

Rethinking High-Leverage Practices in Justice-Oriented Ways

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Abstract:

Justice-oriented teaching must address how classroom-based disciplinary learning is shaped by interactions among local practice *and* systems of privilege and oppression. Our work advances current scholarship on high-leverage practices [HLPs] by emphasizing the need for teaching practices that restructure power relations in classrooms and their intersections with historicized injustice in local practice as a part of disciplinary learning. Drawing upon a critical justice stance, and long-term collaborative work with middle school teachers and youth, we report on empirically driven insights into patterns-in-practice in teaching which yield insight into both what justice-oriented high-leverage practices may be, and the cross-cutting ideals which undergird them. We discuss the patterns-in-practice and their implications for teaching and learning across subject areas: HLPs that work toward equitable and consequential ends need to be understood in terms of the practice itself and its individual and collective impact on classroom life.

Keywords: equity | high-leverage practices | pedagogy | teacher learning | justice | educational reform

Article:

Introduction

Teachers care, but they do not care about the community all the time. We go outside on our time, and find places where we can do science or engineering for our communities. School doesn't know how to do that. School doesn't know that we do that. We need to tell our teachers how we do it. We got to help them. (Samuel, 14-year-old)

Samuel's quote captures a central challenge in the ongoing quest for justice in teaching and learning. Thirty years of reform efforts notwithstanding, patterns of dominant discourses and practices have worked collectively, across scales of activity, to position youth from lower-income communities of color as missing, or out of place, socially, culturally, and academically, despite their embodied presence in classrooms (Lee, 2008).

Forms of justice-oriented teaching are urgently needed to disrupt/restructure such regularities in practice. We argue that for teaching to be justice oriented, it needs to address the ways in which historicized injustices manifest in systems of power that play out in local classroom practice as part of disciplinary-based teaching and learning. We focus on justice-oriented high-leverage practices (HLPs) because HLPs represent the core practices of teaching, which cut across contexts, disciplinary domains, and grade levels. We recognize the promise of HLPs in advancing the field of teaching and equitable opportunities for student learning. However, we also seek to address how and why core practices might further support teachers in addressing historicized injustices in classroom learning, which has been noted as a limitation (Philip et al., 2018).

Our questions are as follows:

- What teaching practices make visible and work to restructure local in-practice classroom manifestations of historicized injustices?
- How might the patterns and variations in these practices inform constructions of justice-oriented HLPs?

We report empirical insights grounded in long-term participatory design work with teachers and students across three middle schools. Our work takes place in science classrooms where there are teaching practices unique to science education (e.g., facilitating scientific inquiry). However, we sought to make sense of patterns in teachers' practices which related to justice-oriented teaching broadly—in ways that disrupted injustices and promoted student learning and development—and that carry implications across subject areas, grade levels, and contexts.

Our participatory approach draws upon teachers' and students' lived experiences in classrooms, addressing the concern that the majority of research on core teaching practices has emerged from expert consensus (Kloser, 2014). Thus, we attend to the power structures entrenched in classrooms that often lead to the marginalization of students of color and from low-income communities.

Equity, Justice, and HLPs

HLPs have been defined as the core practices of teaching, which, when implemented consistently over time, support teacher *and* student learning (Ball & Forzani, 2009; McDonald et al., 2013). HLPs help teachers address common problems of practice faced in classrooms. For example, one HLP previously identified, and specifically related to equity, is that of “[l]earning about students’ cultural, religious, family, intellectual, and personal experiences and resources for use in instruction” (Teaching Works, 2018). This practice consists of pedagogical moves that support teachers in learning about their students, such as understanding cultural norms for communication or participation, so that they can design instruction with these in mind.

HLPs are grounded in a practice-based theory of teaching, foregrounding the routine activities that teachers adopt toward supporting student learning. Some have argued that HLPs oversimplify the complexity of teaching and teacher decision-making (Philip et al., 2018). Although we share this concern, we concur with those who argue that HLPs are not intended to

be standalone technical know-how (Grossman, 2018). HLPs are always enacted in—and thus responsive to—context (Kloser, 2014). They can potentially provide crucial guidance for teachers as they navigate the complexities of classroom life, especially when viewed as part of a larger coherent system of instruction toward promoting equitable outcomes (Thompson et al., 2013).

Early work on HLPs grew out of a perceived need to better prepare beginning teachers to engage the work of teaching. One growing subset of these efforts is to advance how HLPs may support more equitable outcomes (McDonald et al., 2013). These range from focusing on how core practices can respond adaptively to students' thinking (Thompson et al., 2013) to eliciting student voice and performances (Lampert et al., 2013).

HLPs, largely, have been oriented toward the level of the individual. Through improved teaching practices, students, as individual people, will have more powerful opportunities to engage the disciplines meaningfully. The limitation of an individualistic view is that it omits the role systemic, structural oppressions, such as racism, may play in classrooms (McDonald et al., 2013). Negative cycles of racialization limit empowering learning despite existing powerful instructional practices. Without attention to historicized injustices and how they manifest in the local classroom practices, school reform efforts in high-poverty districts have yielded transient impacts (Milner, 2015).

Although HLPs can powerfully support teacher preparation in equity-oriented ways, we argue that HLPs need to be conceived beyond the individual focus. Attention is needed on how HLPs may contribute to disrupting—through local practice—the historicized injustices youth encounter because their lives are often systemically marginal to disciplinary-based classroom activity. We refer to this way of conceiving HLPs as being justice oriented. Limited empirical work has been done in this area, though there is precedent in mathematics education (e.g., Hand, 2012; Rubel, 2017). For example, Hand (2012) illustrates that when teachers engaged in noticing practices that helped students to “take up space” in the classroom, normative racialized and epistemological power hierarchies shifted in equity-oriented ways. We view such work as justice oriented because it disrupts the local practices which maintain injustice while simultaneously supporting meaningful disciplinary learning toward social transformation. Promoting justice-oriented HLPs is necessary for addressing enduring inequalities in education.

Framework: Justice-Oriented Teaching

We ground our work in a justice-oriented social practice stance, asserting that justice-oriented teaching and learning is that which is *equitable* and *consequential*. Equitable refers to teaching practices that expand opportunities for disciplinary engagement and learning in culturally relevant and rigorous ways. Consequential suggests that such opportunities also promote social transformations, including altering patterns of participation and authority structures that perturb the existing, hierarchical social order of classrooms generally rooted in White supremacy and patriarchal dominance (Birmingham et al., 2017).

Teaching and learning take shape *in practice* and are influenced by competing narratives in local contexts by “integrating the study of persons, local practice and long-term historically

institutionalized struggles” (Holland & Lave, 2009, p. 1). This view of teaching foregrounds how teaching and learning are relational in time, place, and power (Gutiérrez et al., 2019). For example, teaching and learning take shape in how ideas, tools, resources, and relationships move and remix as people engage in social practice toward new futures.

Our conceptualization of justice-oriented HLPs is further grounded in research on justice-oriented teaching in the disciplines. Engagement in the disciplines, such as science, is grounded in people’s lived lives and community wisdom (Tuck, 2009), which yield powerful forms of cultural knowledge and practice relevant to learning (Bang et al., 2012). However, some students’ cultural knowledge and practices, even when considered resources for disciplinary learning, may be positioned as nonintegral to the disciplines themselves, and delegitimized among the discourses and practices of classroom learning (Um, 2019).

Nasir and Vakil (2017) describe how classrooms “carry explicit and implicit racialized and gendered notions of who does and does not belong in these classrooms” (p. 378). Such patterns of how students are racialized and gendered through routine practices of teaching have been reported along with concrete resultant inequities. For example, “settled” expectations in school act as “boundaries that control the borders of acceptable meanings and meaning-making practices,” positioning students from nondominant communities as deficit (Bang et al., 2012, p. 303). In addition, normative discourses about and enactments of disciplinary learning can differentially position students with or without epistemic authority and/or agency (Birmingham et al., 2017).

Justice-oriented disciplinary teaching counters these erasures by centering and amplifying the “plural and evolving nature of youth identity and cultural practices” toward their “counterhegemonic potential” (Paris & Alim, 2014, p. 85). It foregrounds the political and humanizing dimensions of teaching/learning, which values students as whole people, whose knowledge/wisdom, experiences, and fraught histories are integral to disciplinary engagement (Davis & Schaeffer, 2019). Justice-oriented disciplinary teaching also foregrounds supporting students in developing critical awareness of and strategies for navigating and transforming current and hoped-for social futures (Morales-Doyle, 2017; Rubel, 2017).

We position our work, which draws upon studies in justice-oriented teaching, in the domain of HLPs because we wish to engage in the broader conversation on the common problems of practice faced by teachers and students, with respect to historicized injustice in classroom settings (Nasir & Vakil, 2017). By historicized injustices, we refer to the chronic oppressions experienced by youth of color, girls, and students from low-income communities that occur across time (30+ years of reform-based science efforts) and place (increased barriers in schools serving majority students of color). These historicized injustices include the marginalization of youth based on deficit perspectives, dehumanizing school practices, and societal practices which position some students with authority and some without because of their race, gender, language, and family economics.

