

**District Science Coordinators' Conceptions of and Levers for Advancing Equity Agendas
at the Elementary Level**

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Introduction

Equity is a core feature of science education reform initiatives in the United States (National Academies of Sciences, Engineering, and Medicine, NASEM, 2022; National Research Council, 2012), and these and other educational reform efforts rely on leaders, broadly construed, to gain momentum, validation, and prioritization (Firestone et al., 2005; Leithwood et al., 2004). Yet, there is not one agreed-upon definition of what equity is, resulting in different approaches for the benefit (and exclusion) of different groups according to different worldviews (Farrell et al., 2023). Thus, attending to those responsible for leading reform initiatives and the context within which they work is imperative for understanding the advancement of equitable reform efforts in science education. In this paper, we focus specifically on the role of district science coordinators and their pursuit of equitable elementary science reforms.

School district leaders play many important roles in implementing educational reform efforts (Turner & Spain, 2016). Burch and Spillane (2004) describe district leaders' roles as brokers, translating upper-level administrative visions and policies into practical tools and resources available to schools and classrooms, thereby brokering "resources, knowledge, and ideas within and across the district" (p. 3). Honig describes district leaders as bridging between policies and practices for schools, for example through capacity building (Honig, 2009), as well as buffering, for example by strategically deciding to engage external demands in limited ways (Honig & Hatch, 2004). Lesaux and colleagues (2014) additionally describe district leaders as instructional leaders, supporting change in classroom instruction through knowledge of instructional practices and adult learning. Still others note that school district leaders may collaborate with schools to support teachers in improving teaching and learning in ways responsive to external policy pressures and internal ambitions (Peurach et al., 2019; Spillane, Seelig, et al., 2019). As such, school district leaders are central actors in mediating relations between policy and classroom practice.

For science education, a science curriculum coordinator in the central office, or what we refer to as a district science coordinator (DSC), often occupies this middle-management role in school districts. Whitworth and colleagues (2017) describe DSCs as key implementers of NGSS-aligned reforms in districts through developing curricula and providing PD, in line with the broad-stroked descriptions of district leaders' roles described above. In addition, Whitworth's research group (2018) describes DSCs as teacher leaders and instructional coaches, sometimes working directly with teachers in classrooms to support their science teaching. Furthermore, Lyle and colleagues (2023a) found that DSCs collaborate with a range of individuals and organizations within and beyond the district to garner attention for elementary science reform, establish an infrastructure for instruction, and support teachers in using infrastructure in practice.

The heretofore described leadership practices of DSCs are neutral on issues of equity—one might imagine they could be enacted with deliberate intentions towards more equitable science learning outcomes and opportunities for elementary students or devoid of such intentions. From other research, we can glean some ideas about how educational leaders think about and enact equity within their leadership practices. For example, Farrell and colleagues (2022) studied

educators involved in research-practice partnerships and classified their 'logics' of equity according to achievement and standardization; identity, culture, and belonging; and power, justice, and anti-racism. They also sorted the solutions that participants identified (including leadership practices) across these three categories. In other research, the work of infrastructuring (e.g., designing, modifying, supporting, or eliminating infrastructures such as curriculum materials, guidelines, and tools) is noted as crucial in promoting equity and justice (Bell, 2019; Penuel, 2019). In addition, Marshall and Penuel (2022) reported how a superintendent of a California school district emphasized the importance of identifying and confronting biases among educators and educational leaders.

Given the key role that district science coordinators play in the implementation of reform, and the wide range of understandings of what equitable science education reform may look like, this paper seeks to better understand how DSCs conceptualize equity as it relates to their work and the levers they use to move their districts toward more equitable elementary science instruction. While we define *equity* in science education as the work of removing barriers to participation in science, through changing policies and practices, and *justice* as addressing the systemic oppressions that cause those barriers (NASEM, 2022), in this paper we are mainly concerned with DSCs' own conceptions and actions.

Theoretical Frameworks

Performative ontology

For this study, we begin from the position that conceptions of equity are not situated in the preferences of individual district science coordinators (DSCs) but are constructed and reproduced in their everyday interactions with other central office staff, teachers, and administrators, as well as the material structural arrangements that define their practice. As such, equity is materialized within the practices DSCs engage in. We take on a performative ontology (Butler, 1993) to position equity as an object that emerges within these discursive practices. This means that equity is not a static epistemological construct; equity is continually brought into being, defined and redefined by different groups of actors through their material-discursive practices to advance particular goals (Farrell et al., 2022; Turner & Spain, 2016). Therefore, equity can change over time or stabilize as it is reproduced. This stance shifts us away from asking questions about how *well* DSCs are defining and/or enacting equity according to some imagined ideal. Instead, this lens allows us to focus on questions about the stabilization and transformation of equity practices, and what this means for DSCs' work in elementary science.

From a performative perspective, the set of practices one is engaged in informs and bounds what equity is and how it is conceptualized by participants in the practice. That conceptualization then (re)informs equity performances, such that equity becomes a "sedimented effect" of these practices (including both conceptualizations and performances) over time (Butler, 1993)—that is, they stabilize. As equity is practiced (and materialized) within a particular context, the concept and associated performances become regulated, marking some

things as in and others as out (Foucault, 1971). Butler (1993) uses Foucault's term *regulatory ideal* to describe this effect. Consequently, if a DSC were thoroughly enmeshed in material-discursive practices that conceptualize and perform equity as predominantly about equal access to high quality and standardized curriculum materials and equitable attainment in standardized tests, this can become a regulatory ideal that shapes how they conceptualize and perform equity. If so, alternative and competing equity discourses, around power, justice, and anti-racism, for example, can become unrecognizable as equity.

Regulatory ideals stabilize and regulate, but there are also opportunities for change and transformation. Since it matters who or what is included within equity practices, including different voices within a practice can redefine how equity is conceptualized and performed. For example, if community members are included in equity practices in a school district, they might advocate for extra resources to support emergent multilingual students in science. Alternatively, the EQUiP rubric (Achieve & National Science Teachers Association, 2014) being used in curriculum adoption might make differentiated instruction a central piece of equity as the DSC conceptualizes and performs it. In both cases, particular ideas about equity become part of how equity is done, or, in terms of performative ontology, what equity *is* within this space.

As practices sediment, events can occur that deviate from the norm and cannot be described, explained, or resolved within the prevailing discourse (Butler, 1993). For example, the murder of George Floyd and the national reckoning with issues of racial justice may have unsettled equity discourses in districts and schools that primarily focused on accommodations for students with learning differences, thus requiring a reinvention of what matters in performing equity in schools and classrooms.

Equity Framework

'Equity' in (science) education is a widely used, yet perpetually negotiated construct. For example, Philip and Azevedo (2017) described three ways that equity appears just in one document, the *Framework for K-12 Science Education* (NRC, 2012): that of building the STEM labor force in the U.S., a colorblind perspective that is concerned with fairness and equality, and a social justice orientation (though one that positions injustices as historic rather than ongoing). They further identify student achievement, student identification with science, what counts as 'science', and a location of science in (contemporary) justice movements as additional "discourses of equity" in science education. NASEM (2022) builds directly on this analysis, framing four necessary and complementary "approaches to equity": increasing opportunity and access, increasing representation and identification, expanding what constitutes science, and seeing science as a part of justice movements. This wide scope of equity conceptualizations illustrates its "contested terrain" (Philip & Azevedo, 2017).

Burgess and Patterson Williams (2022) have worked to (re)orient the field of science education towards equity by describing the "work" of equity, and how it is "created" by actors within a system to move towards justice and to right wrongs. From the framing of performative ontology, this allows us to locate equity in the *work* of system leaders. Burgess and Patterson

Williams (2022) also emphasize the importance of attending to the macro-layer of equity, noting that few researchers in science education do so:

The field needs to deepen its engagement with theories that recognize equity as more than a matter of personal interactions (i.e., at the micro-layer) to a broader acknowledgement of the intersectional nature of the systemic factors (i.e., ideologies, discourses, institutions) that shape science education. (p. 1077)

Thus, attending to the broader ideologies, discourses, and, in our case, central offices, is critical to understanding the equity work, or performances, of district leaders.

For this study, we drew on several equity frameworks to locate and describe the sedimented discourses and ideologies present in our data. First, as noted above, Farrell and colleagues (2022) delineated three approaches (or “logics”) of equity among participants of research-practice partnerships, each with different purposes: achievement and standardization; identity, culture, and belonging; and power, justice, and anti-racism. While Farrell and colleagues combine achievement and standardization as a set of goals, we untangled those concepts as two distinct conceptualizations of equity. From other equity frameworks (NASEM, 2022; The Leadership Academy, 2021), we also borrowed the discourse of access and opportunity. Together, these discourses helped us to analyze normalized patterns of DSCs' equity conceptualizations and performances.

Educational System-Building Framework

We complement the performative ontology and equity framings by also drawing on organizational perspectives in educational reform and leadership to guide our analysis. In particular, we apply an educational system-building perspective to understand DSCs' work advancing equity as situated in broader district efforts to build systems for organizing and managing instruction in elementary science.

