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Journal
Cultural Studies of Science Education, 19(1)

ISSN
1871-1502

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Publication Date
2024-03-01

DOI
10.1007/s11422-023-10202-2

Peer reviewed

Cultural Studies of Science Education
https://doi.org/10.1007/s11422-023-10202-2

ORIGINAL PAPER

(Re)defining expert in science instruction: a community-based science approach to teaching

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Received: 11 February 2023 / Accepted: 24 September 2023

Abstract

Instructional practices in science education often create dichotomies of "expert" and "outsider" that produce distinct power differences in classrooms. Building upon the idea of "making present practice" to disrupt these binaries, this paper presents select findings from a year-long study investigating two urban teachers' use of community-based science (CBS) instructional practices to create relational shifts that reframe expert and expertise in science instruction. By examining how CBS instructional practices reframe power through co-learning experiences, our findings demonstrated that teachers positioned youth as knowledge constructors through three instructional practices: (a) creating space for students to share their knowledge and experiences, (b) positioning students' lives and experiences as assets to/within science, and (c) being responsive to assets in future lessons. We use these findings to demonstrate how CBS instructional practices support shifts in relational dynamics by creating spaces of rightful presence, where students are viewed as legitimate classroom members who contribute scientific knowledge in practice and have power in the classroom space. By relinquishing traditional boundaries in science teaching to deconstruct ideas of who holds power, we position CBS instructional practices as a means to expand educational equity by legitimizing students' diverse sensemaking and re-mediating hierarchical structures in classroom spaces.

Keywords Community-based science · Co-learning · Power · Relational shifts

Science teaching is often structured with distinctive and finite roles of the teacher as the knowledge holder and the students as the knowledge receivers. This arrangement in the

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Published online: 10 February 2024

context of school science leaves little room for variations in approaches to learning, as it is presents science "as a finished body of knowledge" (Carlone and Johnson 2007, p. 1189), where the teacher provides sets of facts to students. This enactment of science as "finished" and "set" knowledge often suppresses opportunities for differing conceptualizations and interpretations of scientific phenomena (Davis and Schaeffer 2019), disconnecting science teaching and learning from students' everyday contexts and understandings (Bellino and Adams 2017). This disconnect can alienate students, specifically students of color that live in urban communities, as portrayals of the natural world in instruction regularly contradict their worldviews, understandings, and everyday practices (Bang and Vossoughi 2016). The positioning of teachers as the sole expert in science classrooms not only perpetuates these disconnects, but limits the possibilities of transformative, equitable learning for minoritized urban youth.

Science education researchers, often in partnership with teachers, have worked to theorize, design, implement, and study new pedagogical and instructional practices that reflect students' everyday ecological contexts. In teaching science through a localized ecological lens, we can support the rightful presence (Barton and Tan 2019) of students and their communities in science learning spaces by recognizing and utilizing their individual and culturally based conceptualizations of scientific phenomenon in classroom contexts (Tan and Barton 2010). Instructional strategies that center community-based knowledge to disrupt the "status quo" in science are not new. Educational partnerships in Indigenous communities have long worked to orient science learning, first, toward community and cultural ways of knowing, and second, to support the learning of Western ideas (Bang and Medin 2010).

Research on instructional strategies in urban spaces utilize similar approaches through local, justice-aligned science instruction. Practices such as culturally relevant pedagogy (Ladson-Billings 1995), place-based science (Davis and Schaeffer 2019), and justice-oriented science (Morales-Doyle 2017), among others, have been utilized as starting points to reconceptualize how we position *knowledge* and *practices* in science teaching and learning to better reflect students and the local community. These strategies, however, underconceptualize how we position *people* within teaching and learning to be reflective of the breadth of knowledge and expertise that all community members bring to the learning environment. While a funds of knowledge (Moll et al. 1992) approach to instruction has been positioned to address the positionality of people (i.e. families and community) as significant to relevant and engaging instruction, the original framework does not explicitly address or problematize power relations (Rodriguez 2013). Gloria Rodriguez (2013) states that "although not explicitly a process of student or community empowerment, what results from the approaches…is a purposeful support for teacher empowerment…[for] the potential for broader forms of empowerment and representation among students, families and community members," (p. 92). Luis González (2005), a co-developer of the funds of knowledge framework, himself, acknowledges this shortcoming, noting, "the issues of whose knowledge and whose voice are embedded in these measures can be answered only as we cross the furthest border between knowledge and power," (p. 42) inviting an examination of power dynamics through this framework.

This study seeks to contribute to, and extend the work of, the robust community of researchers and educators developing instructional strategies that reimagine science teaching to be more representative and inclusive by reframing power dynamics in learning. Specifically, we re-conceptualize ideas of from "whom," and "where," expertise can be derived from in a science classroom using a novel community-based science (CBS) instructional framework. In the next section we characterize CBS as an approach and instructional framework that supports the disruption of power structures that maintain conventional ideas of expertise in science instruction. This includes a discussion of co-learning and power dynamics and how CBS redefines these terms in science learning. We, then, present our study purpose, research questions, and researcher positionality to contextualize our motivation for studying community-based science.

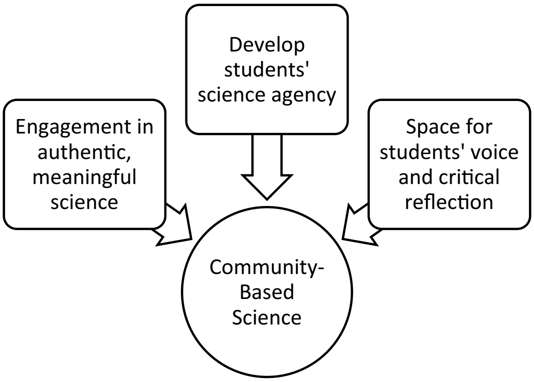
Conceptualizing community-based science as an instructional framework

We define community-based science (CBS) as science instruction anchored in locally and socially relevant phenomena, where community extends beyond the geographical boundaries of a local area to include the cultural epistemologies, historical ontologies, and social structures of a space and the individuals within that space. Our novel CBS framework positions science not as a matter of fact, but rather a collection of social experiences. As such, CBS reclassifies scientific knowledge more broadly to account for the social, political, and historical dimensions of scientific enterprise that influence how students define and interpret phenomena (Patterson and Gray 2019), and the varied heterogeneous expertise that emerges from those interpretations.