These are not isolated oppressions, but widespread, enduring, taking form in local practice. It is the individual, contextualized actions taken by local gatekeepers who police boundaries that act to deny access to quality education of particular students, whether purposeful or not. From this

study's point of view, teachers, through the practices they employ in the classroom, are the most salient authority figures that mete out, often unknowingly and with the best intentions, these gatekeeping practices. These mundane actions have a cumulative effect that can be detrimental to youths' long-term engagement with disciplinary learning.

The promise of justice-oriented teaching in dismantling some of the historicized injustices youth face in schooling requires finding new ways to understand the political and structural continuities that shape life in classrooms and to envision ways to transform them through the practice of teaching.

Method

A Critical Participatory Approach

Drawing upon critical, participatory design-based approaches, we are committed to engaging in sustained, collaborative practice toward social equity and learning. This focus values the *historicity* of people and problems, and *relational* approaches to combining experiences and practices across methods and discourses (Bang et al., 2016). These commitments are central to studying justice-oriented teaching with students from nondominant communities who have been unfairly framed as in need of repair.

Context

Our work is participatory in that we have worked in partnership with teachers and students over many years to study justice-oriented teaching. This study is grounded in three of these partnerships. Our partnership work is critical in that the collective focus has been on transforming classroom learning experiences to be more inclusive of youths' existing expertise and hoped-for social futures. We highlight one focal teacher/classroom per partnership (Table 1). Teachers were selected because they expressed interest in navigating the tensions between working to enact justice-oriented teaching and the challenges related to the injustices experienced by students and teachers in their schools. Each teacher represented a different stage in their journey to becoming more justice oriented.

- Ms. H has taught sixth grade (all subjects) for 7 years, the last three at Wilkenson. She is White and a strong advocate for her students, connecting families with resources and staying late to help students with their work. She was openly inquiring about how to better serve her students in justice-oriented ways. We spent 8 weeks in Ms. H's classroom during two integrated science/engineering units: electric art and sustainable classrooms.
- Mr. J, a White teacher, has been teaching sixth grade science and math at Bayside for 10 years. He described his upbringing in terms of socioeconomic background as similar to his students. He was just beginning to ask questions about justice-oriented teaching. We spent 6 months in Mr. J's classroom.
- Mr. M has 5 years of experience teaching, all at *Inquiry*. Mr. M is White, but grew up in the neighborhood where he teaches, and possessed significant understanding of the local, cultural knowledge. Mr. M actively worked, over 2 years, to transform his practice from

teacher centered to student centered in an effort to be more justice minded. We spent a full year in Mr. M’s classroom.

Table 1. Partner Schools.

Partner school	Focal teacher	Student demographics	# Participating teachers
<i>Wilkinson School</i> , Midwest City District-wide STEM school (attended primarily by students in the catchment zone)	Ms. H	32% White, 28% Latinx, 22% Black, 9% two or more races, 8% Asian, 1% Native American	4
<i>Inquiry School</i> , East Coast City Locally zoned STEM school	Mr. M	45% African American, 55% Latinx	3
Bayside School, Midwest City Locally zoned performing arts school	Mr. J	58% African American, 26% White, 10% Latinx, 5% Asian, 1% Native American	3

Note. STEM = science, technology, engineering, and mathematics.

Data Generation

In partnership with teachers, we sought to co-generate data which reflected their practice and its impact on students. The focus on HLPs emerged in the analysis when we wondered how cross-site, cross-context insights might contribute to the core of teaching, and sought to put our insights into dialogue with the HLP literature. Our approaches to data generation were co-designed and co-enacted with partner teachers and students.

Detailed *fieldnotes* were produced in each teacher’s classroom by the authors and collaborators. We analyzed fieldnotes during focal units which included the following: Ms. H, 12 sessions; Mr. M, 18 sessions; and Mr. J, seven sessions. Fieldnotes documented classroom culture: patterns of participation, teacher moves, teacher–student actions/interactions, and observable aspects of knowledge hierarchies and how these were influenced by teacher/student actions/interactions. Two observational protocols were used. One focused on documenting teacher–student interactions, with efforts to record timestamps, teacher moves/student moves with reference to specific utterances, and quality/quantity of participation. A second protocol focused more broadly on documenting classroom culture focusing on norms, expectations and rules, tools and resources, forms of participation/distribution of labor, participants and observable social networks, and knowledge/practice and its role, and observable outcomes.

Interviews and *conversations* were conducted in a participatory fashion with each partner teacher and audio/video recorded. These included (a) pre/post interviews focused on teaching goals and experiences, (b) conversational implementation reflections, focused on *particular students or teaching moves on specific days/moments* (weekly throughout focal unit implementation, guided by participating teachers), and (c) lesson plan dialogues focused on lesson ideas, critiques, and insights, in collaborative format with other teachers and/or youth; 2 to 6 per/teacher.

We collected student-produced *artifacts generated during the focal unit*.

Video/audio recordings of select implementations were co-identified by teachers as being important to their goals. In Mr. M’s classroom, for the focal unit of analysis, whole-class video records were kept 3 days a week over 6 weeks, with additional recordings of small group activities focused on student-group discussions while scripting their antismoking skit. Ms. H’s

classroom recordings included whole-class lessons on sustainable communities, community ethnography/defining problems and designing solutions, with small group recordings of electric art, sketch-up cycles, and student final presentations. Video recordings were not generated in Mr. J's classroom per institutional review board (IRB) restrictions.

Data Analysis

Strauss and Corbin's (1998) procedures guided open coding and methods of constant comparison. We co-developed coding schemes around teachers' practices regarding justice-oriented teaching, using two phases of analysis.

The first phase involved all three authors perusing classroom data, with an emphasis on fieldnotes, for evidence of changing student participation in terms of (a) number of participating students, paying attention to the ones typically on the periphery; (b) kinds of resources/contributions students brought to lessons and how they were legitimated; (c) new participation norms which emerged; and (d) new ways students presented evidence of learning beyond sanctioned classroom practices, and the outcomes of these modes of participation individually and collectively. Data were open-coded within these categories. We similarly coded teacher interview data for moments that teachers indicated reflected important shifts in practice. Periodic conversations were held among the authors to (a) work toward consensus and (b) identify moments where shifts in participation and outcomes appeared to disrupt normative classroom practices. Two researchers coded data from each site; however, all three researchers discussed the coded data to work toward generalizable claims. Differences in view were discussed until new meanings were generated as a result of differences.

Second, we further analyzed the aforementioned moments of shifts in practice. We relied on fieldnotes and video records (as available) of identified moments. We coded for what distinguished these moments, how teachers/students navigated these moments, and the role of classroom culture. For example, using our theoretical framework, we coded for how identified moments facilitated or constrained dialogic spaces for bridging students in- and out-of-school worlds toward meaningfully engaging science, while also amplifying youths' struggles in schools. We paid attention to how teachers talked about the cultural practices students brought to their classrooms, the productive intersections with disciplinary knowledge and practices they noticed, and how they planned for and responded to these practices. After initial codes were established, we developed a focused coding process where we overlaid our guiding frameworks on our insights.

During this second phase, we generated an analytic figure and table which indicated moments, teacher moves, teacher-student actions and interactions, and student participation (Figure 1 and Table 2). We used these tables to generate assertions around practices that may work toward justice-oriented ends. Data records were analyzed to unearth further confirming and disconfirming evidence for emerging assertions. Disconfirming evidence was used to flesh out the tensions emergent in enacting these practices. We categorized moments as facilitating or constraining justice-oriented teaching/learning based on the presence or absence of social transformation. Constraining moments served as disconfirming evidence.

