer science is taught. This conceptualization of equity centered not simply on who gets taught CS, but the modes of pedagogy utilized within classrooms. Though it often co-occurred with equity commitments around who had access to CS learning opportunities, this conceptualization added an additional dimension of what constitutes equitable access to include the ways that different curricula, tools and guiding pedagogies did, or did not, result in equitable learning for different groups of students.

Various decisions made by the Greenwood Central School District (GCSD) illustrate what this conceptualization of equity looked like in practice. In early goal-setting work by GCSD's team, they set as one goal to find curricula that is culturally and linguistically responsive and relevant to the identities of historically underrepresented and marginalized groups, indexing an orientation towards culturally and linguistically relevant pedagogies.

Throughout the project, GCSD faculty participating in CSed planning actively noted disparities in participation vis-a-vis their CSed offerings at the high school level. During a cross district call, Melissa, a technology integration specialist, noted the existence of high school courses in Advanced Placement CS, non-AP CS, and Computer-aided Design (CAD), stating that:

> "...we have a lot of strong offerings. But we're not reaching a really broad or diverse population of students. [...] The kids who sign up for these classes are the same kids taking all of those classes."
> *- Melissa, Technology Integration Specialist, GCSD, March 13th, 2018*

In order to address this, the curriculum committee within the broader GCSD CS planning team began exploring the possibilities of working with their high school teachers to develop new courses that would be interdisciplinary and integrate computer science practices, setting aside lesson planning days for the coming summer to support integrated course development. They noted possible courses in arts, business, media arts and English language arts that incorporated CS with the rationale that these would appeal to a broader range of students, and not just enroll "the same kids" that were already taking advantage

of existing electives explicitly framed as being about computer science.

Additionally, during the summer of 2018, GCSD sent one of their high school teachers to an external professional development called Tapestry, which focused on "shar[ing] strategies, research-based practices, and field-tested good ideas for teaching high school computer science in a way that reaches all students regardless of sex, race or ethnicity", a manifestation of their commitment to developing the capacity of teachers to engage in CS pedagogies relevant to a broad range students coming from diverse backgrounds.

While an approach to equity in CS education that focuses on how CS is taught is deeply linked to the question of who it is taught to, the decisions noted above that GCSD made based on this commitment show that there are important implications in practice for this particular definition of equity in CSed. Rather than simply assuming that they needed to get computer science to more students, faculty were attending to the very make-up of those learning opportunities. They made decisions about the kinds of pedagogies they employed, understanding that developing culturally relevant teaching strategies for CS would be appropriate for students from diverse cultural and linguistic backgrounds. They invested in developing the capacity of their educators to teach CS in way that attended to student backgrounds. And critically, they re-thought how CS learning opportunities were framed and their purposes - in decentering from only offering electives explicitly focused on CS and developing interdisciplinary courses, they positioned new learning opportunities not solely as means to learn computer science for its own sake, but as ways to engage with other disciplines and student interests such as arts, humanities and business. In doing so, they offer an example of what decisions might be made at the district level when conceptualizing equity as a question of how CS is taught.

### *C. Equity in what Computer Science is taught*

The final conceptualization of equity in CS education present in district planning and decision-making concerned ensuring equity in *what* computer science is taught. Where the two previous conceptualizations focused on who gets taught and how teaching is practiced, this commitment focused on what kinds of skills, practices and learning outcomes should be part of CS curriculum in order to meet equity goals.

In developing their vision for why they wanted to bring CS to their students and the projected impacts associated with CSed, a number of districts included equity-oriented values that would substantively impact curricular learning goals. For example, in Charlesville Central School District, the team included that "as a marginalized/disadvantaged community, our students need to have opportunities to explore the work and career skills that flow from computer science" (their emphasis), centering on professional opportunity and mobility that might address issues of economic inequality facing their students. At the same time, they also included in their vision statement that teaching computer science would help students to be aware and wary of "big institutions - government, media, corporations", though did not specify this in more detail in terms of how it might achieve this. However, it is not hard to imagine how both of these values might lead to specific curricular decisions. For example, in focusing on economic mobility and career opportunity for disadvantaged students, CCSD might aim to develop an internship program that linked their older students to early work experiences in local technology companies.

In Starling Central School District's planning documents we see a more direct link between equity values and what CS curricula might teach. In their values and rationales for bringing CSed to their district, they stated that they aimed to teach CS in order to help students "critique and address structures of power and inequality" and "think critically about technological platforms". In thinking through what these values implied for what their instruction would look like, they included adding content to their curriculum that "specifically explored issues of who possesses power and why", and "specifically looks at the inequality of the technological world, who is making decisions and why, and how to address the power imbalance".

A final example of the how commitments to equity can be indexed in district decisions around what gets taught within CS courses can be seen in Warren CSD's decision that their CS initiative's learning goals must include keyboarding skills in order to achieve equitable CS learning. During a July 2018 planning workshop, as the team discussed the development of a K12 scope and sequence of learning goals for their CSed initiative, they discussed the reality that many of their students didnt have opportunities to develop fundamental typing skills that are necessary for engaging in CS, with one team member noting that "home access [to computers] isnt there for 40% of [our] kids".

Keyboarding - a skill that is more often the subject of derision by CS advocates due to experiences of having to correct misconceptions around 'what counts as CS' - is seen very differently here by a cross-level district team, inclusive of teachers, specialists and leadership. The group was both highly attendant to equity issues facing their students while simultaneously valuing the development of an initiative that focused on far more advanced computing skills. For them, their equity-based values for addressing the needs of a diverse and disadvantaged population of students led to a common understanding of keyboarding as a necessary prerequisite for engagement in more advanced computational tasks, and thus a necessary learning goal to include if the district was going to achieve equity around CS learning.