Through exogenous design (Tabak 2004), our CBS framework was developed across iterative cycles of design and analysis in a three-year research-practice partnership (RPP) (Penuel et al. 2013), where we co-designed locally relevant science units with teacher partners (further discussed in the methods section). The anchoring objective of our RPP was to cultivate a model of science learning to meet three goals: learning disciplinary concepts (knowledge), positioning science learning as and for participation in community (people), and positioning science learning as and for social justice (practice). We were motivated by our shared frustration that current instructional frameworks fail to theorize aspects of knowledge, practice, and people, collectively, to address power and expertise, and specifically in a way that we felt supported science learning for urban students of color. For our team, we believe science education should be oriented to people, place, practice, purpose, and reality through investigations of students' lived experiences.

Within our RPP, we co-developed three grounding principles of CBS (Fig. 1). These principles were established through an iterative five-step process across our partnership: (1) researchers listening to teacher instructional concerns, (2) researchers offering best practice suggestions to teachers to meet those concerns, (3) researchers and teachers co-writing lesson plans to imbed new practices and ideas, (4) teacher implementation of lessons and researcher observation of implementation, and (5) researcher and teacher debriefs to discuss impacts, successes, and shortcomings. Over many cycles of this process, our three instructional framework principles were developed, in turn, supporting the endogenous design of instructional routines. These principles are as follows: (1) CBS supports opportunities for students to engage in authentic, meaningful science to go beyond cognitive gains in learning by contextualizing school science around real-world, community relevant investigations (Davis and Schaeffer 2019). By moving away away from predetermined systems of knowing and understanding, CBS creates space for students and teachers to learning together and develop a mutual conceptualization of scientific phenomenon; (2) CBS develops students' science agency (Mallya et al. 2012) to understand, reflect, make decisions, and take action to transform their communities, by leveraging scientific ideas to ask questions, think and speak more critically. These justice-oriented practices challenge

Fig. 1 Guiding principles of community-based science



set epistemological hierarchies to support "critical, diverse, and lived accounts of scientific phenomena" (Davis & Schaeffer 2019, p. 369); and (3) CBS creates space for student voice and critical reflection to empower students as social and political beings, as well as academic intellectuals. By positioning students in these three dimensions, we open space for shared authority in learning (Dimick 2012).

Through these principles, we argue that CBS serves two main purposes in teaching and learning. First, by grounding science in students' everyday lives and lived experiences, CBS supports the sanctioning of student knowledge, descriptions, and understandings of scientific phenomena as valuable sources of scientific data that contribute to learning and knowledge construction (Vossoughi and Shea 2019). Second, CBS practices view science through a more holistic lens by using students' understandings to transition from a one-dimensional view of concept interpretation to account for and integrate heterogeneity in teaching and learning. Combined, these principles and purposes support and expand educational equity by affirming students' rightful presence (Barton and Tan 2019), legitimizing students' diverse sensemaking, and re-mediating hierarchical structures in classrooms to spaces where teachers and students learn how to see the world with and from each other in re-organized ways. Understanding this positioning is significant to recognizing why and how CBS negates dominant frames of knowing and doing, through co-learning experiences, to render new power relations in science classrooms.

Students and teachers as co-learners

As CBS creates opportunities for students to share their knowledge and understandings as starting points to instruction, students are positioned as having agency to guide interpretations and foundations of learning. When teachers take time to combine these knowledge and understandings with that of their own disciplinary knowledge, co-learning experiences occur as both student and teacher learn together and build off the knowledge of one another. Too often, however, classrooms stifle student agency with fixed and predetermined roles of teachers as the dispenser of knowledge, and students as the receptor of knowledge (Tai and Wei 2021). To address these homogenous roles, research has challenged educators to adopt a pedagogy of vulnerability to "render their frames of knowing, feelings and doing vulnerable" (Brantmeier 2013 p.1), to take the risks of change, not knowing, and failing. A pedagogy of vulnerability alleviates educators the burden of knowing all and, instead, invites in openness and deepen learning by serving as co-learners alongside their students (Tai and Wei 2021).

Co-learning is defined as a "dialogic process that enhance[s] and value[s] the knowledge, values and insights of all involved" (Brantmeier 2013, p. 4), to challenge power relations between perceived experts (teachers) and novices (students) by alleviating teachers of the load of knowing all. To promote equity in knowledge construction through collective and individual meaning-making, co-learning challenges traditional set "roles" in schooling environments that contribute to unequal power relationships and, instead, promote a "more genuine community of practice" (Brantmeier 2013, p. 5). Li Wei (2014) grounds co-learning in classrooms in three principles: (1) mutual trust and respect between all individuals, (2) equal worth of all knowledge sharers, and (3) viewing all knowledge as valued and valuable, all of which support and sustain the responsibility of knowledge construction as shared between teacher and student.

When these three principles are reflected in practice, co-learning promotes a "lived curriculum," where the "content of our lives, [and] the past lived experiences become the foundation of learning new concepts, skills and values" (Brantmeier 2013, p. 3). By centering lived curriculum in classroom instruction, students are positioned as having power in the learning environment. Creating co-learning spaces prompts the sharing of power amongst teachers and students as both their lived curriculum, as well as disciplinary concepts, are seen as relevant, valued, and informative to learning (Wei 2014). Our conceptualization of CBS supports co-learning by moving away from a singular, pre-determined system on knowing and understanding that alienates students from contributing to knowledge construction, to one that situates the varies expertise of all individuals as meaningful to learning and teaching.

Power in science learning spaces

In classrooms, teachers exercise their power by controlling narratives of who, what, and where in learning. Power, generally, is found in one's ability to maintain or alter the "physical, social, structural, cultural, and political conditions, resources, and/or opportunities of individuals and collectives" (Philip and Gupta 2020, p. 197), based on existing assumptions and practices that are considered normal, including constructions of ideology and identity, organization of the learning environment, and the use of tools. These normalized assumptions and practices often mischaracterize and mis-position youth, especially those from non-dominant backgrounds, as uninterested in schooling and education (Gorski 2017). These views are often perpetuated through structures and dynamics that position the teacher as the authority figure and the students as outsiders in the classroom space; therefore, they can only learn from the teacher. The labeling of students as outsiders contributes to how "school[s] position and value certain ways of knowing and doing science and the cultural meaning-making practices youth from non-dominant communities bring with them" (Tolbert, Barton and Moll 2018, p. 14). This supports unequal power relations as the teacher's ways of knowing is positioned as correct and normative.

Kayumova, McGuire and Cardello (2019) argue that children who live in spaces of socio-spatial and environmental challenges, such as those in urban communities, do not need to be empowered in learning as they are already powerful individuals. Instead, they need powerful frameworks in learning that consider the diversity in knowing and being that are "different from the dominant ways in which conventional science education understands and explains it" (p. 21). We present CBS as one such framework to antagonize deficit narratives of students and their abilities by deconstructing how non-dominant youth are positioned as participating in knowledge construction, and making visible the value of youth's sense-making resources in the learning space. As such, we work toward deconstructing traditional narratives of expert and outsider in instruction by repositioning teachers and students as co-learners, with co-equal power, over what counts as correct and valued science in classroom spaces. In the next section, we present the theoretical framework that supported this work.