From an educational system-building perspective, central office leaders collaborate with school leaders and teachers to organize and manage the day-to-day work of classroom instruction (Peurach et al., 2019; Spillane, Peurach, et al., 2019). Educational system-building involves five domains of work, including (a) building educational infrastructure, (b) supporting use of that infrastructure in practice, (c) managing environmental relationships, (d) managing performance, and (e) developing and distributing instructional leadership (Peurach et al., 2019; Spillane, Peurach, et al., 2019). The educational system-building perspective is in contrast to more conventional notions of central office leadership that focused on the administrative functions of education, including staffing teachers in classrooms, resourcing those classrooms with instructional materials (Metz, 1990; Meyer & Rowan, 1978; Peurach et al., 2019), and delegating the work of organizing and managing instruction to classrooms (Cohen & Mehta, 2017; Rentner et al., 2016). Districts engaged in educational system-building move beyond administrative functions of schooling and take on responsibility for organizing and managing instruction in districts.

A key matter for DSCs seeking to advance equity in the context of elementary science is to incorporate equity practices into the work of educational system-building as the district supports instruction and its improvement. In so doing, DSCs have the potential to build equity practices into the broader fabric of district efforts to support instruction. An analytic question to consider is whether or not the domains of educational system-building serve as a context in which DSCs take up equity practices.

Research Questions

Figure 1 offers a conceptual integration of our three frameworks. Combined, these frameworks offer lenses for answering three research questions: (1) How do district science coordinators (DSCs) conceptualize equity? (2) How do DSCs enact or perform equity? (3) How are DSCs constrained, enabled, and empowered in their pursuit of equity in elementary science instruction?

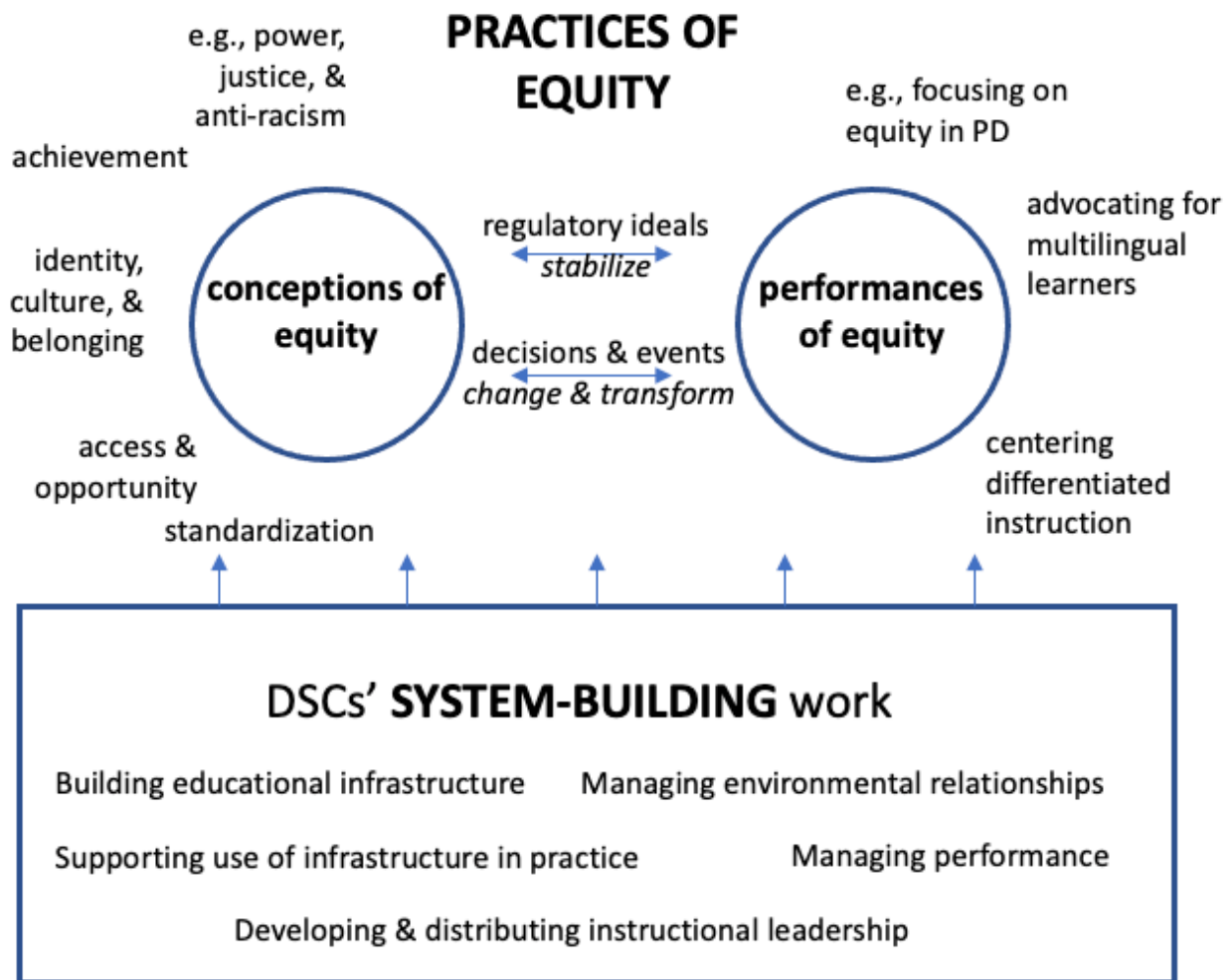


Figure 1. Theoretical frameworks

Methods

This research is part of a larger study of instructional systems supporting improvements in elementary science; thus, there is a focus in the data and analysis on the promotion of elementary science in particular. For this paper, we conducted a comparative case study of one district science coordinator (or equivalent) in each of thirteen school districts across the U.S.

Study Context

The thirteen school districts are located across six states and four regions in the United States and represent urban, suburban, rural, and charter school systems. We utilized a snowball sampling method to select the sites. First, our full research team reached out to our own contacts nationally to inquire about states that were engaged in innovative work to improve elementary science instruction. Those contacts put us in touch with additional people to reach out to. We ultimately contacted 67 people nationwide, resulting in 19 recommended states. After interviewing state science coordinators in 18 states (see analyses in Haverly et al., 2022; Lyle et al., 2023b), we narrowed down that list to six states that we determined had policy environments that may be amenable to districts engaging in system-building work to advance elementary science instruction.

We then conducted snowball sampling again, reaching out to leaders across each of our six states to recommend school districts also engaged in innovative work to improve elementary science instruction. Again, those contacts put us in touch with additional people to contact. We contacted 136 people across all six states, resulting in roughly 45 recommended districts. We researched the districts' websites; tabulated publicly available data on demographics, urbanicity, elementary science programming, and student achievement; and spoke informally with as many district science leads as possible. We created a matrix of districts across the states to select and recruit districts that would represent as wide a diversity in our sample as possible, including in their approaches to science education reform. We ultimately recruited thirteen school districts from this process. Tables 1 and 2 summarize some of the characteristics of our participating districts. All proper names—for districts, DSCs, other school staff, towns, and organizations (e.g., professional development corporations; curriculum developers)—are pseudonyms, with the exception of states.

Table 1
School District Characteristics

District	State	DSC	Total enrollment (K-12)	# of elementary schools	Type of district	Urbanicity
Bartlett	Massachusetts	Yvette	3,000	5	Public	suburban
Brookeport	Massachusetts	Opal	45,000	75	Public	urban

Chester	Oklahoma	Breanna	35,000	30	Public	urban
Fairby	California	Tessa	30,000	25	Public	suburban
Hartwell	Arkansas	Ursa	700	1	Public	rural
Hillman	California	Kaitlyn	3,000	5	Public charter	urban
Jasper	Oklahoma	Trinity	12,000	5	Public	suburban
King Park	Louisiana	Farrah	5,000	5	Public charter	urban
Lockeford	California	Derek	4,000	5	Public	rural
Norhaven	Oklahoma	Keith	14,000	15	Public	suburban
North Valley	Michigan	Fiona	6,000	5	Public	suburban
Rivercrest	Michigan	Whitney	500	1	Public	rural
Silverbay	California	Nicholas	100,000	100	Public	urban

Note. School & enrollment counts have been approximated for anonymity.

Table 2
District Student Demographics (K-12)

District	African American/ Black	Asian (any Race)	Native American	Hispanic (any Race)	Multiple Races	White	English Learners	Students w. Disabilities	Socio-economically Disadvantaged
Bartlett	7%	18%	0%	7%	4%	64%	5%	14%	15%
Brookeport	29%	9%	0%	42%	3%	15%	29%	22%	63%
Chester	21%	2%	3%	58%	5%	12%	41%	19%	58%
Fairby	2%	70%	0%	14%	3%	10%	13%	9%	20%
Hartwell	1%	1%	5%	3%	3%	86%	1%	14%	70%
Hillman	3%	9%	1%	55%	7%	27%	12%	15%	44%
Jasper	7%	13%	6%	13%	11%	50%	15%	19%	35%
King Park	92%	0%	0%	5%	1%	1%	3%	14%	93%
Lockeford	3%	4%	1%	34%	5%	53%	7%	17%	45%
Norhaven	6%	3%	4%	15%	14%	57%	6%	19%	44%
North Valley	7%	48%	1%	5%	3%	36%	20%	6%	12%
Rivercrest	2%	1%	38%	2%	0%	57%	0%	13%	67%
Silverbay	7%	15%	<1%	44%	8%	24%	19%	11%	57%

Note. Race/ethnicity categories vary across states and are synthesized here. Values are approximate percentages

DSC Participants

Data in this analysis draws from n=13 case study DSCs (see Table 1 for pseudonyms). In some districts, there was no identified science coordinator in the central office. For example, in two of our rural districts, the elementary school principal was the closest the district had to an

instructional leader in elementary science, so we counted those participants as 'DSCs' for the purposes of this analysis. Another district organized its curriculum department differently, abandoning mathematics, ELA, or science coordinators, and instead hiring generalist coordinators responsible for all subject areas—here we identified the executive director of the curriculum department as the 'DSC' for the purposes of this analysis.