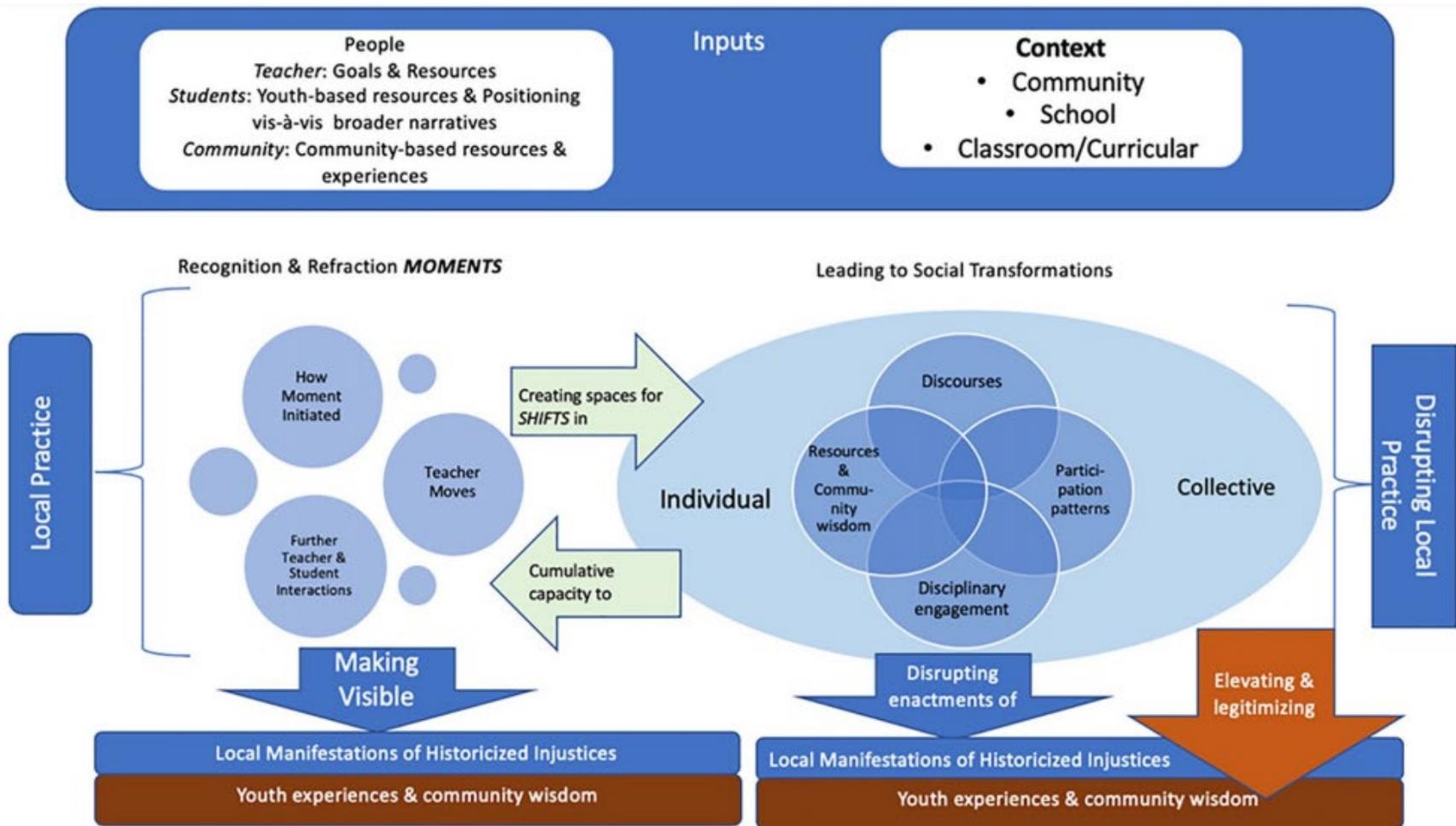


Figure 1. Analytic heuristic: recognition and refraction toward social transformation.

Table 2. Analytic Approach: Example From Ms. H (Case 1).

Moments		Shifts	Outcomes	
Moment	Key features (how/why an R&R moment)	Actions and interactions	Transformative classroom processes	
		<ul style="list-style-type: none"> • How moment initiated • Key teacher moves • Further interactions 	<ul style="list-style-type: none"> • Individual • Collective 	
What is classroom sustainability (Session I)	Ms. H made visible community needs as central to engineering design	<ul style="list-style-type: none"> • Initially defined community sustainability as healthy communities that value everyone, and good for the environment • Solicited student input on what healthy happy communities mean. Students volunteered stories of different situations involving being happy/health or not • Student stories leveraged by teachers to instruct students to figure out what issues mattered in their communities • Revoiced principles on poster, which included involving community members and perspectives • Periodically pointed to poster (making it visible/integral to classroom activity) 	Shifts in: Discourses ⇒ Students talk about stories of injustices in classroom/school/community ⇒ Teacher uses student stories to pose new questions Participation patterns ⇒ Students who usually do not share, tell detailed stories, and get asked questions by peers Disciplinary engagement ⇒ Student stories become the basis for new questions and ideas about sustainability means	Individual students' stories and observations were shared and used as starting points for a larger collective conversation Students positioned as possessing valuable, legitimate knowledge relevant to classroom science
What does the community think— Part 1? (Session 2)	Supported students in designing surveys and conducting surveys among themselves in class, in a buddy fifth grade classroom (also during science class time), and with adults and parents around the school (during recess, open time)	<ul style="list-style-type: none"> • Ms. H co-constructed survey questions with her students • Students volunteered questions that solicited input on health, happiness, worries, and so on • Ms. H described the importance of the nested approach to surveys as helping students think about the questions “in deeper and more personal ways” • She created time in the school day to conduct surveys in different spaces • Sent QR codes and URLs home to families 	Shifts in disciplinary engagement ⇒ Ms. H leveraged her position of authority to further drive and deepen the discourse that mattered to students ⇒ Science lesson extended outside of class into hallways, home, and other classrooms as students engaged in surveys/interviews ⇒ Students added in their own interview questions as new ideas arose in their dialogues with others	Students as experts on who to talk to, and what to ask, teacher as listener and executor of follow-up actions to further the discourse
What does the community think— Part 2? (Session 3)	Supported students in developing interview questions and approaches for reaching out to peers, parents, and others in the community	<ul style="list-style-type: none"> • Ms. H vocally reminded students, as they were designing interview plans, that community involves classrooms, school, and families/neighbors “remember, families matter!” • Presented discussion questions that asked students to use their community insights to guide the engineering process 	Shifts in: Discourses ⇒ Students are laughing and adding their own stories on top of survey findings (expanding and contextualizing ideas) Participation patterns	Students gain expertise in interview and data analysis skills Explicitly moving resources from the community into the classroom

		<ul style="list-style-type: none"> • Asked students to graph survey results to generate new questions to follow up on 	<p>⇒ Students animated in sharing ideas on survey findings, including students who do not participate as much</p> <p>Disciplinary engagement</p> <p>⇒ Integrating community experiences and knowledges into science discourse</p> <p>⇒ Integrating deepening scientific practices (graphing) with community-solicited data</p> <p>⇒ Elevating value and legitimacy of community data and community sensemaking as central to science classroom participation and tasks</p>	
How do I feel? (Session 5)	Recognizing student emotions as tied to historical and systemic practices backdrops; refracting student emotions as responsive to	<ul style="list-style-type: none"> • Ms. H acknowledged students' emotions positively and connected their emotions to the activities in science class • Reframed emotions as legitimate data that point to an issue, encouraged students to gather more corroborating community data to further flesh out the issue 	<p>Shifts in:</p> <p>Discourses</p> <p>⇒ Emotions as legitimate in science class activities and tasks</p>	Student emotions valued as relevant data to inform defining problems being investigated in science class
How can we solve this problem? (Session 6)	Validating student-driven engineering solutions and iterative design during prototyping	<ul style="list-style-type: none"> • As a culminating artifact, Ms. H supported and validated student-driven prototype designs, allowing for different projects in a class • Ms. H facilitated feedback cycles for students to continue iterating toward functional prototypes—she had to engage with and be open to community members, including engineers, visit her classroom 	<p>Shifts in:</p> <p>Disciplinary engagement</p> <p>⇒ Different student-defined projects in one classroom</p>	Authentic student choice in final project of a science class

Findings

Our findings reveal three patterns-in-practice in partner teachers' efforts to enact justice-oriented teaching. We group these patterns-in-practice together, proposing a promising justice-oriented HLP that teachers can learn and develop in their practice, recognition and refraction toward social transformation. We first describe these empirically grounded patterns-in-practice. Then we present three illustrative cases to show how these patterns-in-practice make visible and help disrupt how historicized injustices manifest in local classroom practice. We use the cases to highlight how these patterns-in-practice grew out of planned activity, but also took shape as teachers responded in the moment. We also use the cases to illustrate variations in these patterns-in-practice and the emergent tensions.

Patterns-in-Practice

Recognition

Partner teachers were concerned with *creating spaces for noticing, soliciting, legitimizing, and learning from* the lived lives and community wisdom that are a part of students' lives, though not typically legitimized in classrooms. We noted that these served as resources that youth drew upon in ways that had *epistemological* and *sociopolitical* value in the classroom. In recognizing youth resources, partner teachers acknowledged the political nature of science learning. They sought to create epistemic openings for students to participate in science toward legitimizing students as cultural people, whose knowledge and ways of thinking are integral to learning.

Refraction

We observed that partner teachers engaged in moves that not only made visible the varied and complex youth-based resources, but also centered the possibilities for youth resources to become integral to disciplinary learning and to reveal unjust teaching practices previously normalized or concealed. We refer to this empirical insight as refraction. In science, the term refraction refers to changing the direction of a light ray as it passes from one medium into another. When light is refracted through a prism, it creates a spectrum, *making visible a wide range of light rays*. Through refraction, teachers purposefully reoriented and remixed classroom interactions to leverage upon these insights.