Learning as situated

In conceptualizing and studying CBS, we draw on a sociocultural theory of learning, specifically from a situative perspective (Greeno 2006). Culture is a set of historical practices developed and shaped by communities through certain social norms in activity to which an individual enculturates (Nasir, Rosebery, Warren and Lee 2006). As education systems reflect the larger social systems that they are a part of, students are often forced to enculturate into dominant, hegemonic ways of thinking. Sociocultural theory problematizes this enculturation into hegemony by considering how knowledge is constructed, "internalized, appropriated, transmitted or transformed in formal *and* informal learning settings" (John-Steiner and Mahn 1996, p. 196) to promote multiple ways of knowing (Warren, Vossoughi, Rosebery, Bang and Taylor 2020). Advancing this theory to an analytical lens, the situative perspective centers the assumption that learning and knowledge are situated in social and material contexts, and that situation affects how individuals engage in activities in a system (Lave and Wenger 1991). Despite some researchers arguing that a situative perspective castoffs the importance of conceptual learning, a situative perspective of CBS helps us to understand how "a change in participants' understanding of some fundamental aspect of the activity'' can "bring about a radical expansion of the scope and impact of activity in a system" (Greeno 2006, p. 86).

This theoretical framework is particularly useful in considering CBS instructional strategies in two distinct ways. First, documenting teaching and learning from this perspective promotes diversity and inclusion by incorporating all student' communities and cultures as valuable resources, leading to multiple viewpoints in which to investigate scientific phenomenon; it, also, promotes equity by considering how all students' knowledge construction is shaped by their historical and cultural communities, and how this affects their understandings of content (Brown 2019). Second, this perspective reorganizes traditional norms and practices by shifting away from teachers as the primary sources of knowledge and, instead, toward dynamic classroom structures which invite and validate all cultural and linguistic backgrounds and understandings (Meyer and Crawford 2011). We believe that science education should be situated in local, social contexts that provide students with opportunities to use their knowledge about their environments and communities to engage in science learning within and beyond the classroom**.** In this study, a situative sociocultural perspective theorizes CBS strategies as a means to deconstruct and negotiate roles (Meyer and Crawford, 2011), to view knowledge construction as a shared endeavor (King 2012), and to view learning as a dynamic exchange (Polly, Allman, Castro and Norwood 2017).

Study purpose

In this paper we explore two teachers' enactment of a year long CBS instructional framework through an examination of their use of designed instructional practices in a Los Angeles urban school. Specifically, we examine how these practices repositioned power in the classroom by fostering co-learning environments where knowledge construction was multi-directional from teachers to students, students to teachers, and students to students, rather than solely unidirectional from teachers to students. We argue that by using CBS instructional practices, these teachers reframed institutionalized paradigms of "expert" in the sciences to be situated in all individuals in the classroom space. Specifically, we show how youth were positioned as knowledge constructors when the teachers reconfigured the learning of science concepts as embracing multiple ways of knowing to account for students' lived experiences (Warren, Vossoughi, Rosebery, Bang and Taylor 2020). While in other works we describe the process of co-designing and developing these CBS practices, in this paper, we demonstrate how using CBS instructional practices created moments of co-learning that productively challenged traditional power dynamics by repositioning expertise with students. As such, we asked: 1) What instructional strategies do teachers use to create co-learning environments in science classrooms? and 2) In what ways might community-based science, as an instructional mechanism, transform power structures in science classrooms? In answering these questions, we share the potential of empowering teachers with practices that can be adopted and adapted to support co-learning science classrooms that position youth as classroom intellectuals to expand educational equity.

How we come to this work

We come to our work as learners and partners with the students, teachers, and community in our RPP (Penuel, Coburn and Gallagher 2013). The work described here represents a collaboration with the two teachers who implemented the instructional practices studied here. As non-members of the local community, but integrated members of the school and our distinctive classrooms, we, as researchers, strived to learn the history, sociopolitical contexts, and intimacies of our students and their lives. Author 1 is a Black woman from a large urban East Coast city. She is a former middle school science teacher and marine scientist. Author 2 is a White woman from the greater metropolitan area of the school and former high school chemistry teacher and physical scientist. As justice-oriented learning scientists, our positionality is rooted in our belief that science is not acultural (Bang and Medin 2010), and, therefore, must address issues of equity, power, and institutionalized oppression (Goodman 2011), as well as the historical and current harm that the scientific enterprise has imparted on Black and Brown communities (Morales-Doyle 2019). Through our work, we seek to engage teachers and students in addressing localized, real-world science that critiques the social, political, and ecological contexts of phenomena (Upadhyay 2010). Our view of justice-oriented science values students' authority, autonomy, care, and validation in classroom spaces. We seek to resituate power in science to reorganize the ways in which students of color make sense of science, engage in science, and negotiate space for themselves within science (Barton, Tan and Rivet 2008).

Methods

Research contexts

Data for this manuscript were derived from a larger, multi-year study on the development, design, and use of CBS practices in an urban Black and Latinx Southern California school, Horace Mann UCLA Community School. Mann, for short, has been in partnership with UCLA since 2016 in an effort to position itself as a central hub in the community and serve as a space that provides applicable and rigorous instructional program for its 52% African-American and 48% Latinx student population (Quartz 2019).

The authors, Symone & Heather, have partnered with two teachers at Mann, Ms. V and Ms. T, respectively, since 2018 in efforts to co-design science curriculum to better attend to the everyday experiences and contexts of students through a social justice lens. Symone's partner, Ms. V, an Indian American woman, is a self-identified social justice educator. Ms. V views science learning as a space for students to understand and analyze their surroundings to develop their critical thinking skills and work toward a more just future. Her goal is to provide her students with a "toolbox of skills" that they can take with them into the future to create change in their communities. Heather's partner, Ms. T, is a Vietnamese American woman with an education philosophy deeply rooted in social justice, Ms. T believes that scientific knowledge and skills can and should be empowering and exciting for students. Her goal is to support students in developing practices and dispositions to imagine and create the socioecological futures in which they can thrive.

For this study, we investigate Ms. V and Ms. T's use of CBS practices in their 7th and 8th grade environmental science elective classes and 10th grade chemistry classes, respectively, during the 2020–2021 academic year. The impact of the COVID-19 pandemic was felt nationwide, rendering all instruction online, and prompting significant challenges to instructional and pedagogical practices investigated in this paper, as well as the need for major adjustments to the developed curriculum. In addition, due to school district restrictions, there were limitations in the type and availability of data that were collected for this academic year as students were not required to have their cameras on or be unmuted; as such, many preferred to interact with the teacher via the chat. We note this as it does limit our ability to draw conclusions about the effects of these practices on student learning and understandings of power dynamics. Instead, we use this manuscript as a space to examine the instructional practices of the teachers themselves, and Ms. V and Ms. T's interpretations of their effects on students.