Though we did not inquire about demographic information from our case study DSCs, according to research by Whitworth and colleagues (2017), DSCs are typically white women with science degrees and secondary science teaching backgrounds. In rural or smaller districts, they are less likely to have science degrees and more likely to have responsibility over multiple content areas. In urban or larger districts, they are more likely to have science degrees and have more responsibilities. These statistics appear to be more or less representative of our sampling as well, as most of our DSCs presented as white women with a few white men, some shared with us their educational backgrounds with science degrees (with some exceptions, especially among the three DSCs whose formal roles were not actually science coordinators), and many came from middle or high school science teaching positions (with some exceptions coming from elementary or informal teaching positions).

Data Sources

Three data sources were analyzed for this paper: semi-structured interviews (n=26), field notes from observations (n=34), and artifacts (n=32). Two interviews were conducted with each participant with two exceptions (one interview with Whitney in Rivercrest; three interviews with Nicholas in Silverbay)—interviews were conducted over Zoom, audio-recorded, and transcribed. The first interview took about one hour, and these mostly took place in fall 2020. This protocol was designed to inquire about DSCs' backgrounds, their roles and responsibilities, the communities they serve, their vision and priorities for elementary science teaching and its improvement, the curriculum materials and professional learning opportunities available to elementary teachers in the district for science teaching, how they monitor how well their initiatives are progressing, and the various networks and supports they draw on from their external environment to engage in this work. (Note that these questions largely map onto the system-building framework presented above.)

The second interview took between 45 minutes to one hour, and these mostly took place in summer 2021. This follow-up interview protocol was designed as an opportunity for us to check our understanding given the data we had gathered in the interim (including interviews with other central office administrators, observations of routines and practices related to elementary science, and artifact collection). We also used the follow-up interview to ask questions directly related to the COVID-19 pandemic and to George Floyd's murder given the effects these two events were having on districts nationwide.

A secondary source of data for this analysis were observations. We asked to observe at least one district-level routine related to elementary science. In many cases, this involved observing a PD offered by the central office for elementary teachers. We also observed

curriculum adoption committee meetings, PLC meetings with some district-level oversight, and teacher advisory meetings. For this analysis, we focused our attention on those observations that directly involved the DSC. Members of our research team conducted the observations remotely, mostly over Zoom, and took field notes. The field note protocol relied largely on low-inference note-taking with reflections afterwards according to the system-building framework presented previously.

Finally, a third source of data involved artifact collection. These artifacts included such things as: district vision statements, PowerPoint slide decks from observed PDs, evaluation rubrics for curriculum materials selection, samples of district-created curriculum materials or scopes and sequences, and so on. For this analysis, we primarily used these data sources to triangulate claims from the first two sets of data.

Data Analysis

We first analyzed the full data corpus by coding all district-level interviews according to the system-building domains presented previously in addition to a few ancillary codes, including 'equity.' The ancillary codes served as large buckets to capture references that may be salient (Saldaña, 2016). We also developed detailed analytic memos for each district that synthesized our learning across all gathered data and described each district's system-building work (Miles & Huberman, 1994).

For the purposes of this analysis, we then analyzed the 'equity' coded references from our case study DSCs' interviews across multiple indicators of equity (including how equity was defined, how students were talked about, and how the system was talked about), frameworks of equity (as described above), along with open coding (e.g., to account for the influence of the external environment) (Saldaña, 2016). After this preliminary coding, we then returned to the full data set to more fully capture DSCs' conceptualizations and performances, beyond what we had originally coded as 'equity'. We used our preliminary coding alongside existing equity frameworks (Farrell et al., 2023; Khalifa et al., 2016; NASEM, 2022; Shah, 2018; The Leadership Academy, 2021) to develop memo templates. The templates included several sections for organizing data along with example indicators from existing frameworks or our own preliminary coding. The section headers for the memo templates were:

- (1) How is equity defined?
- (2) How are students and communities talked about?
- (3) How is the school system talked about?
- (4) How is elementary science talked about?
- (5) What levers do DSCs identify for equity work?
- (6) How well-developed and/or coordinated is the equity program in the district and/or science department?

As a group, we iteratively moved back and forth between the data set described above (interview transcripts, observation field notes, and artifacts), existing equity frameworks, and the memos,

discussing along the way our interpretations of the data, comparing across cases, and identifying emergent themes in response to our research questions (Saldaña, 2016).

As a research team, we decided early on that we did not want to ask too directly about how DSCs conceptualized equity (e.g., In what ways do you think about equity in your work?). This was because we believed that some DSCs would feel pressure to describe equity in ways that they understood to be politically correct or in ways that they expected we would want to hear. We also recognized that some of our DSCs worked in state political contexts in which they might reasonably feel uneasy about being recorded talking about equity. To manage this dilemma, we instead asked questions about DSCs' communities and whether they served any groups of students differently in the district. Toward the larger project goals, most of our interview protocol was focused on DSCs' efforts to improve elementary science education, and from these responses, too, we were able to glean insight into their priorities around equity. The interviews thus provided us with rather candid, if sometimes roundabout, responses about equity. These responses offered us insight into whether, to what degree, and how DSCs incorporated equity commitments into their leadership practices. For example, when asked about curricular adoption processes, some DSCs raised equity as something they cared deeply about and described how they went about selecting materials that would support their equity commitments. In their responses, we were able to infer equity conceptualizations related to, for example, access, identity, or justice. We were careful, however, to keep the limitations of our interview protocol in mind as we interpreted our data. For example, if a DSC did *not* mention equity as a consideration in curriculum adoption, we took care to analyze their comments in light of the questions that were asked, rather than assuming a "right answer" to the question.

We explore our findings next.

Findings

We begin our findings by looking across all 13 case studies comparatively to understand variation in how DSCs conceptualized and performed equity in their work, as well as factors that appeared to enable or constrain said performances. We then round out our findings section with the presentation of two case study DSCs who performed equity in elementary science education differently, and as such, represent interesting cases to compare and contrast in more detail.

Research Question 1: DSCs' Equity Conceptualizations

Our first research question was, *How do DSCs conceptualize equity?* Across our data set (Table 3), discourses of access and opportunity were present in the majority of cases. We also found evidence of an achievement stance; an equity stance related to standardization; an equity stance rooted in identity, culture, and belonging; and one of power, justice, and anti-racism. Many DSCs practiced equity in ways that included multiple conceptualizations.

Table 3

DSCs' Conceptualizations of Equity

DSC	District	Access & Opportunity	Achievement	Standardization	Identity, Culture, & Belonging	Power, Justice, & Anti-Racism
Yvette	Bartlett	X			X	
Opal	Brookeport	X			X	
Breanna	Chester	X		X		
Tessa	Fairby	X				
Ursa	Hartwell	X	X		X	X
Kaitlyn	Hillman		X		X	X
Trinity	Jasper	X		X		
Farrah	King Park	X	X		X	X
Derek	Lockeford	X		X		
Keith	Norhaven	X				
Fiona	North Valley	X		X		
Whitney	Rivercrest		X			
Nicholas	Silverbay	X	X	X	X	X

DSCs used a range of language to describe how they thought about and enacted equity. To briefly illustrate some of their conceptualizations, Table 4 provides sample quotes for each conceptualization that we saw evidenced in the data.

Table 4

Examples of how DSCs talked about equity

Conceptualization of equity	Example quotes
Access and opportunity	Trinity, Jasper: We do a three-year goal process, and our three areas support and celebrate our diverse community of learners. That takes into account all of the ways we provide opportunities and learning for all of our students and that we're good at it and that we do it well, and we keep doing it better. Keith, Norhaven: It's that idea of providing the supports that different groups need and that those supports don't necessarily have to all look

	the same. That make sense? The comic/meme/whatever of the kids looking over the fence.
Achievement	Farrah, King Park: [The science assessments] were a way to ... identify, are we all achieving at the same level, or is one teacher spiking? Let's go in and figure out what's happening there. Is one teacher far behind? Let's pour some more resources into them. ... Also, to identify, yeah, if something's a trend across five schools—if all the kids across five schools are getting the same question wrong, then I think that's—I use that data to be like, "Okay, so the next flex day, let's do X, Y, or Z to fill this gap," and I can use it as a planning forward. Ursa, Hartwell: We talked about as a staff, if you were a parent, if this was your child, are you going to send your child to the C school? Or are you going to drive 10 minutes down the road where you can put them in an A or a B school?
Standardization	Derek, Lockeford: We don't want [there] to be inconsistent experience[s] for students. ... We're shooting for some consistency for kids...
Identity, culture, and belonging	Farrah, King Park (from her district's vision): Who gets to be a scientist? Name three famous scientists. Could you do it? Was one of them Bill Nye or Albert Einstein? From the color TV to fiber optic cables, cell phones and medical breakthroughs Black, Indigenous, people of color have had a great hand in advancing our society. However, when we ask our students about famous scientists, do they mention Banneker, Jemison, or Carver? Do they talk about Katherine Johnson and Ellen Ochoa? This matters. Opal, Brookeport, naming three (of six) objectives for elementary science from her state: - Incorporate students' cultural knowledge and affirm students' racial and cultural identities. - Establish educator care in culturally responsive learning environments - Promote open communication between families and the district in developing partnerships with parents and caregivers and valuing "funds of knowledge."
Power, justice, and anti-racism	Nicholas, Silverbay: Then as we're looking at each of those [priorities], how do we take an anti-racist perspective on that? How do we make sure that we're being culturally inclusive? How are we building teacher capacity and leadership capacity in those areas?