Social transformation

As partner teachers engaged in recognition and refraction, individual students were repositioned with hybrid forms of epistemic authority or with the power and agency to act on new forms of hybrid expertise. At the same time, valued classroom discourses, participation patterns, and distributions of power also shifted as students' lives were recognized and refracted into classroom activity in different ways. Thus, we use social transformation to speak to how we observed engaging in recognition and refraction as pedagogical and political possibilities that supported new forms of valued learning and modes of participation that transformed classroom activity. We noted that social transformation occurred at both individual and collective levels in partner teacher classrooms.

We noticed in partner teacher classrooms how these three patterns worked together—enabling students and teachers to collaboratively disrupt local practices that operated as *manifestations of historicized injustices*. We can think of how historicized injustices are manifested in local practices as the normalized backgrounds that govern existing norms in classrooms, including discourses and participation patterns that shape who has authority and the forms of valued knowledge/practice. Recognition and refraction happened within/against these local practices. Local practices support injustices not because they are homogenously executed in kind but because they reflect and sustain historical, widespread and enduring oppressions.

Figure 1 presents how these patterns-in-practice worked together in our partner teachers' classrooms. Below, we present three cases to illustrate these patterns-in-practice and their variations.

Case 1: Community Knowledge as Expertise

This case explores how Ms. H employed pedagogical moves during an engineering design unit focused on sustainable communities, which recognized and refracted community-held insights and concerns regarding sustainable communities as integral to engineering practices. Ms. H's practices supported action-taking by students on community concerns by utilizing students' engineering designs in her classroom and school. We see this in how classroom interactions supported projects that made visible injustices, fostered new practices which disrupted those injustices, and educated others about these injustices and how they may be disrupted. We also see this in the emergent discourse threads on what it means to learn engineering and why science classrooms ought to be concerned with addressing injustice.

Recognizing how community perspectives matter in engineering

At the start of the unit (Session 1), Ms. H began with a class discussion unpacking the term "classroom sustainability" and why it is important. In eliciting student ideas, she co-defined classroom sustainability with students as "being healthy for the people in the classroom and school," "valuing everyone, and that includes families," and "good for the environment." In this discussion, Ms. H referenced how classroom communities were nested in school, family, and neighborhood communities. She encouraged her students to consider what issues mattered in these different spaces by conducting community surveys and interviews with peers, family members, and community members, if they were to engineer solutions for classroom community sustainability.

Pointing to a poster on the wall (that she co-created with authors of this article) that highlighted the importance of community perspectives in engineering for sustainable communities, she revoiced many times that "community perspectives matter throughout the engineering design cycle" because they helped make engineering designs work in ways that "help others now and in the future." The pedagogical move of recognizing the local classroom, school, and neighborhood community knowledge through this revoicing helped legitimize the value of community perspectives in their classroom investigation (Figure 2).

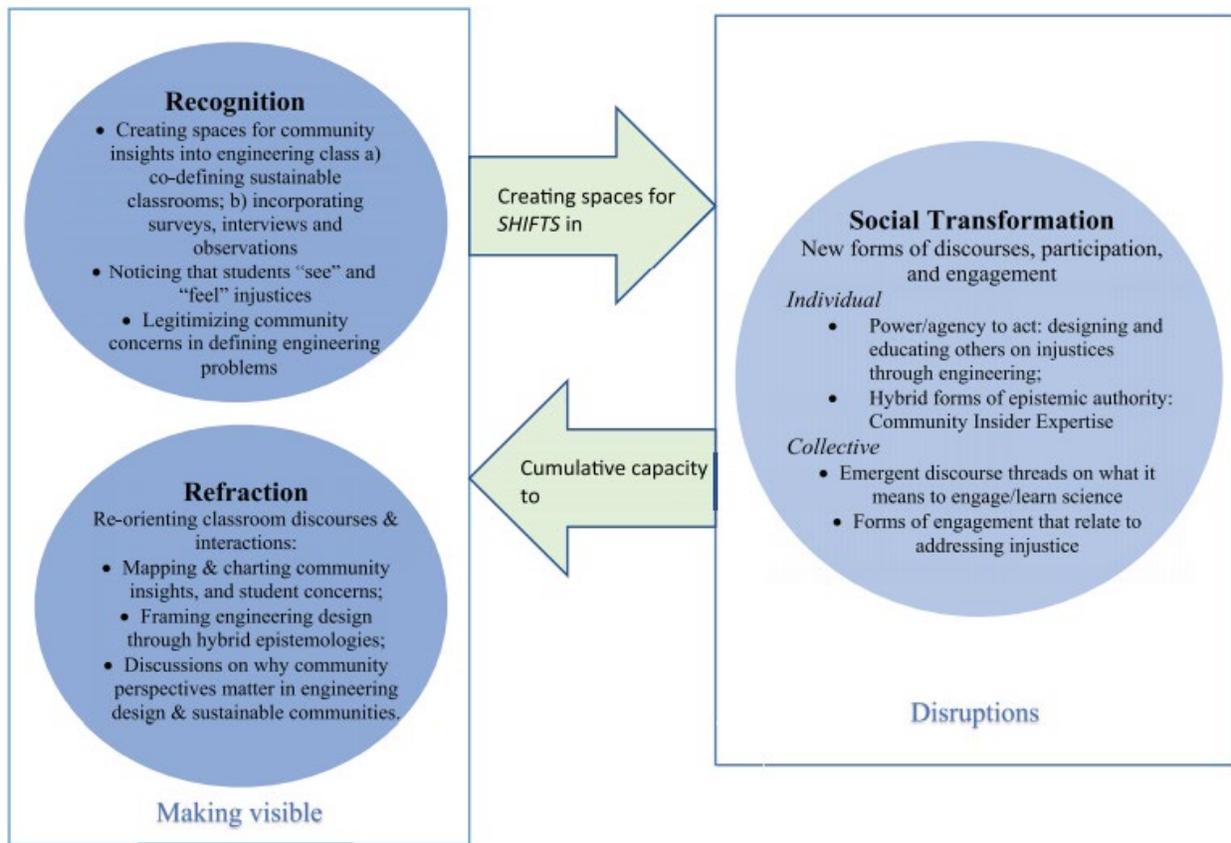


Figure 2. Ms. H's practice.

Refracting community perspectives into engineering

Ms. H incorporated discussion questions that asked students to make sense of how their own experiences compared with community insights gleaned from surveys and interviews (Session 3). After the class completed the surveys, Ms. H and her students created and examined graphs of survey results. She asked students "Which problems received votes?" Students were animated, noting that the "lack of fun" and "a need for inclusive classrooms" garnered the highest percentages. She encouraged them to offer examples of what this "looked like" or "felt like," and to write evidence-based arguments for the ideas they found most compelling.

She set up groupwork by asking, "What were some of the reasons that people gave for why these were problems?" and "Which problems and reasons are most compelling to you? Why?" Ms. H felt this group analysis was important because it provided students opportunities to talk about how findings mattered to them and their peers, creating spaces to notice and value community knowledge and students' experiences as important forms of epistemic authority. She noted in her interview that she wondered what the finding, "67% of the people surveyed indicated we needed to build a more inclusive school community," would mean to her students. She "thought we could spend time brainstorming what we *see* and *feel* in our classroom" relative to that finding. Ms. H was curious about what these data meant to her students, suggesting a willingness to share authority with her students for what could matter in their classroom.

Here, Ms. H refracted community knowledge into engineering design by having students chart and graph their results. This process allowed community concerns to be visible in ways that held power in a science classroom. By asking students to map their experiences (“how I feel” and “what I see”) onto graphs and charts, she positioned students as a part of a larger community with voice in science.

Ms. H expected students to use these insights as starting points for defining engineering problems, an engineering practice she was tasked to teach. These moves further legitimized community perspectives in her classroom and made them integral to engineering design. Such refraction promoted positioning the students as *expert-insiders* to their communities, able to represent, challenge, and actively respond to problems that reflected critical power dynamics in their classrooms and home communities.

Make-a-Friend board: Working toward social transformation

As illustrated by the “Make-a-Friend” group, one of those problems identified in Ms. H’s classroom was that of bullying of immigrant and refugee youth due to linguistic, ethnic, and racial differences. Given that their school served the local refugee center and that a discourse violent toward immigrants and refugees had been legitimized nationally, this concern was visceral for many.

During the discussions of surveys, Valia, an immigrant, White, English-speaking girl, said that the surveys gave her a way to talk about what she was “feeling inside”:

I get so upset when kids get bullied. It’s like, just because my friends don’t speak English, they don’t count. I see it everywhere. When the survey showed that everyone cares if we are inclusive, it was just like what I was feeling. It was like we had to do something.