Curricular topics. Ms. T's chemistry class included four units that explored the overarching question of "How can we use chemistry as a tool to understand and address climate injustice?" Addressing Next Generation Science Standards (NGSS) disciplinary core ideas of weather and climate and performance expectations aligned with Chemistry of Earth Systems (Science Framework 2016), the 10th grade students brought together scientific phenomena of the carbon cycle and greenhouse effect with the social phenomena of inequitable distribution of greenspace and extreme heat. Ms. V's environmental justice classes included four project-based learning (Rivet, Krajcik, Marx and Riser 2003) units that engaged students in an exploration of complex, real-world socioscientific issues through investigations of their own communities including food justice, environmental pollution, and gentrification among others. Bringing together students' funds of knowledge (Moll, Amanti, Neff and Gonzalez 1992) and science disciplinary knowledge, these project-based

Table 1 Overview of curricular units

	Ms. V	Ms. T
Unit 1 Topic	Nutrition and food justice	The flow of energy released from fuels in combustion reactions powers our world
Unit 1 Guiding Question	How can I make my favorite recipe healthier?	Why aren't we using vegetable oil to fuel our cars?
Unit 2 Topic	Making my home work better for me	Carbon is transformed and transferred and is always conserved
Unit 2 Guiding Question	How can I make my home work better during the COVID-19 global pandemic?	How does land use in LA impact the carbon cycle?
Unit 3 Topic	Community socioscientific issues (teacher created)	Energy change in chemical reactions shows the change in chemical bonds
Unit 3 Guiding Question	Student generated	How do chemical reactions happen all around me?
Unit 4 Topic	Community socioscientific issues (student choice)	Human activity has altered the climate system
Unit 4 Guiding Question	Student generated	What are the impacts of LA getting hotter?

units explored the causes and effects of environmental and social justice issues through the lens of students' lived experiences (Table 1).

Design approaches

Our partnership contexts and goals played a significant role in the methodological approach to our research. We employed participatory design research (PDR) (Bang and Vossoughi 2016) as an umbrella method to combat prescribed traditional roles and relationships between researcher and teacher and transform the ways we engaged in collaborative design in research and practice. PDR practices supported non-hierarchical structures to our partnership work where we, as teachers and researchers, worked side-by-side in both curriculum development, as co-designers, and classroom implementation, as co-teachers. We used co-design methods (Gomez, Kyza and Mancevice 2018), specifically, to employ joint learning experiences and cooperatively engage in curriculum design. Drawing upon the rich and varied expertise of both the researchers and practitioners, we co-designed curricular interventions that were locally useful and feasible (Penuel, Coburn and Gallagher 2007). As separate, but supportive methodological approaches, PDR and co-design allowed us to engage in open dialog about instructional resources and teaching methods, and develop a shared understanding of how our developed curricula could support transformative educational outcomes. The use of co-design methods is particularly salient in this study due to our theoretical commitment to learning from and designing for local contexts (Wardrip, Gomez and Gomez 2015).

Within our approach, it is important to differentiate between aspects of CBS that were formally designed among our team, and what was improvised by the teachers, recognized as significant, and became routine over time. CBS practices were exogenously designed (Tabak 2004) during the development of the CBS instructional framework to support our understanding of what it means to engage in meaningful and relevant science learning. Exogenous design practices signify "strategies that have been developed for the purposes of the research" (p. 227). The ways in which these practices played out in instruction, however, were endogenously designed (Tabak 2004), or reflected each teachers' voice, demonstrating their personal interpretation of what this CBS practice looked like in action in their classroom.

Data collection methods and sources

Data for this study were derived from three different sources. We collected instructional artifacts and field notes as participant observers three to five times per week over nine months of instructional observation during the academic year in two of Ms. V's classes and two of Ms. T's classes. In field notes, we documented descriptions of the instructional strategies the teachers used and the contexts in which they used them. Instructional artifacts, including lesson plans, co-designed instructional materials, and daily lecture/activity slides were also analyzed to note specific strategies that the teachers utilized to connect school science and students' community and situate expertise within the students and their community. For purposes of this paper, we only provide data analysis of these strategies from one academic year; however, Ms. V and Ms. T were in partnership with the authors to develop their CBS practices over a three-year period.

We, further, conducted 90-min document elicitation interviews with the teachers to reflect on their CBS practices in instruction. Our aim in conducting the interviews was to determine the teachers' understandings of these instructional practices, purpose and goals of using these practices in moment-to-moment instruction, and the role of these practices in creating relational shifts in the classroom.

Data analysis

Our data analytic approach consisted of an iterative and emergent process of investigating the teachers' CBS practices in classroom contexts. We analyzed teacher interviews, classroom artifacts, and our field observations to determine the primary and noteworthy instructional practices used by the teachers to situate concepts locally and engage students as experts in instruction to re-situate power.

Table 2 Community-Based Science Instructional Practices

Designed Practice	Interpretation of Practice in Classroom Instruction
Creating Space for Students to Share Their Knowledge and Experiences	Storytelling Asking "Bridging" Questions
Positioning Students' Lives and Experiences as Assets to/within Science	Validating Cultural Understandings Openly Positioning Students with Authority
Being Responsive to Students' Assets in Future Lessons	Responsiveness in the Near/Short-term Future Responsiveness in the Distant Future

Across all data sources, we used a three-phase analytical process following Bazeley's (2009) "describe-compare-relate" formula for data analysis. In phase 1, we individually examined data sources to describe the data and develop meta-categories. These meta-categories included objectives, challenges or tensions, student positioning, teacher positioning, questioning and elicitation strategies, and observations of student participation. In field notes we looked for patterns in instructional practice, specifically documenting times where the teachers and students were engaging in co-learning, or the teachers utilized students' conceptualizations of scientific concepts. Instructional artifacts were coded to document how these practices were translated into the design of resources, specifically structures in curricular design that re-distributed power to students. Teacher interviews were analyzed to determine their values and goals in using CBS practices in their classroom, as well as their perceived outcomes for these practices around co-learning and power for students.

We then compared our individual analysis to determine areas of overlap and divergence, and expanded or consolidated meta-categories based on a common consensus. To move from meta-categories to conceptual themes in phase 2, we compared our findings across contexts to determine the boundaries of our codes and themes. In this step we specified the conceptual themes and identified the visible classroom practices. After, we compared embedded practices across the two teachers and explained the value each ascribed in utilizing a CBS framework. The final themes we identified are used to organize the Findings section.