Farrah, King Park: We can't be non-racist, we need to be anti-racist.

We move next to our second research question, where these conceptualizations of equity come into play in how DSCs enacted equity in their district contexts.

Research Question 2: DSCs' Equity Performances

Our second research question was, *How do DSCs enact or perform equity?* Our findings indicate that their performances or enactments of equity centered largely around providing curriculum materials, which was the case in most districts, and providing professional learning opportunities, which was the case in several districts. Table 5 summarizes our findings at a high level. We unpack DSCs' performances next.

Table 5
DSCs' levers for performing equity

DSC	District	Curriculum Materials: Access	Curriculum Materials: Equity Goals	Access to Professional Learning	Professional Learning for Equity Goals	Additional Levers
Yvette	Bartlett		X		X	
Opal	Brookeport		X		X	
Breanna	Chester	X				
Tessa	Fairby	X				
Ursa	Hartwell			X		
Kaitlyn	Hillman					X
Trinity	Jasper	X				
Farrah	King Park		X		X	X
Derek	Lockeford			X		
Keith	Norhaven	X		X		X
Fiona	North Valley	X				
Whitney	Rivercrest	X				
Nicholas	Silverbay		X		X	X

Curriculum materials. Districts used two main approaches when they leaned on curriculum materials to support their engagement with issues of equity. First, in some districts, the DSCs' emphasis was on purchasing curriculum materials and making them available to all of the district's schools and classrooms. Here, the provision of the high-quality curriculum materials, in and of itself, seemed to be viewed as the equity move. This was the case for the

DSCs in Chester, North Valley, Norhaven, Rivercrest, Fairby, and Jasper. In Jasper, Trinity had a keen focus on securing instructional materials for elementary science, supporting their use in practice, and then monitoring implementation. In one of her advisory board meetings for adopting new curriculum materials, Trinity described the future materials as follows:

And then we want it [future instructional materials] to be friendly for and supportive of multiple ways of demonstrating learning. It supports debate and argumentation. It supports use of science notebooks. It incorporates mathematical and computational thinking. ... That in the structure of it, and the way, the strategies that are used, it provides opportunities for differentiation and different ways of delivering the content.

Here Trinity seems to suggest that these efforts are done in the service of removing barriers to learning for students and securing access and opportunities for all students in the district to experience inquiry-based, hands-on science instruction. For Trinity, it was in selecting and distributing the 'right' curriculum materials that equity is enacted.

In Fairby, Tessa framed the materials as being an entry point to help elementary teachers become comfortable enough with science teaching to get science taught at all. Tessa—like Trinity—worked to ensure that resources were evenly distributed. At the same time, Tessa acknowledged that the materials her district had adopted were not rigorous enough—opening the possibility for students to be disadvantaged.

Second, for the DSCs in Bartlett, Brookeport, King Park, and Silverbay, practicing equity was manifested in aligning the materials with the districts' specific equity commitments. In each case the DSC either designed new materials or adapted commercial materials with the explicit intention of making them more equitable for students. In three of the urban districts, Brookeport, King Park, and Silverbay, the DSC included anti-racism and/or multiculturalism in practicing equity, which had implications for materializing equity within curriculum materials. In Silverbay, for example, Nicholas discussed how his office was developing STEAM curriculum materials for a pilot program. Nicholas said,

We try to ground what we're doing through the anti-bias, anti-racist, ethnic-studies lens. When we're developing STEAM curriculum, we're checking in regularly on that ethnic-studies lens.

Silverbay was an example where home-grown curriculum materials seemed to be a central aspect of how the district was working to achieve an equity agenda that entailed a focus on anti-racism and ethnic studies. King Park, led by Farrah, adopted commercial curriculum materials and embarked on a multiyear process of making the curriculum materials useful for teachers in her classrooms, including as support for anti-racist teaching practices. Like King Park, Brookeport also adopted commercially available curriculum materials. Opal, the DSC, wanted to adapt these materials to be more culturally relevant for Brookeport's highly diverse student body, and the district even modified the EQuIP rubric to incorporate an additional focus on cultural relevance as part of the curriculum audit process. When asked about her district's priorities, Opal stated,

The ones that come to mind are addressing race and equity. That is the top priority. Making things culturally relevant through all of our curriculum.

Yet realistically, her office did not have the bandwidth to make adaptations to the curriculum materials to increase cultural relevance, and even student access was a concern, because the commercial provider declined to provide translated materials for the district's many languages. So, while Opal practiced cultural relevance in her construction of equity, the district and curriculum vendor were not yet able to support Opal's ideals. Norms around distributing human and material resources can be deeply sedimented in extant practices, such that garnering organizational support for 'next generation' approaches can take time.

Professional learning. Some DSCs used professional learning opportunities (mainly aimed at teachers) to support their performances of equity. This seemed to take two main forms. First, paralleling the first version of the use of curriculum materials, for some DSCs, the emphasis was on *providing* professional learning for all of the teachers in the district as a way of performing the equity goals of the district related to elementary science. This was the case for Ursa (in Hartwell), Keith (Norhaven), and Derek (Lockeford).

Second, in some cases, the professional learning opportunities themselves were focused on equity—paralleling the second version of using curriculum materials to support equity. This was the case for the DSCs in Bartlett, King Park, Silverbay, and Brookeport. For example, in Silverbay, Nicholas emphasized cultural relevance in the professional learning experience he led that we observed. As one example from that professional learning experience, Nicholas asked teachers to reflect on to what extent they believed that “All students are capable of success in science lessons/projects” and that “Students can make relevant impactful changes in their community.” Similarly, Farrah, at King Park, oriented the professional learning experience that we observed squarely on anti-racist science instruction, saying, for example, “We can't be non-racist, we need to be anti-racist” and then continuing with naming and unpacking the charter district's four anti-racism commitments, which she described as her “guiding light.” In both of these cases, the emphasis on equity and anti-racism seemed central to the professional learning work we observed and that the DSCs described as their intention.

In Bartlett, in a meeting with the elementary science advisory board, Yvette emphasized supporting representation and identification with science and STEM. For example, one slide in the meeting included a list of bullet points focused on children's STEM identities (Figure 2). Yvette, who was leading the meeting, later asked, “How are we centering, considering, or dismissing students' sense of identity in our work as STEM educators?”

What is STEM Identity?



When we talk about STEM identity, we don't mean that every student has to want to be in a STEM profession. Rather:

- Students should feel confident in their ability to use STEM in their own lives and communities
- Students should know that others like them already do participate in STEM
- Students should know that a STEM career is a viable option for them
- Students should feel welcome to "be themselves" as they engage in STEM

Figure 2. Image of slide from advisory board meeting on STEM identity

In Brookeport—as above, with regard to curriculum materials—there was a disconnect between Opal's performance of equity and equity as practiced in elementary science professional development led by the commercial curriculum providers. In an interview, Opal referred to the events of the previous months—the pandemic, George Floyd's murder, and other racial justice discussions and debates—and emphasized the importance of providing professional learning experiences focused squarely on issues related to equity:

This year, I think, in conjunction with everything that's happening in the world, all of our professional development had to align with those priorities. The schools' priorities have shifted, or the district's—I should say the district's priorities have shifted to focus even more on race and equity, cultural relevance.

Opal framed the K-2 and 3-5 professional learning experiences teachers attended as oriented around equity in her opening remarks, but the sessions were largely led by the commercial curriculum provider's representative, and they did not maintain the focus on equity. In fact, when one teacher participant pulled in an equity-related idea (linking air resistance in their parachute activity to students' familiarity with resistance "often heard in social movements"), the facilitator (from the curriculum provider) said it's a "good thing" but not to get too "sidetracked." This seems to have been a missed opportunity for the DSC and the PD provider to leverage productive tension and rethink what matters in equity-focused instruction.

Additional levers. While curriculum materials and professional learning were the most central focus for most of our DSCs' equity performances, there were, of course, some

exceptions, where one or both of these levers were absent or excluded, or where a district used levers beyond these.