Pairing up with Deena (a nonimmigrant, White, and monolingual English speaker), the two decided to address this problem by designing and building the “Make-a-Friend” board. This turned out to be a colorful poster-sized board with blinking LED lights powered by a hand crank generator “to get everyone’s attention.” The board contained suggestions to help people make friends (e.g., “Take a risk and sit next to a new person at lunch. Share your snack.”), star-shaped ribbons for when people made friends, and welcoming notes written in 12 of the languages spoken at their school.¹ Valia explained, “We thought if we made it, people would start making more friends.”

Ms. H challenged the girls to use their data to provide a design rationale (Session 5). They wrote,

¹ Students were charged with creating an engineering design that would foster “sustainable classrooms” using knowledge of energy transformations and circuits, and investigation into community members’ ideas/experiences. Students also had available LED lights, copper tape (a conductor), renewable energy sources (e.g., solar panels, hand cranks), and reusable materials found in their classroom.

We are going to address the problems of “needing more sense of community” and this is our rationale: 1. Lots of bullying & gossip, 2. Lots of people being left out of groups; 3. Not enough chance to be recognized.

These reasons addressed how they wished to challenge and restructure classroom power so that immigrant and refugee youth had equitable opportunities to learn.

Noting her own monolingualism, Mr. H supported and leveraged on the girls’ idea to seek out emergent bilingual peers to identify and translate friendship strategies into multiple languages. She stated,

They thought encouraging people to become friends and learning cultures would make a difference to people’s lives. It was big and important. They really cared. They came to me and said “I know this girl who speaks a different language. Can I ask her what language she speaks and can I ask her to write it down?”

Ms. H further used this example in whole-class discussion to challenge students to think about how they could solicit further community input for their own projects, essentially expanding project ownership beyond the small groups.

Ms. H shifted the discourse of engineering design by refracting community perspectives through her students’ experiences and as critical resources for defining problems and designing solutions. The Make-a-Friend board further contributed to expanding a discourse thread around immigration in her classroom and school. For example, as students moved about the classrooms for input, they discussed the problem, getting their peers thinking about the sources of and possible solutions to the marginalization of immigrant students. In their desire to hang their board by the front office, they further engaged school leadership in discussing how and why this issue was school-wide.

Discussions of community perspectives also became spaces for helping students further consider the technical dimensions of their projects such as how to design for the higher power requirements of multiple lights, creating opportunities for deepening disciplinary learning. Deciding on a power source took significant time as they debated the affordances of their choices given their design goals of helping people make friends. Ms. H explained,

They wanted the board bright to attract attention . . . Their final design used the hand crank because they thought that would last longer than the other [energy sources]. Plus, they wanted it to light just at that moment when they made a friend. The hand crank could do that and the solar panel would have it on all of the time.

These moves created spaces for recognizing students’ emerging hybrid forms of expertise fostering new knowledge hierarchies in her classroom, as community perspectives—and ownership—became integral to technical know-how. Valia and Deena were positioned as expert-insiders of their communities, able to draw upon, contribute, and respond to community concerns with engineering design. Their peers, who were immigrant and refugee members of the school community, contributed to the project as they sought help across linguistic and cultural

boundaries, and had their expertise made visible as well. Students in Ms. H's class took up new discourse threads about immigrant students and bullying as a part of engineering design, as they discussed and used the design in school. Students' locations as expert-insiders were brought to bear in projects focused on making real differences in the school community, expanding what it means to be an engineering expert.

Case 2: Bridging Science and Larger Social Narratives

This case explores how Mr. M employed pedagogical moves to recognize and refract students' challenging everyday experiences in ways that re-presented those experiences as collectively agentic spaces of learning by emphasizing the wider social narrative rather than spotlighting individual students. We see movement toward social transformation in co-authored learning outcomes created by Mr. M and his students, and in the emergent discourse threads on the realities of growing up in their particular neighborhood amid peer pressure. To highlight how these practices challenged local classroom manifestations of historicized injustices, we tell the story of how Mr. M. engaged his students in debating the youth smoking.

Creating spaces for youth-based realities

Mr. M used a range of pedagogical approaches to craft discourses in his classroom that reflected the "real world" of students' lived experiences (Figure 3). He paid attention to what he called "youth-based reality," which was composed of discourses and practices that dominate youth's out-of-school experiences and activate epistemic knowledge rooted in that experience. We see this term suggesting an authenticity regarding who one must be to engage in the world of schooling, often informed by systemic injustices historically marginalizing to youth of color (Milner, 2015).

After teaching about the human respiratory system, including diseases brought on by smoking and air quality, Mr. M engaged his students in making sense of the respiratory system in everyday living. Apart from content-specific discussions such as the dangers of secondhand smoke to children and babies in utero, the class discussed teenage pregnancy and smoking in their school and neighborhood. Mr. M assigned his students to write, in teams, a skit with an antismoking theme, putting into action what they learned in the unit and their experiences. Here, Mr. M. made a pedagogical move to expand the outcomes of participating with science beyond traditional measures.

When Mr. M set up this task, he invited a beloved fellow teacher, Mr. R, a heavy smoker, to share why he found quitting difficult. Mr. M set up the conversation to position the challenges as real, involving people they knew and cared about, including authority figures in school. Mr. M was careful to frame the discussion by not positioning the person as bad, but rather the action of smoking as potentially harmful, healthwise. The students were riveted during Mr. R's sharing.

Mr. M then suggested the students create a skit to help Mr. R learn about the health consequences of smoking. When students said that they also knew students and friends who smoked and needed support, Mr. M expanded the task to include their desired audiences, with attention to why audience matters.

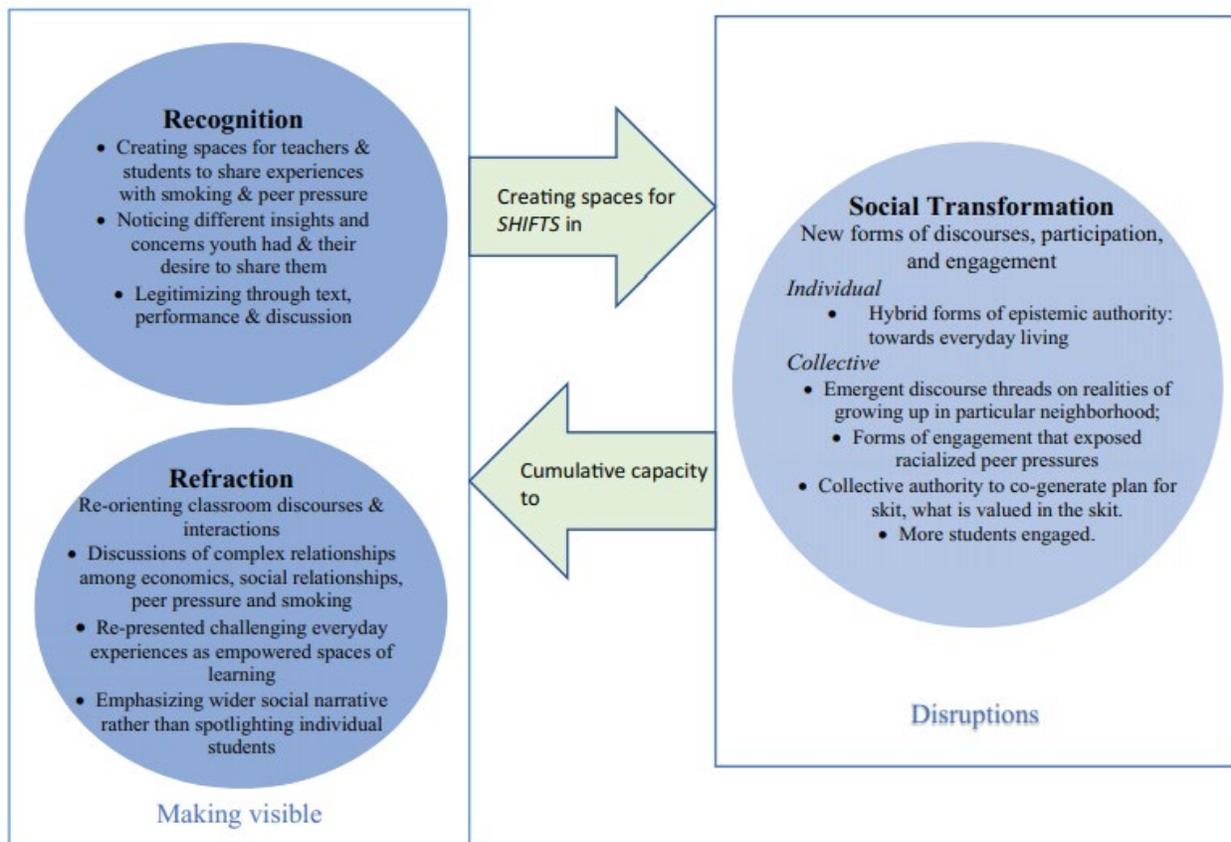


Figure 3. Mr. M's practice.