Finally, in phase 3, we related our themes to the relevant literature on co-learning, re-mediating power, and equity-oriented science instruction. This step provided analytical reliability by connecting what was noticed in our data to theoretical and empirical concepts in the literature. In this next section we will present our findings to document how CBS instructional practices were used to reconceptualize where expertise resides in two science classrooms through the construction of co-learning experiences. We demonstrate that by positioning youth as holders and constructors of knowledge, teachers move away from a one-dimensional lens of science teaching and scientific knowledge to reconceptualize power in science learning spaces.

Findings

In what follows, we describe how two teachers redefined expertise, and where it resides, in science teaching and practice by engaging in co-learning experiences with their students to position students as knowledge constructors. Selected findings are organized as three exogenous design practices and the emergent, endogenous implementation of that practice (Table 2). Paper constraints do not allow us to examine every exogenous practice and the endogenous implementation of that practice these two teachers used. However, we present these selected strategies as representative of the teachers' practice. For each practice, we provide two examples in action, one from each teacher, and describe how these practices cumulatively supported the redistribution of roles in the learning space. Each practice is representative of both Ms. V and Ms. T's classroom, but the implementation of the practices illustrate the varied ways in which each teacher enacted it. Along with examples and analysis of classroom interactions, we provide excerpts and analysis from interviews to contextualize the practices. Our analysis shows that in anchoring phenomena in contexts that are socially and locally relevant to students, Ms. V and Ms. T recognized, incorporated, and integrated students' views and understandings of science issues in their instruction. By including students' perspectives, the teachers positioned students as knowledge constructors that teachers were able to learn from and with. We present evidence of how these three distinct but interconnected instructional practices expand the definition of "expert" in these two classrooms.

Practice 1: creating space for students to share their knowledge and experiences

Both teachers constructed a space for students to share their knowledge and experiences during instructional implementation to support equity by incorporating students' diverse understandings and interpretations in teaching. Ms. V created this space by explicitly and consistently stating to students that their stories were welcome, such as in October 2020, when she said, "We want to hear your opinions and your experiences," to invite students into open and shared dialog. In her interview, Ms. T described this strategy as a way for students to "give a glimpse on their worldviews and a little bit about how they come to [them]," noting these instances as opportunities for her to understand students' ideas, assumptions, and values about place, space, and/or concepts. This instructional practice served as a critical point that allowed the teachers to, as Ms. T described in her interview, "understand who the students are." We observed the teachers creating this space through storytelling and through asking questions to bridge school and community. Below we describe the instructional mechanisms each teacher used to create space for students to share their knowledge and experiences.

Storytelling. In Ms. V's classroom, storytelling was a significant practice used to create space for students to share their knowledge. In a food justice unit taught in fall 2020, Ms. V engaged students in a storytelling activity where students detailed the significance of food in their lives biologically, communally, and culturally. The activity started off by asking students to "Tell a story about your personal connection/memory of food in your life." In this activity, 7th grade student Marisol (all student names as pseudonyms) wrote about the hardship of accessing grocery stores in her neighborhood and discussed how her mom had to take multiple buses to get fresh fruits and vegetables at stores far from their home. During the next class period, Ms. V reflected on reading Marisol's story and used it as a basis for whole-class discussion on the effects and consequences of transportation access to healthy food. The discussion started as such:

> Ms. V: Marisol's point kind of also gets us thinking about transportation. So, who has transportation that's available to get to these places where we can get food?"
> Pablo: *in chat* You could bicycle to a lot of those places

> Ms. V: Yeah, you definitely could, but then that's hard thinking about it too because if you have to have a bunch of groceries on a bicycle you have to think about how we can carry that
> Jose: *in chat* Bus
> Ms. V: I was talking to a couple students, and they said a lot of places had access to the bus to get there, but the stops were too far away…

Based on Marisol's story, more students began to chime in about different ways you can access healthy and fresh food in South Los Angeles. This discussion served as the introduction for an activity that investigated transportation access points and food access points across West and South Los Angeles.

The storytelling activity served as a mechanism for Ms. V to teach about food access points (knowledge) and its intersections with transportation issues (practice) by learning about her students' lived experiences and sensemaking of food justice issues in the community (people), which she would later account for in instruction. In reflecting on this practice in her interview, she noted how it assisted her in not "divorc[ing] what's happening in class from things [students] would do in real life," explaining that when concepts and life experiences are divorced, students are unable to find science applicable, leading to disconnects in learning. In the example above, Ms. V positioned transportation as a necessary discussion of the social and political barriers that affect accessing healthy food based on Marisol's story. The intentionality of the connection between classroom discussion and her direct note that Marisol's story brought up a significant point indicates how storytelling legitimized space for students to share their knowledge and experiences, which, in turn, became useful in classroom contexts.

Ms. V continued to use storytelling as a CBS instructional practice to create space for students to share their knowledge and experiences and immediately integrated these stories into learning and instruction. By integrating students' stories to support her teaching, Ms. V sanctioned students as knowledge constructors and supported a co-learning experience by giving equal worth and value to all knowledge sharers, a guiding principle of co-learning. In doing this, power was redistributed as Ms. V utilized students' stories as foundations of teaching, positioning students as having authority in directing and contributing to instruction.

Asking "bridging" questions. Ms. T developed an instructional practice of asking "bridging" questions that supported her in learning about and connecting students nuanced and diverse real-world experiences with canonical explanations of scientific phenomena. Although often worded simplistically, questions in this style were multidimensional, as they prompted students to consider their experiences within different social worlds and use those experiences to support meaning-making. For example, while completing an assignment on how different physical mechanisms impact the greenhouse effect in March 2021, Ms. T had students complete an activity on the winning and losing stakeholders from differing climate policies. She simply asked students "Does everyone have equal access to solar panels to make their electricity?" A student, Juan Carlos answered, "No. It's more difficult to put solar panels on apartment buildings. Where we live solar panels aren't so simple." Juan Carlos' response to Ms. T's bridging question sparked a multitude of students chiming into the conversation, stating how renters do not have power over decision making about electricity production, and that landlords can be greedy and negligent. Essentially, students connected emission mitigation technology to their critical awareness of inequalities faced by low-income urban renters. Ms. T's questioning opened dialog for students to share their life experiences (people) to support their understanding of the socio-political and scientific dimensions of solutions (practice) to the human-altered greenhouse effect (knowledge).