Nicholas and Farrah, the DSCs in Silverbay and King Park, both situated their curriculum materials and professional learning experiences in equity frameworks, and they also used additional levers. King Park, for example, included critical language about equity, justice, and anti-racism in their district vision statement, and Farrah drew on this language in many of her leadership practices, as discussed in full below. In Silverbay, as another example, the district's argument for focusing on elementary science was framed around increasing graduation rates as an equity argument. Nicholas from Silverbay described how his district started looking not just at graduation rates, *per se*, but at students' success throughout the K-12 pipeline. He stated,

That was really the impetus for moving out of just the secondary Band-Aid like, “How do we get kids to graduate?” to “How do we ensure that students are going to be successful throughout this system?” That’s where we started working in the elementary space, and so that’s where the STEAM initiative has grown out of.

In both of these cases, though enacted differently, district values and orientations seemed to deeply inform how DSCs conceptualized the importance of equity and its relationship to elementary science.

As another example, Kaitlyn, the DSC in Hillman, described three levers for equity that they used: project-based learning, a lack of tracking, and a lottery system for admissions. About the latter two, Kaitlyn said:

We admit students via a zip-code-based lottery so that the population of kids at our schools really closely mirrors the demographics of Rockbridge as a whole. We don’t track kids—not that you would in elementary—but there’s some, you know, regular public schools here, I think, maybe in second or fourth grade, kids test into different programs like gifted-and-talented programs.

Examples like these show how DSCs drew on a range of solutions as they worked to enact their equity agendas.

Research Question 3: Enabling, Constraining, and Empowering DSCs in their Equity Work

Our third research question asks, *What is enabling, constraining, and/or empowering DSCs in their equity performances?* In this section, we explore three interconnected themes that emerged: (1) how equity practices in and near the central office shaped DSCs' conceptualizations and performances of equity, (2) how DSCs' roles and responsibilities defined the scope of their work, including their equity performances, and (3) how a broader discourse surrounding equality in schooling regulated how DSCs defined and enacted equity.

The central office and proximal environment. DSCs' proximal environments, including their central offices, played an important role in enabling, empowering, and sometimes constraining equity practice in their education systems. One way we saw DSCs being enabled

and empowered in their equity practice was in their interactions with people in 'diversity, equity, and inclusion' (DEI) leadership roles in their central offices, as well as the work done by those DEI, or comparable, departments. For example, Keith in Norhaven described the impact of initiatives from the new Executive Director of DEI, hired in the central office shortly after George Floyd's murder and in direct response to national calls for racial justice. Keith commented:

...now it's [the work from the new Executive Director of DEI] starting to filter down into our—into what I consider the middle management, which is what I feel like I am if you were looking at a business model; it's starting to filter down. I mean, what we did in Advisory Board at both levels [with elementary and secondary science teachers] this last month was a prompt. We did some initial writing to a prompt: ...what would a diverse, equitable, and inclusive education look like for a graduating senior in Norhaven Public Schools if everything got perfect? ... It's going to be used to inform the...goals and action plans that we developed for that process.

Here, newly-implemented, coordinated efforts across the central office to promote equity in Norhaven appeared to enable Keith to take actions in his work that further coordinated and supported next steps for equitable elementary science education in the school district. Similarly, in Brookeport, Opal was influenced by the district's DEI office, as many of the equity frameworks that she presented in the PD we observed came directly from this office. These frameworks enabled Opal to present language around equity as part of her vision for elementary science education. In Silverbay, Nicholas talked about his team's work with the ethnic studies department as enabling their curriculum design work:

Another department that we more, that we've started working with very closely is we have an ethnic studies department. That's also integrated with history [and] social science. We've found that as part of STEAM, ... we can incorporate the history [and] social science framework as well as anti-racist teaching practices.

In these cases, the districts' DEI (or equivalent) departments enabled DSCs in their equity practice.

One DSC described this kind of direct support from a leader within the system as necessary to enable equity practice within the district. In Lockeford, a rural district, Derek expressed optimism about an incoming board member with regards to potential future divisiveness in the community around the national critical race theory ban debates:

...because he is such an amazing person and very gregarious, but has a way to pull people together and help people see things that maybe they didn't see before, and always with a different lens in a way that doesn't—he can advocate very, very hard without seeming like he's shoving something down your throat.

Derek was hopeful that this board member would help to unify the board in the face of a divided community to maintain a more inclusive district environment and facilitate equity practice.

Alongside the existence of a DEI or ethnic studies department, DSCs also named professional development they had been involved in as important for empowering them to

perform equity work in elementary science. In Silverbay, Nicholas described training that he participated in with other central office staff members that focused on “what does it mean in practice [to be] anti-bias, anti-racist?” This training, in addition to his collaboration with the ethnic studies department, and Silverbay’s district improvement plan that emphasized equity, all seemed to influence how Nicholas prioritized and performed his equity work. In Bartlett, DSC Yvette shared that she learned about equity in science instruction during training she took part in at the state level. During a district science curriculum council meeting we observed, Yvette described taking part in a “STEM Equity Walk” with other DSCs in the state and then led her teachers through a similar activity.

While supports within and proximal to the central office were named as important for enabling DSCs’ equity practices, some DSCs shared that systemic dysfunction constrained their work. For example, Nicholas also described the larger bureaucracy in Silverbay as making it difficult to coordinate equity work across levels of the system.

It’s that I find at least in our system... the information doesn’t always seamlessly flow from executive leadership through middle management and down to the school sites or even through principals and down to teachers. I think whenever possible, you can have a clear flow of information and understand the initiatives and the mission, the more smoothly things go. You can see we have a large leadership structure that’s in place. In Brookeport, Opal reflected on the difficulty of collaborating with colleagues in the emergent multilingual (or English Language Learners; ELL) and special education departments.

They're their own separate departments. They were all, for the longest time, compliance-only, and over the last two years have started to add instructional coaches and become more instructionally focused. Like when we started our work on the academic response teams, on those cross-content teams that I spoke about, we had a special education person, we had an ELL person there, but we didn't know—none of us knew how to work together. It took a long enough, hard enough time to figure out how to cross-content-wise work with each other. ... We were ahead of the times. Now the district is catching up, and we're figuring it out.

Furthermore, Opal’s intention to adapt the curriculum materials to bring them more in alignment with her equity commitments was frustrated by a lack of bandwidth in her own office. This was linked to curriculum director positions in the central office being eliminated across all subject areas, severely limiting the curricular and instructional support they were able to provide. So, in Brookeport, while their DEI office was producing actionable and useful frameworks for equity that began, at least, to enable Opal’s equity work, in other ways, a siloed departmental structure, and the district’s efforts to streamline the work of central office administrators served to constrain her work as well. In Silverbay and Brookeport, while both districts have equity programs in place, both DSCs also commented on the difficulty presented by the large bureaucratic, siloed structures within their systems.

Thus, the central office and proximal environment played an important role in both enabling and constraining the work of DSCs—sometimes even within the same district.

The role of the DSC. Across our cases, DSCs' roles differed in terms of the scope of their work and their domain of responsibility. While in some districts, the DSC was in a more traditional central office role with responsibility for selecting curriculum materials and providing PD for science teachers K-12, the roles and responsibilities of DSCs varied significantly, as did the size of their teams. In our two smallest districts, for example, the elementary school principal acted as the *de facto* DSC given that central offices were limited to superintendents and very few administrative staff. As such, these DSCs also had significant responsibilities outside of science, compelling one in particular (Whitney in Rivercrest) to rely on teacher leaders within her school for much of the day-to-day management of science instruction. On the other hand, in two of our largest districts, the DSCs had small teams working with them in the central office, some with elementary or early childhood backgrounds. As such, these DSCs had additional resources to draw on when implementing equity practices in elementary science.

DSCs' roles, including their equity practices, within their districts were shaped both by the scope of work on their job description and the histories of how their roles had evolved over time. In Bartlett, for example, the science center where Yvette worked had existed for over 20 years as a well-resourced and relatively independent entity providing science materials and enrichment activities for the district. It was only recently becoming more entwined with the central office under the current superintendent. This shaped Yvette's work in two ways. First, the historical role of the science center meant that Yvette's equity performance focused predominantly on designing hands-on curriculum materials that "tied into the real world" and providing teachers with support to use them as designed. Second, the stability and pseudo-independence of the science center ensured that Yvette faced limited structural constraints to her equity performances. In contrast, the DSC in Lockeford had been a teacher on special assignment in a transient role whose funding dissolved at the outset of our project. Presently, he was back in his position as a middle school teacher. As such, Derek's resources, authority, and agency were much more limited. For Breanna in Chester, recent structural changes at the district level shaped the scope of her work. Chester had dismantled its curriculum department in 1999 to focus district level efforts on ELA, and only rehired an elementary science coordinator in 2014. For Breanna, then, the main challenge was that teachers had focused almost exclusively on ELA for over a decade, and so simply getting science taught so that students had (equal) access and opportunity became the main driver of her equity performance.