Performing to refract youth-based realities into science

Mr. M opted to have students perform their skits, as a culminating performance task. This move helped make visible the youth-based realities that his students experienced around smoking, and each group's experience became a public resource for the whole class to draw upon in furthering their knowledge. In the skits, community-based funds of knowledge and ways of speech were showcased and students' everyday lives became part of the core content of a science class.

An example of one part of a skit is as follows:

Chantelle holds up a sign that says "In a corner" to set the scene.

Chantelle: *saunters in holding imaginary newspapers* Newport! Who wants Newport??
 Tricia: *saunters up to C and greet with elaborate hand shaking ritual* HEY CHANTELLE! How you doing GIRL?!!
 Chantelle: Whassup?! *while engaging in hand ritual*
 Tricia: This is my friend, Lionel, that's Tom . . . *gestures to boys*
 Chantelle: Whassup . . . *grips hands of boys as if to arm wrestle* You guys wanna smoke? *holds up imaginary cigarettes*
 Tricia: Yeah!

Chantelle: *hands imaginary cigarette to others who mime lighting each cigarette. Tom throws his cigarette to the floor*

Chantelle: *to Tom* Why you don't wanna smoke? You a wussy?

Tricia: You're a WUSSY!

Chantelle: Get out of here, get out of here! *pushes Tom away* You're wasting my money, get out of here man!

Tricia: Yeah, we don't want you!

Tom tries to get Lionel and Tricia to leave with him but was unsuccessful. Tom leaves. Chantelle turns attention to Lionel and Tricia as they continue "smoking."

Lionel coughs violently while "smoking."

Chantelle: *pats Lionel's back* Yo yo!!! That's not how you do it, yo, that's not how you do it! Slowly, softly . . . *gestures to Lionel*

In the skit, the students alluded to having contact with youth with concerns different from school, but no less important in students' lives. The language and body gestures enacted illustrated the unique code of conduct that is part of local practice among youth in this neighborhood. Peer pressure featured prominently alongside painful consequences of public humiliation, involving disparaging name-calling and rejection. As Chantelle's character alluded, taking up smoking from peers could be made desirable when a youth is faced with choosing between suffering social pressure and gaining acceptance through free cigarettes and guidance from expert friends who could convincingly coach one to inhale the first puffs of smoke "slowly" and "softly."

The students' discourse was dramatically woven into classroom discourse. Classmates loudly applauded their friends at the skit's conclusion, with calls of "That's hot!" and "That's cool!" They related to the skit, laughing at Chantelle's antics but falling silent in those moments when Tom was ostracized, suggesting that they empathized with his situation. It was an act that mirrored personal experiences, reenacted, and made valid in their science classroom.

Mr. M refracted youth-based realities into science through discussions of complex relationships among economics, social relationships, peer pressure, and smoking, and re-presented challenging everyday experiences as relevant and agentic spaces of learning. While giving voice to more students and showing how individual action intersects with the social background, the focus was nonetheless trained on the wider social narrative rather than spotlighting individual students.

Humanizing youth lives: Transforming learning goals

Mr. M also incorporated discussion questions which elicited student experiences struggling against peer pressure, expanding the learning goals to include explicit attention to the forms it took in students' peer groups and community. Mr. M built on and improvised with youth-based realities as powerful epistemic resources. When one student pointed out a local bodega that sold cigarettes to minors, Mr. M did not outright ask the student the source of this information but directed the conversation to "how we can support one another when it is so easy to get a cigarette in our neighborhood?" Instead of concentrating solely on emphysema and carcinogenic ingredients in cigarette smoke as the required curriculum indicated, Mr. M centered the class discussion on how smoking intersected with his students' lived realities. Consequentially, students brought in worries about pregnant teen relatives who smoked and the need for options to

cope with peer pressure. Mr. M made clear that the students' out-of-school lives and discourse were welcomed in his classroom and should be used to make sense of and communicate the dangers of smoking. He engaged students in debating the merits of smoking within the context of a series of lessons on the respiratory system through both disciplinary and cultural knowledge.

As the teacher who grew up in this neighborhood, Mr. M framed the neighborhood as a place where positive relationships abounded, despite the realities students faced. The related bands of collective student knowledge that were refracted through his recognition included how poverty intersected with increased smoking risk exposure (e.g., when working youth on the street rub shoulders with working adults resulting in premature introduction to adult practices such as smoking); how economics and lack of regulation intersected with illegal business practices and vulnerable customers (e.g., the ease with which minors can procure cigarettes in this neighborhood); and how peer pressure could saturate the whole lives of students that were not easily separated into "school" and "out-of-school" categories (e.g., peers teaching one another how to smoke, specific spaces within the school building where students hide to smoke). Mr. M wove discourse threads about finding strength in positive peer alliances to counteract peer pressure along with students' lived realities, into the study of science content, positioning students as expert-insiders on where and how to build such alliances.

It is well established that youth of color experience particular racialized forms of peer pressure to take up substance use (e.g., cigarette and marijuana) related to tensions between societal expectations of acculturation and familial cultural orientation (Unger et al., 2009). By taking up the local and racialized ways, in which youth experienced pressures to smoke, and centering these experiences as integral to science discourse, systemic injustices, as enacted in local practices, were made visible and disrupted, at least in the moment. When these relevant knowledge and experiences, often socially constructed in normative schooling discourses as deviant, were brought to bear in a consequential science classroom activity, learning goals were transformed beyond knowledge acquisition to include how science is applicable to youths' lives *now*, in ways that required robust epistemic knowledge integrated with community knowledge. Students who were typically silent in science class actively participated through acting and speaking up in discussions, when their expertise beyond epistemic knowledge were shared and validated as core classroom discourse. This challenges what counts as powerful forms of knowing in science and who decides—the core of epistemological work. As Mr. M reflected,

These kids know a lot . . . I want to frame science as where they can get more of their own voice in and talk about issues important to them. I think that makes them want to pay more attention too in science. That's why they like science.

Case 3: Transforming Participation Through Co-designing Outcomes

This case explores how Mr. J sought to recognize and refract his students' lived lives and social relationships through how he planned and enacted his lessons to broaden who, and what, counts as scientific against the backdrop of a school and district culture which prioritizes scripted curricula and test-taking. We explore the tensions Mr. J experienced as a result. Due to Mr. J's explicit attention to the tensions he felt during implementation, the organization and presentation of this case differs slightly from those of the previous two. We highlight the discomfort Mr. J.

experienced in introducing pedagogical moves that challenged his long-held conceptions of teaching and learning science—conceptions underpinned by the normative culture of schooling. Despite this discomfort, he persisted in the implementation of pedagogical practices that opened space for the inclusion of youth expertise and shared authority in ways that disrupted traditional power structures that guided teacher–student relationships as well as how science outcomes were defined.

Noticing what engages students

Mr. J was known for building strong relationships with students and creating a caring classroom environment. When reflecting on youth-produced artifacts on “science that matters,” Mr. J noticed that several of his students described doing community-based science investigations in ways that centered their interests and community concerns. He contrasted this with his observation that in science class his students were not engaging with science in similar participatory ways. He noted that although this bothered him over the years, it was how schools worked, especially in his district which has limited resources—including materials and time—for science, typical of schools serving low-income communities of color. Noting this contrast led Mr. J to implicate his teaching practices in how and why his students may not be engaged in classroom science: “That’s not the way I’d ever want to be in a classroom if I was twelve, and I certainly don’t want to teach a classroom that way.”

Being a teacher in a school that was designated a “performing arts school” led Mr. J to reflect on what his students brought into the classroom each day. He first mentioned the amazing abilities his students exhibited during school performances. He remarked, “every time I went to one of their performances I came away absolutely floored.” He noted that these strengths were not apparent in his classroom, suggesting to him that spaces were not provided for these strengths to be displayed.

Inviting students to co-design science that matters

To alter student participation, Mr. J sought to change how he designed and implemented a unit he had previously taught, the solar system (Figure 4). This unit had traditionally ended with a test, focused on standard knowledge and representations of learning. For many of his students, this made science “boring” and limited the possible ways in which they could participate.

Mr. J invited students to co-design the outcomes of the unit, along with how they might publicly demonstrate their learning toward those outcomes. He stated,

I told them about going to their performances throughout the year. I told them I see these amazing things they do. I said our final project for this solar system unit . . . is for them to present [what they learn] in any way they want to, whether it’s a rap, song, poem, acting it out, or a public service announcement.

He introduced the solar system project in mid-May with the idea that students would share authority for what science learning would entail. The final project asked students to design a solar system–related question that interested them, investigate, and then create a presentation that

showcased their findings and artistic skills. There were times when classroom instruction looked traditional in terms of Mr. J providing knowledge and steering the conversation toward concepts he deemed important. He mentioned that this was done to ensure students received relevant background knowledge. At other times, students used the computer lab to complete research or met as groups to design final presentations.