By asking bridging questions, Ms. T supported students in interrogating homogenous and traditional conceptualizations of phenomena by integrating their own perceptions. These types of questions invited students to, first, share their knowledge and experiences and, then, make connections to the scientific phenomenon of inquiry. Other examples of bridging questions include "How does climate change affect your life in Los Angeles?" and "Are the people most impacted by extreme heat also responsible for releasing the most greenhouse gasses?" These bridging questions connected students' observations of the causes and consequences of climate change with standard-aligned concepts of technological solutions that mitigate climate change (HS-ESS3-2 and HS-ESS3-4). Asking bridging questions served as a mechanism for Ms. T to learn about her students' understanding and experiences within a phenomenon, and supported a co-learning opportunity, as students' knowledge became the foundation of future instructional experiences. Although it is clear that for some questions Ms. T might have known the "correct" answer in advance, others she genuinely needed to learn from students, as the answer was personal and unique to each of them. As such, students were positioned as participants in knowledge construction with their lived experiences situated as necessary sensemaking resources. Collectively, this generated relational changes in the classroom spaces as students were positioned as agents in their own learning.

Practice 2: positioning students' lives and experiences as assets to/within science

As Ms. V and Ms. T took time to learn about their students and their lives, they were able to integrate those experiences, and the knowledge students derived from those experiences, as valuable assets to science learning. Both teachers regarded CBS practices as a mechanism to validate the knowledge and experiences of their students as resources for sensemaking to conceptualize science concepts, as well as legitimate bases of scientific data during instructional implementation, an important practice within CBS. In the CBS framework, validation means that the knowledge, experiences, and understandings that students share are not ignored, but instead, uplifted as important *and* necessary contributions to the learning environment, which can and should be utilized as assets in instruction. Positioning these understandings as valid sources of science knowledge, whether or not they can be proven or generalized, separates CBS from similar frameworks. The two examples, below, show the mechanisms the teachers used to validate this student knowledge as essential to classroom work, thus shifting power dynamics in instruction.

Validating cultural understandings. In Ms. V's class, positioning students' lived experiences as assets in the learning space was grounded in the practice of responding to and respecting students' cultural and familial conceptualizations of phenomena even if it was not, traditionally, scientifically "correct." This was illustrated in dialog between her and a 7th grade student, Matthew, as they discussed his final project for the food justice unit. In this project, students were asked to recreate a healthier recipe of their favorite cultural and/or familial food. Matthew decided that he wanted to investigate how to recreate a healthier milkshake recipe. In explaining his recipe, Matthew stated that he wanted to include chocolate in his milkshake, describing it as a healthy fruit, which confused Ms. V. The following dialog occurred:

Ms. V: Um I mean even the chocolate bars you get, unless it's dark chocolate, are still going to have a lot of fat and sugar, so maybe think about what type of chocolate
Matthew: The cocoa ones, the normal ones that grow on trees
Ms. V: Oh, like the cocoa bean?
Matthew: Yeah
Ms. V: Can you do that? You have cocoa beans?
Matthew: Yeah, in my backyard
Ms. V: Yeah, okay, cool! Put cocoa beans in your milkshake. That is for sure healthier.

In this example we see that Matthew conceptualized chocolate as "healthy" because of his cultural association of chocolate as a cocoa bean, to which Ms. V validated as a healthy alternative and encouraged him to use it in his recipe. By positioning Matthew's cultural and historical understandings of cocoa as chocolate as scientifically accurate (knowledge), she positioned him (people) as participating in the construction of a contextual understanding of "healthy" (practice). This served as a co-learning moment for Ms. V, as she herself learned a new way of conceptualizing "healthy" to include a historically "unhealthy" food. By moving away from a singular definition of healthy, she demonstrated that students have a multitude of conceptual resources that can support learning and situated Matthew as having expertise of healthy food through his own conceptualization. By decentering her normative understanding of chocolate as unhealthy to account for Matthew's cultural understanding, she redistributed power by supporting and uplifting heterogeneity in conceptualizations of nutrition.

Openly positioning students with authority. For Ms. T, positioning students' lived experiences as assets was often done through a direct approach of verbalizing and affirming their understandings as supportive to sensemaking and crafting explanations of phenomena. With this practice, she positioned students as not only experts of their own experiences, but experts of science concepts *because* of those experiences. For example, during a modeling activity in the fall semester, Ms. T asked her students to create a carbon cycle model of Los Angeles to include human influences and positioned this model in contrast to generic representations at large scale that did not represent the everyday people, places, and spaces that influence carbon emissions. She said to her students, "You all live here, and you all live in the present day, so you know what this model needs to be better." In noting that students "know what this model needs" she disconnected herself as the sole proprietor of scientific knowledge and positioned students as knowledge constructors who could more accurately develop carbon cycle models than their curricular resources because of their experiences living in and being part of the community.

In another activity, Ms. T had students discuss Los Angeles' sustainability plan. She stated, "Even though Mayor Garcetti is the mayor of the whole city, he is not an expert on every single neighborhood. Parts of Los Angeles you know better than he does." In this statement, Ms. T publicly positioned her students with authority and as experts by stating that their lived experiences made them more aware of what is needed in that space than a person in power. As such, she positioned the knowledge that students brought from their neighborhood (people) as assets to understanding the carbon cycle and land use (knowledge), and developing solutions to greenspace inequalities (practice). This change in relational dynamic supported a co-learning experience for Ms. T as she was able to use students' sensemaking resources to contextualize and support classroom instruction, positioning students as experts in the classroom space. By publicly de-centered herself and her authority, Ms. T. created relational shifts that elevated the authority of students in explaining the phenomenon of inquiry and directing the learning experience.

Practice 3: Being responsive to students' assets in future lessons

Building on what the teachers learned with students from their stories and the knowledge they shared, the teachers, as co-learners, positioned what they learned as sensemaking resources and modified future lessons to draw on these resources. In her interview, Ms. V described this process as "validat[ing] the anecdotal, cultural [and] oral traditions and knowledge that exists in a lot of communities," and accounting for it in the learning space. Within their instructional practices, we observed the teachers being responsive to what they learned about students in the near/short-term future during instructional planning, such as modifying a lesson plan week to week or unit to unit, as well as in the more distant future, such as revising future lessons and units year to year.