In two of our districts, DSCs talked about how institutional arrangements ensuring school independence and autonomy limited their roles (and their power) in ways that regulated their equity performances. For Opal, from Brookeport, school autonomy was a hindrance to her equity practice as, for her, doing equity meant building educational infrastructure and managing its use across the district. In this way, selecting and distributing curriculum materials for use across the district and providing PD for teachers on how to use those resources was central to her equity work, but as schools could choose their own curriculum materials, and a number did, Opal felt frustrated in her efforts:

[T]he principals ... because, while we have district curriculum, they're not mandated to use it. They don't have to use what we say—what we have vetted and what we have [determined] qualify as high-quality instructional materials. They don't have to. ... Even if we've said, "We piloted it, and it did not do well with our students, and here is why," they can still go on their own and do that.

Tessa, from Fairby, also argued that access to elementary science instruction was ultimately determined in schools:

[It makes a difference if there is] a principal who's got a passion for bringing these opportunities to kids, and somehow is able to get connected with either a student group that's working on it from the high school, or a grant or something like that. Now our Fairby Education Foundation, last year their focus was on maker ed. And so, they went to every single elementary school and did a little presentation on it, and it might just have ended there. Or, sometimes a teacher will say, 'That's great, I'm going to bring a maker space into my own classroom.' Again, just not consistent.

Tessa emphasized here that her own priorities were, in some ways, second to the priorities of others—the principal, the Foundation, or even an individual teacher. Relatedly, Tessa also emphasized how important the school staff was in the ways school autonomy shaped instruction, saying:

I think it's the personnel. I think a principal who makes time for it and promotes it is an important component. In the schools where there is a commitment to science, often the principal is right on board for that. Also, I think it takes willingness from teachers and a sense of knowledge from the teachers, as well. The science specialist can be that person, and sometimes they are definitely not the person. Sometimes we just find a teacher who's got a passion for science, and they're driving it at their grade level. If they change grade levels, then they're driving it at another grade level. I think it's really personnel-dependent.

Both of these DSCs—Opal and Tessa—recognized the limited power of their roles to initiate and embed equity practices in their districts. Both made efforts to distribute elementary science resources equally—curriculum resources, PD, presentations on maker education—but saw differences in uptake at the school level as part of how equity was performed in their districts.

While institutionalized school autonomy played a part in constraining DSCs' equity practices, so too did parental autonomy. In Fairby, Tessa argued that affluent parents provided additional, extra-curricular resources in some schools that disrupted district equity efforts in terms of access and opportunity: "It's the very affluent, because you've got a parent who will run Science Olympiad and the Makerspace, and so forth." For Tessa, these differences across schools disrupted students' equitable opportunities in elementary science. Building curricular infrastructure and supporting its use, by selecting materials and providing PD, was firmly within the DSCs' roles across most of our districts. However, responsibility over extra-curricular provision in elementary science was less clearly defined. Fiona in North Valley also recognized

the impact of parental autonomy, particularly in terms of access to private tutoring outside of school. This shaped how she constructed her role in terms of performing equity:

We saw a big disparity from building to building. That's been part of our mission to make sure every child no matter who your parent is, no matter who your teacher is, no matter what your principal of your building believes, has access to the materials that they need to be successful. Not just materials, the curriculum and the teachers prepared, all that stuff.

For Fiona, the impact of (patterned) parental autonomy outside of school pushed her to practice equity in terms of working to (a) ensure all students had access to science instruction within school and (b) standardize that in terms of curriculum materials and teacher capacity.

How DSCs' roles were defined in many ways regulated DSCs' equity performances. For many DSCs in traditional roles, their roles were defined as (and they practiced their roles as) predominantly as about vetting, adapting (or designing), and distributing curriculum materials, and then organizing and designing PD to support teachers in using the materials. As such, their equity performances were centered on using these levers to support their equity agendas. However, some DSCs, including Opal, Tessa, and Fiona, saw (institutionalized) school and parental autonomy as defining their roles (and equity performances), and other DSCs redefined their roles, such as through drawing on additional levers (discussed above), to make space for their equity performances.

Equality as a regulatory ideal: Effects of describing equitable as equal. Sometimes, it wasn't only the district structure or role construction that enabled or constrained how DSCs practiced equity—it was the nature of the discourse around equity itself that did so. In some cases, we found evidence that a discourse of equality shaped and constrained what equity was for DSCs. By this we mean that some DSCs described equity as an equal distribution of opportunities, or as ensuring experiences for students were the same across the district. In this sense, equality acted as a regulatory ideal within which equity was (re)defined.

For Derek in Lockeford, “consistency” across school sites and classrooms was part of performing equity:

Helping teachers around the access and equity piece was important because not only is there an access and equity issue for teachers, like who gets training? Who knows these things? Who gets materials? Are those things available? Also, for students. We don't want [there] to be inconsistent experience[s] for students. They have “Ms. Felicity” for science one year; they had a great, awesome year. But the next year they have “Mr. Derek” and he's really into social studies. They didn't get much science. Then the next year you get something else. We're shooting for some consistency for kids and pushing the idea to all kids.

Consistent, equal experiences in terms of access and opportunity for both teachers and students was part of how Derek performed equity in terms of providing teachers with PD so they could enact science instruction consistently for students. In this way, equal access and opportunity for

teachers was linked to standardization of curriculum experiences for students. This discourse of equality also framed Trinity's equity practice. She described the district's goals in her interview as follows: "What we can say to a family member, 'The education your children get at one of our elementaries is as high quality as it is the other because here's what we do. We do this across the district.'" The discourse of consistency and standardization here was that Trinity wanted educational experiences to be equivalent, or equal, at each elementary school for every student in the district. For both of these DSCs, how they conceptualized equity was regulated by a broader discourse around the importance of equality in schooling; as such, they understood their roles in terms of their responsibility to build educational infrastructure by distributing resources equally across the district and to support the use of that infrastructure by providing equal access to PD for teachers so that elementary science instruction was enacted consistently and standardized across their districts.

We saw evidence in some districts that DSCs were making efforts to step outside of this broader regulatory ideal. Keith in Norhaven, for example, took a different tack than we saw in other settings – he focused on distributing some resources to schools with fewer resources, rather than distributing all resources equally. This was in contrast with many of our cases that emphasized equally distributing resources and opportunities across all school sites. Keith shared:

Sometimes when an opportunity comes across my desk, I'm going, oh, that needs to go to this school or that school because those kids have fewer opportunities. I'm trying to build those opportunities for the kids there. As I was saying, we're trying to level the playing field with those experiences and then providing opportunities for the kids to engage in conversations about those experiences.

Keith explicitly referenced the meme of kids trying to watch a baseball game over a fence and described his role as 'leveling the playing field' for them to be able to see the game together. He explained that what this meme entailed was something central office leaders had discussed during the PD led by the new Executive Director of DEI (discussed previously). In this case, the support being offered in the central office enabled Keith to (re)define his equity practices such that his actions explicitly challenged equality as the prevailing regulatory ideal. Like Keith, DSC Farrah in King Park also distributed resources across the district according to need, pushing back against a norm of equality.

Equity practice in the central office, the construction of the DSC role, and broader regulatory ideals for what equity is in a particular district are deeply interconnected. Equality as a regulatory ideal shapes the scope of DSC's work in terms of what matters in performing access and opportunity and standardization of instruction, as we saw in Lockeford and Jasper (as well as Fairby and Brookeport above). But this can also be disrupted, as we saw in Norhaven, as new actors in the central office can modify the practices that DSCs are involved in, such that both equity is redefined and the DSC's responsibilities are reconfigured.

A Closer Look at Two Case Studies

In the remainder of the findings, we draw on extended case studies to unpack two DSCs' equity practices: Farrah from King Park, a medium-sized urban charter district, and Ursa from Hartwell, a small rural district. We use these cases to illustrate more holistically the levers each DSC used to perform equity; their associated equity conceptualizations; how one conception or performance of equity might inform another; and the forces that enabled, empowered, or constrained each DSC. We also use these cases to illustrate a constellation of equity practices that each DSC engaged in, as well as limitations in their work, at the time of our data collection.

Farrah from King Park. Farrah's case in King Park allows us to examine how anti-racist equity practice was built into the fabric of the district, and how this shaped Farrah's equity practice. However, the district's attention to student achievement in literacy and mathematics had it limiting students' access to science instruction in the early elementary grades.

King Park operates in an active and competitive charter environment in Louisiana where the district competes with other local schools for student enrollment, and this competition has King Park keenly focused on demonstrating student achievement on state assessments. Farrah, the Primary Science Achievement Manager was largely responsible for managing the curriculum, providing instructional support, and monitoring student achievement in elementary science across the regional network. The community King Park serves is largely comprised of historically marginalized people of color living in a large vibrant city with a great deal of natural beauty and cultural depth.

Farrah, with support from the greater charter network's central office administrators, espoused a justice-oriented perspective on elementary science education that views unequal outcomes as a consequence of systemic inequities based on power and race. Farrah was one of the only DSCs in our sample that named systemic racism as a challenge and conceptualized equity largely in terms of racial equity. King Park had a set of district-wide anti-racist commitments that were designed to operate across subject areas. The commitments document, including the parenthetical labels for each point, read:

1. We are fighting lack of access to resources and opportunities. (Access)
2. We commit to teaching in ways that fight oppression - building deep and authentic relationships, allowing students to work together as a community, increase in student voice in classrooms, holding a high bar for rigor and a focus on exploration, honor the skills and capital students bring to class, etc. (Affirmation and Relationships, Voice, Rigor)
3. We commit to advocating for more narratives from scientists of color and will support teachers in developing these and make them come alive in their classrooms. (Cultural Relevance, Voice)
4. We will infuse social justice into the curriculum by creating lessons on global warming, activism, environmental racism, sex/gender and other topics that expose students to social justice. (Cultural Relevance, Voice).