The primary examples shared in this section highlight the ways that commitments to equity manifest in variety of ways when it comes to what is included within CSed curricula within districts. On the one hand, Starling's equity orientation led to a decision to include learning goals around the social impacts of computing including curricula that "specifically looks at the inequality of the technological world". In choosing to include keyboarding skills within the larger scope and sequence of learning outcomes associated with the larger CSed initiative, Warren CSD shifted what constituted the 'what'

of computer science in their district in a way they believed was necessary in order to achieve equitable participation the broader computer science learning opportunities they were planning.

The two examples are also quite distinct from each other in terms of their equity goals. In the case of Warren CSD, the decision to include keyboarding can be seen as a decision around *what is taught* thats in service of an equity goal around *who is taught*. If WCSD was not concerned with its CS learning opportunities reaching all students - a conception of equity centered who is taught CS - they may not have needed to include this shift in what is taught as part of that initiative. In the case of Starling CSD, the equity goals associated with teaching about social impacts are not connected to questions of who their students are, but ostensibly in promoting a more equitable world by equipping their students with knowledge about how to critique and change structures of power embedded in technological systems.

## VI. Discussion

Guided by both existing notions of equitable computer science and frameworks around district-level planning and implementation, this study aimed to shed light on how ideas about equity play out on the ground. Data highlight three distinct, but intertwined, broad conceptions of equity in CSed as they were expressed and enacted in district decision-making - *who* is taught computer science, *how* computer science is taught, and *what* computer science is taught. Data highlighted ways that such commitments translated into practical choices in areas like curriculum and course development, professional learning, learning outcomes and broad visions that guided implementation.

In the data, we see variation in how complex the 'translation' was between conceptions of equity and how these commitments were put into practice. For example, Greenwood CSD's understanding of equity as needing to focus on how computer science is taught led to one fairly straightforward decision - sending teachers to a professional development opportunity about teaching under-represented groups - and another that was more nuanced - deciding to develop integrated, cross-disciplinary courses at the high school level that they believed would attract more diverse students.

Indeed, in some cases we see highly complex considerations on the part of district leadership in their efforts to enact their particular equity goals. Warren CSD's district team, for example, actively shaped their definition of CS-related learning goals such that it might create greater buy-in from teachers through a broader conception of what kinds of teacher capacity would be required. They believed that a sole focus on coding would result in teachers not seeing themselves as being able to teach CS, and thus not be bought into the district's CSed initiative. In carefully crafting learning goals to include ones that were beyond coding, they believed they would be able to reach more students and achieve their equity goals.

This example highlights an important consideration regarding intersecting relationships between different conceptualizations of equity - in seeing the ways that "who is taught CS" might mediate "what CS is taught", the example invites consideration about ensuring equity on multiple dimensions. It was not the case with Warren, but it is possible to imagine districts, in their efforts to reach all students (equity in 'who' is taught), might choose to water down learning goals to the point where what is taught might no longer considered equitable (equity in 'what' is taught).

We believe that it is important for policymakers at all levels to consider multiple conceptions of equitable computer science education, as well as their intersections. For district leaders, this can mean thinking through not just the ways to ensure that all students have access to CSed learning opportunities (equity in 'who' is taught), but also that these experiences are taught in equitable ways (equity in 'how' teaching happens), and that learning goals speak to both equity needs and as well as consideration of how equity issues associated with technology are taught within curricula (in equity in 'what' is taught). For those that operate at the state-level, where often the primary levers of change might focus purely on standards (the 'what') or graduation requirements (the 'who') they should also consider ways that their policies might positively impact equity in terms of equitable approaches to teaching CS (the 'how'), through supporting particular forms of professional development that aim to build teacher capacity to teach under-represented groups.

A number of limitations are important to qualify the findings of this study. From the standpoint of organizational change, looking at implementation data from one year, especially the first year of planning and activities in an area of reform, is a short period of time. Many of the districts highlighted were more engaged in activities related to long term planning, buy-in and resource allocation than ones that focused on direct instruction or even professional development. As such, we are not able to make robust claims about how various commitments and understandings of equity might be ultimately translated, or not, into direct student learning experiences and outcomes. To more deeply understand this issue, further research should aim to develop more robust longitudinal case studies and data sets to see how decisions play out over time, and especially how data can shed light on equity outcomes related to teaching and learning.

Additionally, this study did not examine differences within district actors' viewpoints about equity in computer science. There is no reason to believe that such views are consistent within a district; indeed broader factors related to organizational coherence would likely mediate whether faculty have shared understandings of equity. The intersection and negotiation of such viewpoints among district leadership, principals, and teachers presents an important area for future research on enactment of equitable computer science in K12 schools.

This study represents a first step in developing a deeper understanding of the relationship between implementation of computer science in districts and varied conceptualizations of equity. We believe that our findings definitively show that how equity is understood by actors in K12 education systems

matters in terms of what happens on the ground. In that K12 CS education is a young field, we see it as critical to center questions of equity from the start. If we better consider how different dimensions of equity are being addressed, or not, by current efforts, we can better focus attention and resources on areas where improvement is needed.

## VII. Acknowledgements

The authors would like to thank our district partners who generously and openly shared about their work to bring computer science education to their students. Support for this project was provided by the National Science Foundation award #1738675.

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