Responsiveness in the near/short-term future. For Ms. V, responsiveness to students' assets could be seen in the design and development of the projects across units. For example, unit 3 focused on "Community Socioscientific Issues," of which Symone and Ms. V developed topics for investigation. During earlier units, students brought forth a number of life experiences related to science content areas throughout classroom discussions which Symone and Ms. V had not accounted for when originally designing the unit. These conversations with students served as the basis for the re-design of this unit during the 2020 winter break. For instance, as this class took place during the COVID-19 pandemic, many students continually discussed ongoing health issues that were severely impacting their family and community. Prior to these conversations Symone and Ms. V had not considered a project on socioscientific inequities around COVID-19. Students' continued interest and understanding of these inequities served as the foundation of the development of two project topics including "Health Inequities in Los Angeles," as well as "Greenspace Equity" to investigate connections between the presence of greenspace and healthy/unhealthy communities. Students, also, often discussed the environmental conditions of their community, noting littering and air pollution as significant sources of contamination. These conversations laid the foundation for the development of the "Environmental Pollution" project topic. Collectively, the assets students brought from the lived experiences in community (people) contributed to changes in classroom instruction (practice) by serving as the foundation of lesson topics for the next unit in the class (knowledge), demonstrating a co-learning experience between teacher and students, and positioning students as knowledge constructors and authorities that support instructional design.

Responsiveness in the distant future. Ms. T's design of her carbon cycle modeling lesson provides an example of distant future lesson planning. During the 2019 SY, Ms. T's students brought to her attention a significant source of carbon emissions close to their neighborhood, the Los Angeles International Airport (LAX), that she had not previously included in her models. During the 2020 SY, Ms. T was responsive to this noticing, highlighting LAX as a significant carbon source in her modeling lesson plans. In her interview, she reflected on this responsiveness when she stated,

> The students talk about LAX a lot and I feel like I forget about LAX…but when the students were putting it in their Los Angeles carbon cycle models last year, I was like 'Oh my God!' That's a huge impact on our climate.

The knowledge Ms. T's students brought to the classroom from the everyday observations of their community (people) reminded her of a major source of carbon emission that was relevant and present for them (knowledge), but she had overlooked. She learned how significant the airport was in students' daily lives and that it was meaningful for them to include in models and explanations of the human-altered carbon cycle in their community (practice). Ms. T demonstrated a repositioning of students as experts in instruction by altering her future lesson design to elevate airports as a major source of carbon emissions, and prepared data on airport emissions for students to evaluate during the 2020–2021 AY.

Cumulative impact of CBS practices

We argue that creating, positioning, and responding to students' lived experiences supported relational shifts between teacher and students in the classroom. Our findings suggest that when teachers more concretely and consistently generate opportunities to learn about, from, and with students, including their communities and cultures, students are positioned as knowledge constructors who reconceptualize disciplinary and social concepts and constructions of scientific phenomena to be more meaningful and relevant, along with the teacher. Thus, utilizing CBS instructional practices renders an expanded definition of the students not only as learners, but as experts who contribute to conceptualizations, knowledge, and understandings of scientific issues in their community. Empirically, our findings show that by expanding who is considered an expert in the classroom, Ms. V and Ms. T were able to use multiple forms of knowing, and knowledge, as legitimate and needed sensemaking resources (Warren, Vossoughi, Rosebery, Bang and Taylor 2020). Teachers' responsiveness to these sensemaking resources (1) supported co-learning experiences as they utilize students' individual meaning-making to support collective meaning-making across instruction, (2) reconceptualized sanctioned disciplinary knowledge, and (3) reconstructed the ways students and teachers jointly engaged in science practice. By using CBS instructional practices Ms. V and Ms. T challenged traditional roles of "expert" and "outsider" in their classrooms to promote an unscaffolded and authentic community of practice where teaching and learning was multi-directional (Brantmeier 2013).

Discussion

By examining two urban teachers' use of community-based science instructional practices, this study provides empirical evidence of the mechanism's educators used to re-conceptualize expert and outsider in science instruction by employing co-learning to problematize power dynamics in science classrooms. By (a) creating space for students to share their knowledge and experiences, (b) positioning students' lives and experiences as assets to/within science, and (3) being responsive to those assets in future lessons, we found that deficit views of students' knowledge were countered, as CBS instructional practices positioned teachers and students as co-learners, where the knowledge from both groups was supported and valued (Gorski 2017). Through these practices, students were able to contribute their knowledge and representations in classroom instruction to contextualize concepts and phenomena in the reality of their lives, and teachers were able to learn from and about students' cultures and communities and utilize those assets to support instruction. This utilization supported a reshaping of relational and power dynamics in the classroom, as Ms. V and Ms. T sanctioned students as having authoritative expertise that supported science learning (Donnelly, McGarr and O'Reilly 2014). These instructional practices differ from other traditionally present in the literature as the teachers did not pick and choose aspects of students' lives that were significant to classroom learning, privileging certain knowledge and experiences over others, a critique of a traditional funds of knowledge approach (Oughton 2010; Rodriguez 2013). Instead, Ms. V and Ms. T let students' experiences and understandings guide instruction and knowledge construction, giving equal value to the multiplicity of students' funds.

We believe that this work offers an example of how shifts in relational dynamics can take place when teachers release their grasp of controlling the narratives of who, what, and where in learning (Tolbert, Barton and Moll 2018) and adopt a pedagogy of vulnerability (Brantmeier 2013). This control perpetuates deficit views of multiplicity in disciplinary knowledge that are derived from students, communities, and cultures (Warren, Vossoughi, Rosebery, Bang and Taylor 2020). The release and realignment of control can promote multiplicity as a valued sensemaking resource in science learning (Brown 2019), creating expectations and norms for the classroom community that view all student contributions as equal, respected, intelligent, and valued (Michaels, O'Connor, Hall and Resnick 2010). The inclusion of students' contemporary knowledge further deconstructs traditional roles in classroom learning, rendering a repositioning of expertise by distributing normalized and existing power relations in the classroom across teachers and students. In resituating power in science, teachers may be able to reorganize the ways in which urban students of color make sense of science, engage in science, and negotiate space for themselves within science to support equitable, transformative futures (Tan and Barton 2010). In this section, we build on the current literature to position CBS practices as a potential catalyst for change in science classroom power dynamics through expansive co-learning opportunities.

To engage in justice-oriented education, Angela Calabrese Barton and Edna Tan (2019) call for the production of spaces of rightful presence for students in STEM learning. In creating a classroom that encompasses rightful presence, students must be positioned as.

> "legitimate and legitimized [members] in a classroom community because of who one is (not who one should be), in which the practices of that community support restricting power dynamics toward more just ends through making both injustice and social change visible" (p. 619).

In this study, we characterize students' rightful presence as deconstructing historicized positionalities of students as outsiders to the learning environment. The instructional practices presented in this study add empirical evidence to Barton and Tan's assertion that in order to support a rightful presence, there is a need for change in hierarchical teacher–student relational dynamics. CBS instructional practices position students rightfully "at the table" with their teachers as they learn and engage in knowledge construction together, versus students being traditionally positioned to memorize the facts and figures of science knowing, reinforcing and reproducing inequalities (Brown 2019). These findings position CBS instructional practices as approaches that move beyond gatekeeping in science, in this case, by creating spaces for students' lived experiences, positioning them as assets in learning, and being responsive to those assets in future lessons, Ms. V and Ms. T transitioned from being situated as only figures of authority and established knowledge sources (Tolbert, Barton and Moll 2018), to teachers and learners alongside their students.