Farrah and her team then developed a vision statement that bridged these anti-racist commitments into elementary science. The vision statement for elementary science instruction (excerpted here) illustrated Farrah's justice-oriented perspective:

Science holds the key to meeting many of humanity's most pressing current and future challenges like environmental racism, disparities in health care, the ethics of genetic modification and climate change. Science education ensures our students have a seat at the table and use their voice to solve the world's toughest problems and equitable access to careers in the fastest growing and highest paid fields. In King Park science classrooms, students explore problems and develop ideas with a joyful sense of curiosity. Instead of seeing science as an inaccessible body of facts, it is an avenue for exploration and agency. Students will express their knowledge in a variety of ways to fight for social justice.

The elementary science vision statement was complemented by a further document: a set of guiding principles, or questions, intended to hold teachers, coaches, and administrators (including herself) accountable to King Park's anti-racist goals in science and to audit lessons. For example, one question concerned student voice, "How does the lesson value student voice and ideas? Where are opportunities to amplify student voice and ideas? What do I need to add in?" and another focused on cultural relevance, "How does the lesson connect to our students' culture? What are opportunities to connect or extend learning to make it more relevant or focused on social justice?" These artifacts lay a foundation for the rest of the equity and science work that Farrah coordinated.

This anti-racist and justice-oriented stance regulated Farrah's practices relating to her other equity stances (see Table 3). For example, equity in student achievement was important for her (perhaps unsurprisingly given the competitive charter environment King Park operated in), but Farrah primarily used student achievement data to identify differences in student outcomes in order to channel more resources and supports to schools and teachers with lower achievement rates. In other words, rather than respond to achievement data punitively, Farrah leaned on her understanding of systemic barriers to achievement and responded to the data by (re)distributing resources and supports to where they were most needed. Similarly, purchasing (not inexpensive) comprehensive elementary science curriculum materials could have been practiced as enacting equity in terms of access and opportunity or standardization, but by enacting this through a justice-orientation, Farrah redefined what these stances entailed. As part of their implementation plan, Farrah and her team focused on "just refining and focusing on the cultural relevance piece. Where can we make deeper connections, and where can we add counternarratives to the science?" They also centered developing students' agency, as seen in the vision statement above. As well, they made the curriculum more "accessible" to teachers by establishing a detailed scope and sequence with daily lesson plans for teachers. This moves towards standardizing the materials for teachers, though Farrah also invited teachers to modify the materials based on their students' needs.

Different from other cases in our sample set, Farrah's case illuminated more clearly an equity stance for science *instruction* from a central office leader, whereas in many other cases, equity was more confined to administrative and system-building tasks such as distributing curriculum materials. This focus on instruction was also seen in how she performed equity in central-office-led elementary science PD and coaching. She explained:

The way that it's lived in science PD is we always start with that, either a video observation, and talking about, what tenets of anti-racist teaching is this living up to and how is this fulfilling our vision for that.

She went on to describe the importance of building values around equity and social justice for elementary teachers of science. Again, we see performing equity as central to Farrah's practice: providing professional development was not just a way to improve all students' access to high quality instruction, but, at its core, was a means of cultivating anti-racist pedagogy in elementary science.

That equity was so central to Farrah's work was, at least in part, shaped by the way the King Park central office had cultivated equity discourse. To support district leaders with anti-racist goals, central office staff participated in anti-racism trainings, and those trainings had a direct impact on the nature and scope of work for Farrah (and her colleagues in other departments). In this way, as part of the central office, Farrah was enmeshed in practices that served to enable and even accelerate her equity work for elementary science.

Despite this, broader district discourses also troubled the justice-oriented approach to elementary science that Farrah enacted. In King Park, elementary science instruction did not begin until third grade. This was justified in terms of the importance of prioritizing ELA and mathematics in the early grades for students' access and opportunity to early literacy and numeracy experiences, but this impacted the youngest students' access and opportunities in science. These competing equity discourses operated uneasily together: from third grade Farrah worked to show students that science was culturally relevant to their lives but the absence of science in K-2 somewhat undermined the message.

Ursa from Hartwell. In Hartwell, Ursa framed equity in terms of the systemic marginalization of rural communities. Similar to how anti-racist practice regulated other equity practices in King Park, Ursa's focus on rurality and locality in Hartwell had implications for what enacting equity was in this district and community.

Hartwell is a small rural school district in Arkansas. Ursa, the elementary school principal, serves as the 'district science coordinator' for the purposes of our study given the lean composition of Hartwell's central office and absence of anyone in a curriculum coordinator role. Ursa has fairly typical roles and responsibilities of school principals (interfacing with students, families, staff, and administrators), in addition to those more often ascribed to central office leaders, such as selecting curriculum materials and finding or designing professional learning opportunities for teachers. The communities Hartwell serves are predominantly white, living in isolated, mountainous, and scenic parts of the rural South.

Across interviews, Ursa repeatedly referenced the small size of their school, and without naming it as such, she described opportunity gaps due to their small size. This included being repeatedly denied funding for a partnership with Pyramid Learning to support her staff with curriculum writing and professional learning:

The State of Arkansas ... began to create grants for cohort schools that you could apply for and be partnered with Pyramid Learning coaches. ... I've applied for that cohort a couple of times, but being what it is, we are a small school, about 800 K-12, and Pyramid Learning is rather costly. ... We don't get the grant, simply because I think—I mean, I've talked with the State, and [they] said, "Yeah, your grant application looks great," but I really think when it comes down to dollars, they look at a school that has ... 375 [kids compared to] a school that has 1500. I think they wound up putting their money where they're going to impact more students.

A key practice for Ursa, then, in response to this, was to mediate those gaps with support (for both students and teachers): “we’re just going to do this on our own.” Ursa convinced the superintendent to fund a slimmed-down and more budget-friendly version of Pyramid Learning, limited to a single coach focused on ELA and mathematics. However, Ursa leveraged this partnership to support science instruction despite the facilitator from Pyramid Learning de-emphasizing science in one of our observations. Teachers across grade levels developed science instructional materials with the use of the professional learning community infrastructure and processes taught by Pyramid Learning.

A common refrain heard about rural areas is the high level of poverty and need that their geographic and economic isolation creates, as well as the collapse of former industries that once sustained the community. Notably, this refrain is largely absent from Ursa’s discourse. Though she does not name equity in her work, nor does she have the “critical” language that Farrah displays for talking about marginalization, she does take on a distinct and important community-centered discourse that in essence is her equity performance. Ursa does not tell a singular story of poverty, but rather acknowledges the systemic challenges associated with rurality while expressing a deep love for her community and its assets.

For example, as she elucidated the challenges that some of her families faced during the pandemic, Ursa described the systemic marginalization of rural communities not having access to ‘basic’ infrastructure taken for granted in other places:

Like I say, [it is] a very rural community.... Internet coverage is extremely limited around here. If you can't get Atlas Cable, you don't have many options for internet. The farther south you go, the worse that gets. We are surrounded by a mountain, and that blocks a lot of reception. Cell phone is the same way. You get down to the middle of the [Stars Hollow] area, cell phone and internet reception are very, very sketchy. ... The state has provided some hot spots that families can check out, but again, once you get south of Hartwell, these really don't do much.

Her discourse here did not focus on poverty, but rather rurality. Similarly, Ursa described limited financial support from the community as an ‘essential condition’ of rurality, while emphasizing

the support they do get from one local business in the context of expressing appreciation for broader support from the community:

As far as financial support, we don't get much of that, because again, we have about five or six businesses that really can't afford to support our school much. ... We do have one manufacturing company I failed to mention, here in Hartwell, that makes conveyor belt systems. They've been a great support. We have a competitive robotics team, we have fourth, fifth and sixth graders that compete. ... That company is great to support us. They make sure we have—it costs us about \$750, and to enter these tournaments, they make sure we have that entry fee paid. They support us with engineers that come in and help our kids, and learn to code the robots for the competitions. Overall, I would say we have tremendous community support, support if they are able.

Ursa also reframed economic or opportunity challenges as things that could be managed by thinking creatively and leveraging the assets within the school community. For example, she described the school librarian as “another really great innovative teacher” who built a “Lego wall” for the makerspace, as the commercially available options were prohibitively expensive. Similarly, Ursa mentioned not being inclined to purchase science curriculum materials given that teachers had already created many of their own resources and she wanted to honor the work teachers had done through the Pyramid Learning process. In both of these examples, Ursa reframed systemic funding challenges in terms of the assets in her community.

Ursa's focus on locality and rurality redefined her equity practices (see Table 3), regulating what enacting equity is in Hartwell. Like Farrah in King Park, Ursa had an achievement stance, but instead of using test scores to identify schools and classrooms in need of additional support in elementary science, Ursa marked achievement as a means of social mobility within their local community. She explained that focusing on elementary science was about providing her students with the skills to take on science jobs within the community as “those are the jobs they're going to be doing.” Achievement for Ursa was not about students having the access and opportunities to get out of their rural community (a single story of poverty), but to build the community from within. A key piece of evidence for this is when Ursa described the argument she made to the regional medical school to do more outreach with her elementary grades (as opposed to just focusing on high schoolers):

Doctors are made in elementary school, so that is where you start. That medical school needs to get more of realizing that, hey, if you want those kids to go to medical school, and you want them to stay local, you need to start getting into your elementary schools. That's where you start building that interest.