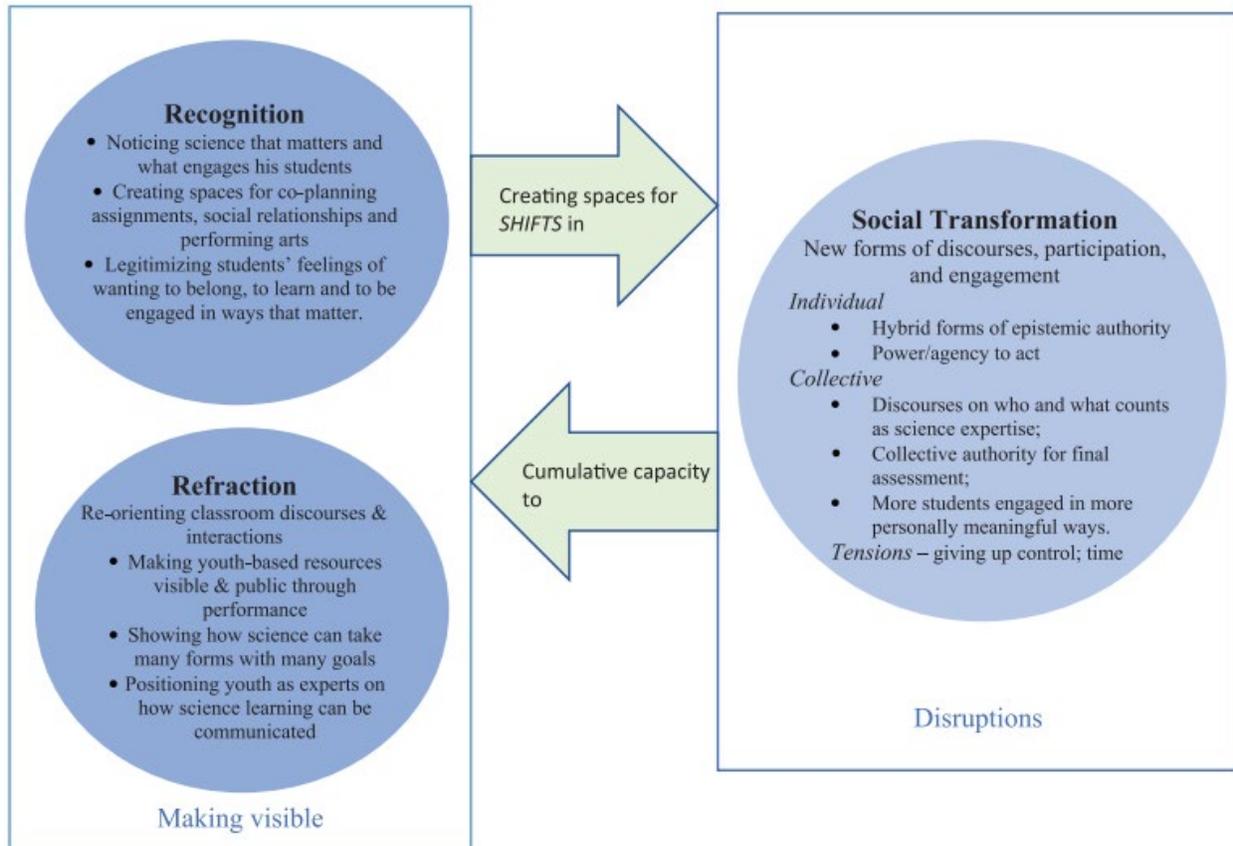


Figure 4. Mr. J's practice.

As students neared the end of their investigations and were preparing to present what they found, they ran up against a common issue in school—time. The school year was ending and the class worried they were not going to be afforded time for final presentations. This issue was met with frustration and sadness from many students, which surprised Mr. J. After all, it was the end of the school year and his students were upset they might not have time to complete their work before summer break commenced. This was exemplified by one student who came to Mr. J crying that she would not have the opportunity to share what she had discovered. Mr. J reflected,

She said to me, “I just wanted you to see how well I was able to act this out. I want to do it so bad.” I was like . . . dang. She really wanted to perform, and she’s not a kid who I would think . . . she’s really shy . . . Acting is a totally different identity for her. She can put herself in that role and not be the quiet, shy [person] everyone knows.

Mr. J engaged in a powerful form of recognition and refraction work by opening up possibilities for his students to leverage their ways of knowing and being outside of classroom norms as

integral to expressing their scientific expertise. Mr. J created a space where youth could bring in their own expertise, experience, and interests and see that it matters to how science knowledge is generated and communicated. During the process, he began to realize that many of the interests and areas of expertise students possessed were not valued in his science classroom. He believed that a way to legitimize such student expertise was through the expansion of learning outcomes.

Tensions: Redefining roles and outcomes

As the unit progressed, Mr. J discovered that, to shift toward co-created outcomes, *his role* required change. Instead of being the authority for legitimized knowledge, he found that epistemic authority needed to be restructured for students to investigate consequential questions and communicate findings in accessible ways. As he reflected, “I think they see me more as a researcher for their team rather than a teacher who is telling them these are the facts that you need to know for the test.” This comment speaks to a shift in classroom practices in two ways. First, students saw Mr. J as a teammate rather than a holder of knowledge. This shift speaks to a perceived share of power and authority between the teacher and students. The expertise of his students, and the community wisdom they brought from experiences outside of the classroom, were valued and encouraged in this investigation. Second, Mr. J’s comments revealed a shift in how he believed his students saw the outcomes of this project. The knowledge was not being gained for a test, but instead students were gaining understandings to be incorporated into the findings and presentations of their groups’ investigations.

These shifts came with tensions for Mr. J who spent the majority of his career teaching in traditional ways. The tension arose between the shifts in participation he was seeing from all of his students (including students who historically struggled or did not often participate as observed in fieldnotes and confirmed in subsequent conversations with Mr. J) and his own discomfort in his shifting classroom role. He noted,

Even kids like Hannah (a struggling student) are looking forward to doing it and that’s cool . . . I am really getting to these kids right now. But, now what do I do with it? I get nervous giving up that much control.

Posing the question “what do I do with it?” highlights the discomfort Mr. J felt as he shared authority with his students in terms of what learning and participating with science can look like. However, the ways in which his students were participating in the process of investigating aspects of the solar system persuaded him to continue with the project.

Despite 10 years of teaching experience, this shift caused uncertainty about what was to come next in the project and what he was supposed to do to help his students. Mr. J’s statement regarding “now what” reveals the tensions he felt as he gave up some control over what science looked like in his classroom, something he struggled with due to his own institutional history. This point also shows how historicized injustices endure in school settings as well. Mr. J was well intentioned, yet had histories that shaped for him what teaching and learning should look like, without attention to who was privileged and who was positioned as an outsider. In the end, his students’ participation outweighed his own discomfort as he forged ahead with the project allowing students to explore and communicate in ways they felt were consequential. His students

revealed to him not only the power of being able to bring what they knew and cared about into that classroom, but also the power of having those abilities legitimized.

Cross-Case Discussion

Below, we further examine the variations in how partner teachers engaged in recognition and refraction toward social transformation. We highlight how learning experiences and classroom cultures amplified the importance of students' lived experiences and challenged the processes by which historicized injustices manifest in classroom practices.

Making Visible: Moments of Recognition

Recognition asks teachers not just to notice students' lived lives, but to do so differently—shifting not only *what* they see, but *where* they see, and to see the seen anew (Gutiérrez et al., 2019). Across the cases, recognition moments made visible students' lived lives and community wisdom. They also made visible the possibilities for change-making through the new forms of legitimate knowledge and practice as students' cultural practices became more visible.

Returning to Figure 1, recognition moments were initiated by both teachers and students. For example, Ms. H initiated several of these moments through scaffolds for soliciting and amplifying student and community expertise, such as through co-designing surveys for community members to help students define engineering problems and involving community members in providing feedback as students optimized their designs. Likewise, Mr. M organized a discussion with a beloved teacher on the everyday challenges of smoking, humanizing these challenges and giving space for students' own stories. Some moments were youth initiated, requiring teachers to improvise in the moment, such as when Mr. M adapted the skit activity to extend to student concerns for family and friends. Sometimes, recognition happened outside the classroom and moved into the classroom for refraction to take shape, as when Mr. J noticed anew his students' talents and interests in their performances outside of his class. In each of these instances, teachers created spaces for making visible students' lived lives and community wisdom in the classroom.

Across the cases, we noted that recognition was facilitated by sharing authority to co-define learning goals and outcomes. When Mr. J co-designed the solar system unit with his students, the new learning goals and ways to represent such learning made space for students' cultural lives. Co-planning/co-adapting lesson was a practice used by both Mr. M and Mr. J in support of recognition. Ms. H engaged in improvisation frequently as she co-defined learning goals as part of classroom discussions, such as when she co-defined sustainable communities with her students, and used their words and ideas throughout the unit to push them to consider how their projects responded to their communities.