We further argue that CBS instructional practices make injustice and social change visible by recognizing and addressing the harmful relational hierarchies that are imbedded in schooling structures. The CBS instructional practices Ms. V and Ms. T engaged in supported *making present practices* (Tedesco and Bagelman 2017), or making visible historically marginalized human and non-human entities that suffer as a result of systemic oppression. By providing students legitimate and legitimized opportunities for their knowledge to be a part of classroom practice and inform instruction, CBS deepens their understanding of scientific concepts and phenomenon, and position students with epistemic authority (Lee 2006). By employing CBS practices in teaching, Ms. V and Ms. T were able to engage the community and cultural knowledge of their students in classroom practice and use that knowledge to support instructional design. In making present students' positionality as knowledge constructors, these findings support Barton and Tan's (2019) notion that making present practices "disrupt binaries between outsider/insider and novice/expert" (p. 624) by reconfiguring the existing order of the classroom space (Vrasti and Dayal 2016).

Limitations and future research

While our work presents evidence of expansive instructional practice, this study was centered in an examination of teachers' ability to redefine expertise to reconstruct power dynamics and their perceptions of its effects. It does not present an analysis of student outcomes, in general, or students' perspectives on the effects of CBS instructional practices on expertise, co-learning, and, consequently, power in the classroom more specifically. While we argue these instructional practices present mechanisms that transform power in classroom learning, we also recognize the inherent constraints, challenges and tensions of CBS as it relates to mitigating power within student-teacher relations. These practices can be challenging for teachers to engage in due to broader power structures, such as cross-cultural understandings, commitments to school and district curricular standards, standardized testing, and other such responsibilities that come from school administration or districts that can serve to constrain teachers' agency to enact such practices. The structured nature of science teaching, current ideas of what alignment to the Next Generation Science Standards (NGSS) looks like, and time limitations, also present obstacles for teachers seeking to engage in these practices and reimagine relational structures. Further, the enculturation of students into schooling which has socialized them as receivers of knowledge. rather than depositors of knowledge (Freire 1970), may limit students in seeing themselves as having power and expertise, despite teacher validation. We highlight these constraints to note that engaging in CBS strategies is not a complete fix to remediate power in science teaching and learning. Instead, we position it as a strategy towards deconstruction, as we work towards addressing larger power structures that currently render completed remediation impossible.

It is worth noting, however, that Ms. V and Ms. T's class were rich in science and engineering practices and core disciplinary ideas promoted in the NGSS while addressing community oriented and sociopolitical dimensions of phenomena. Therefore, we note the importance of recognizing CBS as not an oppositional practice to NGSS-aligned instruction, but one that supports and expands it. CBS still represents tremendous change in practice and work on the part of teachers. Although the teachers in our study have worked hard over years to put these practices into play, it remains challenging to them to balance and implement CBS consistently. Despite these challenges, our findings present evidence that there are everyday CBS practices that teachers can engage in that work toward more just and equitable science learning spaces.

Our future research hopes to investigate the effects of the enactment of these practices across multiple years. By investigating these practices over time, we hope to document and demonstrate how students appropriate reconstructions of power in the classroom and utilize their reconstructions to create new forms of engagement in learning. Future work could, also, investigate how CBS practice are transformed across other contexts to co-learning experiences, redistributions of power, and expansive meaning-making for youth. Overall, our hope for this study is that teachers can adopt and adapt these instructional approaches to support *their* students in *their* communities and create science learning environments that recognize and utilize the bountiful resources and intellect that are found within *their* ways of knowing.

Conclusion

We end by going back to Kayumova, McGuire and Cardello's (2019) stance that urban students of color do not need to be empowered, but, instead, need powerful frameworks that consider diversity in knowing. Through our findings, we present CBS as such a framework that supports this stance by redefining "what it means to be scientific [and] who can participate in science" (Tolbert, Barton and Moll 2018, p.14). In all, our findings offer evidence that teachers can develop and implement classroom instructional practices that encourage the exploration and learning of science not as a set of grounded "facts" that cannot be construed or expressed in different ways, to, instead, a subjective set of "understandings'' that are interpreted through different contexts. By engaging in science instruction through a more holistic view that address people, practice and knowledge, collectively, teachers move away from a one-dimensional view of concept interpretation to, instead, incorporate a diversity of student conceptualizations in learning. By transforming the view of multiple forms of knowing as in *competition* with scientific conceptualizations to, instead, in *harmony* with and supporting of, Ms. V and Ms. T were able to learn along with their students, creating new relational dynamics that empowered multiple epistemologies. When practices are metamorphosized to reflect these multiple epistemologies, expertise is redefined as emanating from students, relinquishing power by the teachers.

Collectively, the implications of our findings demonstrate that CBS instructional practices may support equitable and expansive learning opportunities for both teachers and students in science by bridging and blurring the lines between science, school, community, and learning. In doing this, the totality of students' lives and experiences is made present as their knowledge is legitimized in learning, and teachers relinquish traditional roles in classroom practice by viewing students as knowledge holders and contributors, by sanctioning students to determine what knowledge and experiences are valued in the classroom setting and can support instruction. This restructuring of relational dynamics nurtures new collaborative relationships and possibilities in learning and instruction as power structures are dismantled through reconsiderations of whose expertise matters. As we imagine a more just educational future, disrupting knowledge hierarchies, participation boundaries, and power dynamics are the foundation with which we must begin. With hopes and dreams of this more just future, through a transformation in science learning that accounts for students' broad knowledge to support co-learning experiences, we encourage educators to consider the ways in which they can transform their classrooms to spaces of diversity in thinking, doing, and knowing through the use of CBS instructional practices.

Acknowledgements We would like to thank Ms. V, Ms. T, and their students at Horace Mann who graciously welcomed us into their community. We would also like to thank Drs. Kimberley Gomez and Karen Hunter Quartz for their support.

Author contributions S.A. Gyles wrote the main manuscript text and prepared tables 1-2. H.F. Clark supported data analysis and manuscript editing and revising throughout the writing process. All authors reviewed the manuscript.

Funding This study was supported by funds from the University of California, Los Angeles Graduate Division.

Data availability The datasets generated during and/or analyzed during the current study are not publicly available due to ongoing analysis and publications around this work, but are available from the corresponding author upon reasonable request.

Declarations

Competing interests The authors declare no competing interests.

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Publisher's Note Springer Nature remains neutral with regard to jurisdictional claims in published maps and institutional affiliations.

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