Ursa's focus on locality and rurality also shaped how she conceptualized elementary science as related to identity, culture, and belonging. In particular, Ursa leveraged local connections to build students' science identities:

We do have a former student that is a doctor. Right now, he's doing a fellowship in Washington, DC, but his mom and dad still live here. He'll come back from time to time to visit them, and he always wants to come to the school. It's neat. We'll bring him in for

the day, and he'll wear his doctor outfit and talk to the kids about what it's like to be a doctor. "It doesn't matter if you go to a small school. If that's your desire, then you can do that too." Like I said, always looking for those opportunities where we can get those kinds of professionals to come in and interact with our kids.

Ursa made it clear that few students from Hartwell go on to become doctors, but then emphasized this former student's commitment to the community (rather than that they are now living elsewhere). She also saw this visit as important to her rural students seeing themselves in science profession(al)s. In this sense, Ursa's conception of equity was more akin to a justice movement within rural communities, and enacting equity was for rural students and families (and even teachers). Furthermore, she saw science as a key to addressing challenges around social mobility and local opportunity development in rural communities.

Finally, while Ursa's focus on rurality and locality is in many ways akin to a focus on power and justice, her discourse lacks any explicit attention to race. This suggests there may be opportunities for ongoing transformation of equity practices in Hartwell as national discourses about racial justice come into dialogue with Ursa's focus on rural justice.

Discussion

District Science Coordinators are key leaders in educational systems for enacting reform and improving science instruction—they play critical roles in provisioning curriculum materials for teachers, supporting teachers' use of those materials, and monitoring how well the use of the materials is going, among other roles. Given widespread commitments to equity within the field of science education, it stands to reason that DSCs also play a key role in the equitable implementation of science instruction. Yet, the word 'equity' is used frequently in public and private domains without a shared definition, so what equity means and how it is performed by different leaders varies widely across individuals and contexts. With this paper, we explored the equity conceptualizations and performances of thirteen case study DSCs in districts that varied in size, urbanicity, charter/traditional, and student demographics. Their equity conceptualizations and performances were equally variable, displaying differences in attention to systemic racism or other forms of oppression and marginalization, differences in understanding the roles of assessments and achievement in equity, and differences in enactments as primarily equal distribution or otherwise.

Access and opportunity was the most commonly held conceptualization of equity among our DSCs, reflecting the fundamental role and responsibility of DSCs engaged in educational system-building. For central office leaders engaged in educational system-building, core domains of their work involve supporting student learning at scale across their districts by establishing an educational infrastructure and supporting the use of that infrastructure in practice (Peurach et al., 2019; Spillane et al., 2019). As such, providing access to high-quality curriculum materials and professional learning opportunities for all teachers is a central part of their scope of work. The findings from this study bring light to how some DSCs use these core domains of their work as levers to advance equity in their districts.

It surfaced in our data, however, that equality as a regulatory ideal (Butler, 1993) played a role in constructing equity for many of these DSCs. Access and opportunity became understood and performed as equal distribution of resources and opportunities across a district, with school and parental autonomy recognized as a constraint for some. Jabbar and Childs (2022) argue that such equity performances that are devoid of attention to systemic issues that create inequalities have the potential to reproduce those inequalities in systems through a focus on efficiency, accountability, or other neoliberal ideals.

In contrast, some DSCs (re)constructed their roles, or were supported or compelled to (re)construct their roles to enact equity differently. For example, with support from his new DEI director in the central office, Keith, in Norhaven, used his role to manage and bridge resources from the external environment to those elementary schools with fewer science learning opportunities in addition to provisioning curriculum materials to all schools. This type of support from a DEI director is in line with how researchers describe their intended role (Lewis et al., 2023), and it resulted in Keith's performance that went against the grain of equality as a regulatory ideal and enabled him to think about access and opportunity differently. As another example, Ursa, in Hartwell, from her position as the elementary school principal and *de facto* DSC, thought critically about an opportunity gap in her community given their small size and rurality. She felt compelled to close the gap. So, among other moves, she advocated to the regional medical school to extend their outreach to her elementary students, expressing an interest both in her students' social mobility and in their opportunities to remain in and contribute to their community long-term. Framing equity work as an opportunity to (re)build a community rather than escape from a community is a key justice orientation. As Duncan-Andrade argued in a keynote for the Open Educational Leadership Conference, "the purpose of education is not to escape poverty: the purpose of education is to end it" (2014; see also 2009).

In the above examples, both Ursa and Keith managed relationships outside of their districts to practice equity; Nicholas in Silverbay, on the other hand, managed relationships within his district. He collaborated with other district leaders in the ethnic studies department to construct curriculum materials that attended to anti-racist, culturally relevant science teaching. Thus, the access schools had to the curriculum was not simply a matter of equal distribution; rather, the materials themselves offered critical pedagogies to shift students' learning experiences in classrooms—a key consideration in critical improvement research (Jabbar & Childs, 2022). He was aided in this work given the sizeable team of four that he led, though was constrained by the bureaucracy of the large system within which he worked. These examples, among others, highlight how DSCs defined and enacted equity to fit the space they do their work in, as supported by their environments, and as possible given their roles and responsibilities.

The regulatory ideal of equality, with deep roots in U.S. ideology, may presently be linked to conservative agendas across the U.S. which seek to limit discourse about race, gender, and sexuality (Castillo, 2023; Kelly, 2023; Kelly et al., 2022). Indeed, early in the course of our data collection for this study, lawmakers in Oklahoma passed a 'critical race theory ban' that prohibited teaching about race and gender in schools (Bronstein et al., 2023; "Oklahoma House

Bill 1775," 2021). Equity stances aligned with notions of equality, then, became more palatable—indeed legal—than those aligned with anti-racism or justice. Three of our case study DSCs lived and worked in Oklahoma, and two of them displayed equity performances that aligned more closely with ideas of equality. While we cannot make any causal claims from our data for these two DSCs, we can note that the third, Keith in Norhaven, appeared supported by his district to enact at least some equity performances that confronted the regulatory ideals enshrined in state policy.

Our analysis here has implications for curriculum design and selection. Given some DSCs' reliance on the provisioning of materials as an equity performance, the materials themselves become lively interlocutors in how equity in elementary science is enacted across the district (Kayumova & Buxton, 2021; Moore et al., 2021; Strom & Martin, 2017). Drawing on Bennet's (2010) concept of *thing-power*, the "curious ability of inanimate things to animate, to act, to produce effects dramatic and subtle" (p. 6), curriculum materials can be understood to co-construct instruction along with teachers and students (Thiel, 2015); teachers or other educators and curriculum materials can be seen as having a participatory relationship with one another (Remillard, 2005). Conceptualizing curriculum materials as powerful agents in instruction underscores the importance of centering equity and justice in the materials themselves. Carefully designed curriculum materials work in concert with professional learning experiences to support teachers' learning (Davis et al., 2017; Moore et al., 2021); such synergistic supports can play a role in raising awareness, for example, about race, gender, linguistic resources, or class (Haas et al., 2021). Some DSCs in this study worked to create or adapt materials as part of their equity performances, ensuring that materials had an ethnic studies, culturally relevant, and/or anti-racist lens, recognizing the thing-power in these objects to transform instruction. Many DSCs also drew on resources like the EQUIP rubric (Achieve & National Science Teachers Association, 2014)—another object with thing-power—to support them in identifying curriculum materials designed to support more equitable science instruction. But in many districts, DSCs were limited in their abilities to select and modify the commercial materials either due to constraints of their roles, resources, or surrounding regulatory ideals, and instead relied on teachers to make adaptations, sometimes, though not often, with support from equity-focused PD. Given the importance of the materials in how DSCs practice equity, our analysis underscores the need for commercial curriculum providers to design materials that center equity and justice in elementary science instruction.

In closing, this paper makes three key contributions to the field. First, the paper's findings provide insight into DSCs' current conceptions of equity. These may be considered a starting place from which to build (Milner, 2010), working towards conceptions of equity that attend to identity and belonging and link science to justice movements in elementary classrooms (NASEM, 2022). Second, the findings illustrate a variety of avenues available to DSCs to promote equity agendas, and the importance of constructing their roles as broader than curriculum materials and PD in order to off-set school and parental autonomy that can reproduce inequities—a key understanding as the field seeks to engage leaders to advance equity in science

education (Penuel et al., 2018). Though many DSCs necessarily relied on instructional materials and professional learning in their equity practices, evidence also showed DSCs thinking carefully about leveraging external partnerships and distributing science resources to eliminate or at least reduce disparities in learning opportunities for minoritized students (The Leadership Academy, 2021). Finally, our findings suggest that DEI departments and trainings can enable and empower equity practices for DSCs, in addition to systems that allow for, even encourage, DSCs to (re)construct their roles creatively and with agency to perform equity.

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