Recognition of students' lived lives and community wisdom involved not just acknowledging their existence. It involved a kind of specialized attention that made visible youths' assets such that they could move from individual resources to public, shared resources, while also invoking the historicity of such moments, giving space to that which structures of schooling have long made invisible. This was evident in co-defining learning goals, but also through the skit

performances, survey graphs, or the sketch-ups and designs used in the classroom community, and the discourses they engendered.

Refraction: Moving From Making Visible to Disruption

Refraction involved pedagogical moves that expanded how newly recognized resources could be leveraged collectively as a part of disciplinary learning, while also challenging, disrupting, and/or restructuring forms of practice which delegitimized them. Our research reveals that recognition needed to be coupled with refraction to desettle the powered dimensions of disciplinary learning in sociopolitical ways, where “expert knowledge” has been codified and passed down to students through core curricula and standards. Recognition alone is insufficient.

For example, refraction required each partner teacher to reorganize what learning looked like in their classroom, often in the moment when previously hidden student expertise have been identified, to support students in seeing how their lived lives were central to disciplinary learning. For example, after Ms. H and her students sought community input through surveys, they graphed their survey results and centered these graphs in classroom discussions of how to define and constrain engineering problems. These graphs made visible the collective wisdom generated through community ethnography *and* disrupted normative learning discourses by framing engineering practices through hybrid epistemologies. This refractive move shifted traditional knowledge hierarchies in Ms. H’s classroom and opened up spaces for students to be different kinds of experts. These community resources were shared and leveraged upon across the rest of the design unit, as students were tasked with including these data in their design rationale, solidifying this shift across the engineering design process.

Refraction also reoriented who was teaching/learning and how. As new forms of youth expertise were projected *into* disciplinary activities, youth were positioned as experts of necessary forms of cultural knowledge for learning science, such as about the forms and locations of peer pressure, the particular sustainability challenges, needs, and expertise of community members, or artistic expression.

Practices of refraction comprise a *justice-oriented step* in the teaching process toward social transformation and challenging systemic injustices in local practice, as indicated by the top arrow in Figure 1. Refraction as a pattern-in-practice targets local practice in ways that disrupt the reproduction of systemic injustices. Across these cases, these injustices included the following: (a) epistemic injustices related to marginalization because of deficit perspectives of the knowledge and practices youth bring, (b) school practices which dehumanize students through delegitimizing multiple and varied forms of experiences, and (c) societal practices which position some students with authority and power and some without because of their language, family economics, and race. These are not the only injustices students experience in classrooms which reproduce inequities. Rather, they collectively reflected the ways in which local practices amplified the education debt in schools in our partner teacher classrooms as made visible through these patterns-in-practice.

For example, when Mr. M responded to his students’ experiences by expanding the antismoking activity and follow-up discussions, he re-presented challenging everyday experiences as

empowered spaces of learning, emphasizing how and why emergent tensions related to racialized forms of peer pressure and smoking should be critically engaged. As Mr. J sought to refract his students' experiences into the solar system unit, he positioned his students as intellectuals who could collectively decide on how scientific experience could be represented and communicated. In so doing, he invited youths' various interests and talents as imaginative enactments of new embodied science practices.

Collectively, these moments of refraction helped make injustices visible by creating spaces for and legitimizing students' lived lives and community wisdom as integral to investigating and/or solving science-related problems, shifting valued forms of expertise toward more hybrid and distributed forms. These pedagogical moves are vital for responding to the historicized legacy of injustice in schooling. Without opportunities for students to have their own and their community's expert knowledge legitimately matter as a part of classroom practice toward deepening content understandings/practices and social transformation *is* to position them without authority (Lee, 2008).

Organizing for Social Transformation

We consider social transformation within classrooms to be a manifestation of recognition and refraction, *and* an orienting compass for these practices. Across these cases, justice work was localized in practice because the particular ways that oppression manifests were tied to local contexts. Recognition and refraction, enacted through pedagogical moves by teachers, reoriented classroom discourses and interactions. We saw this in terms of who participated and how in substantive classroom activity and in how youths' repertoires were integrated into official classroom scripts, and integrated into objects of learning. These shifts helped to reorganize the social order of classrooms and its attendant practices.

Furthermore, the recursive aspect of recognition and refraction allowed social transformations to incrementally and directionally build. Learning to recognize and refract students' lived lives opened possibilities for making visible how historicized injustices played out in local practice as evidenced by the cases. Figure 1 illustrates this cumulative capacity with the left-pointing arrow, indicating that as new moments of recognition and refraction arise, they increase what can be observed and acted upon, promoting opportunities for more meaningful learning while further disrupting power structures which shape life in classrooms. We saw glimpses of cumulative effect across the engineering unit in Ms. H's classroom as students built on community perspectives to address bullying, ultimately actively involving the refugee and immigrant youth they hoped at first to help.

Working Toward Justice-Oriented HLPs

Based on an analysis of partner teacher practices, we have argued that HLPs need to be identified which consider the ways in which injustices are enacted, often in mundane and invisible ways, in local practice. We have further argued that HLPs are always a part of a larger complex practice of teaching, rather than reductive bits of know-how, especially when they are enacted at the juncture of local classroom practice and systemic injustices. Identifying patterns-in-practice that attend to recognizing and refracting students' lived lives, in historicized ways *and* in practice, is

necessary toward promoting classrooms where equitable forms of discourses, power sharing, and participation are experienced.

Our work advances the conceptual and political underpinnings of how HLPs may be conceptualized and enacted toward justice-oriented ends in several ways. Our findings emphasize the need for teaching practices that challenge and disrupt historically entrenched marginalizing practices that, over time, result in limiting opportunities for meaningful disciplinary learning, agency, and identity development (Nasir & Vakil, 2017). We argue that justice-oriented practices provide concrete approaches for helping make visible—and thus something upon which one can act—the particular normed local practices in teachers' classrooms enacted through their pedagogical decisions but that which may reproduce injustice. The practice of recognition and refraction toward social transformation centers justice, asking teachers to situate what they recognize with how they understand and respond to historicized injustices.

Central to this point is how teaching practices simultaneously happen along the individual *and* sociohistorical. To challenge/disrupt practices tied to power structures, students' lived lives must be viewed as resources for collective learning. They must also be viewed as a reflection of historicized experience which may either be integral or marginal to schooling. This last point illustrates the ways in which HLPs are more than technical know-how (Philip et al., 2018). Justice-oriented HLPs require not only intellect, creativity, and reflection, but also are filtered through nuanced understandings grounded in criticality.

The literature reminds us that HLPs should be accessible to both novice and veteran teachers, opening up new spaces for teacher learning (Grossman, 2018). We view justice-oriented HLPs as supporting teacher learning, but specifically on how they may learn to see and act upon the ways in which schooling itself sustains injustice. As teachers try out a range of pedagogical moves that promote recognition and refraction practices, they create opportunities to learn more about how their own teaching practices contribute to but can also desettle oppressive norms.

Finally, our findings indicate that HLPs need to be understood in terms of the practice itself (e.g., the pedagogical moves teachers make) *and* its individual and collective impacts on classroom life (e.g., redistribution of authority, expanding views of legitimate expertise). This stance advances how HLPs are currently understood in terms of promoting equitable outcomes (McDonald et al., 2013) with its focus on social transformation. Such consequentiality-in-practice is core to justice-centered initiatives.

Conclusion

Traditionally, youth from lower-income communities of color disproportionately experience classrooms as outsiders as a consequence of how cultural systems position them. Instead of being positioned marginally, we think of recognition and refraction toward social transformation as supporting such youth in authoring a rightful presence in the classroom (Calabrese Barton & Tan, 2019). Beyond simply “increasing student voice” by soliciting students' opinions while classroom routines were largely kept intact, the cases showed how normative power relations were disrupted and who legitimately belonged in the space of school science was reconfigured.

Who youth are and want to be should be grounded in their lived lives and communities, not in some abstracted sense of who youth should be. But, as the field has suggested, and we further illustrate, for this to be possible, teaching practices that disrupt and reconfigure what it means to rightfully belong in the classroom are needed.

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Angela Calabrese Barton’s research focuses on equity and social justice in science education. Working within the intersection of formal/informal education, she studies the design of teaching–learning environments and pedagogies that address historicized injustices and promote

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Edna Tan takes a critical, sociocultural, ethnographic approach in her work with youth and science teachers, both in the classroom, informal science programs, and across these spaces. Her work focuses on how youth from underrepresented backgrounds can be empowered to use science as a tool to address systemic injustice and to work with their teachers in creating transformative spaces for meaningful science engagement.

Daniel J. Birmingham's research with youth and teachers examines potential avenues to bridge community and school experiences to alter modes of participation in STEM and support transformative learning opportunities for marginalized youth.