Designing for Rightful Presence in STEM: The Role of Making Present Practices

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Abstract:

Opportunities to learn in consequential ways are shaped by the historicized injustices students encounter in relation to participation in STEM and schooling. In this article, it is argued that the construct of rightful presence, and the coconstructed "making present" practices that give rise to moments of rightful presence, is 1 way to consider how to make sense of the historicized and relational nature of consequential learning. Drawing on theories of consequential learning and critical justice, we analyze ethnographic data from 3 urban middle school classrooms in 2 states during a STEM unit focused on engineering for sustainable communities. Findings describe 2 making present practices students enacted as they engaged in engineering design: modeling ethnographic data and reperforming injustices toward solidarity building. We discuss how these practices supported moments of rightful presence in the STEM classrooms by inscribing youths' marginalizing school experiences as a part of classroom science discourse and co-opting school science tasks as tools for exposing, critiquing, and addressing these unjust experiences. That which was silent and previously concealed from school authority figures gained a rightful place through the voices and scientific actions of the youth and their allies.

Keywords: STEM | science education | middle school | learning | equity

Article:

INTRODUCTION

Equity remains elusive in science education despite decades of school reform. Barriers to equitable opportunities in STEM persist, especially for African American and Latinx youth from lower income communities (National Science Foundation, 2014). These barriers can have long-term effects, including limiting access to and opportunity for science-empowered futures (e.g., higher paying jobs, a voice in environmental and health injustices). Inequities result from cumulative historical, sociopolitical, economic, and educational practices and policies (Ladson-

Billings, 2006). How youth are legitimately welcomed and positioned as powerful producers of new social futures in their STEM classrooms shapes their opportunities to learn.

Consider a group of sixth-grade students who prototyped "The Occupied" over a 6-week STEM[1] unit focused on engineering for sustainable communities. Mateo explained,

> We built The Occupied because kids were getting walked in on in the bathroom. It's terrible. It's a big problem … Our project solves it because it shows everyone when the bathroom "is occupied." Now you can't just walk in and pretend you didn't know … This is a good problem to solve. I think it will help our community. Especially boys. The girls usually have someone watch the door, but a lot of us don't.

The Occupied was a lighting system that allowed classroom members to know when the class bathroom was occupied. In this school, each classroom had an individual bathroom with a nonlocking door. The Occupied had three 10-mm light-emitting diode (LED) lights in parallel circuit affixed to the wall outside the bathroom door. It used the bathroom lightbulb as a switch to activate a solar panel that powered the LEDs, connected by 12 m of copper tape. When someone turned on the bathroom light, the LEDs lit up. However, getting to the point of a working prototype was challenging. The group members needed to figure out how to make the design work from a science and engineering standpoint. They also needed to convince their teacher, Ms. J, that this was a problem worth solving in a STEM classroom.

In this vignette, youth took up a significant real-world issue that shaped their experiences in their STEM classroom. The Occupied was an engineering solution to the problem of bathroom barge-ins, which the youth documented as largely purposeful rather than honest mistakes. As Meg indicated, "Sometimes kids make a mistake. We want to stop the kids *who do this on purpose*" and "then spread rumors" about the students barged in on.

Mateo described The Occupied as doing "something in school" that "actually matters," as he noted that the hallway rumors were "embarrassing." His teammate Meg said that it was the "most, most, most, most, most complex project" she had "ever worked on" and one that "changed" her classroom. Trynn, a third group member, said that The Occupied showed "how hard" their group worked together. Ms. J noted that The Occupied was a project that changed their classroom culture. She noted that this was a project she could "never have imagined," addressing a challenge she did not realize was so "anxiety provoking" for her students. She described how pleased she was at the group's success given the complexity of the project and noted, "I've never seem them work that hard on anything."

This short vignette offers a glimpse into the ways in which one group of students and their teacher shifted the discourses and practices in their STEM classroom toward new legitimate outcomes and possible social futures in STEM learning. In this article, we build the argument that opportunities to learn in consequential ways are shaped by the historicized injustices students encounter in relation to their participation in STEM and schooling. We suggest that the

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[1] We use the term *STEM* to refer to the integration of engineering into science learning goals and experiences as outlined by the Next Generation Science Standards. We do not refer to *STEM* as science, technology, engineering, and mathematics.

construct of rightful presence is one way to make sense of the historicized and relational nature of consequential learning. We view *rightful presence* as legitimate membership in a classroom community because of who one is (not who one should be), in which the practices of that community work toward and support restructuring power dynamics toward more just ends through making injustice and social change visible. Our guiding questions are as follows:

1. How and when do moments of rightful presence emerge during the enactment of an engineering for sustainable communities unit in sixth-grade science classrooms?
2. What practices and attendant discourses facilitate such moments in the STEM classroom and school community?

Consequential Learning and Rightful Presence

We take a critical justice stance toward defining equity. In taking this stance, we consider the importance of (a) access to resources and opportunities (b) that recognize, respect, and value differences among people and contexts (c) while also disrupting, rather than reproducing, injustice and promoting justice-oriented futures (Calabrese Barton & Tan, 2018).

Engaging in STEM is always deeply grounded in people's experiences in the world and their families' and communities' cultural practices (Bang & Medin, 2010). However, for many students, engaging in STEM can be constrained and limited. Students from historically marginalized communities have cultural knowledge and experience that are highly relevant to doing STEM. However, the way in which STEM is often taught—through the discourse, practices, and activities promoted—does not always encourage and support students in leveraging their powerful expertise toward empowered learning in STEM. When students are expected to engage in STEM through power-mediated cultural norms, some people (e.g., boys, White students, monolingual English speakers) are unfairly privileged, while others (e.g., girls, students of color, emerging bilinguals) may be positioned as outsiders, which creates barriers to meaningful engagement and participation. It is well documented that youth from lower income communities of color disproportionately experience classrooms as outsiders as a consequence of these cultural systems and structures (e.g., Nasir & Vakil, 2017).

Being an outsider means more than not having one's experiences, knowledge, or practices valued in the learning community. When students are positioned as outsiders because of who they are and the cultural assets they bring to learning, they are made invisible—they are made "missing" (Tedesco & Bagelman, 2017). They are continually dehumanized and positioned without important forms of power and authority, which significantly limits or completely denies them opportunities to be important contributing members of the learning community in ways that support their own growth and development, that of others, and that of the social context in which learning takes place. We refer to this as being denied a *rightful presence* in their learning community.

Having a rightful presence in STEM class is central to justice-oriented education. Here we define a *rightful presence* as legitimate and legitimized membership in a classroom community because of who one is (not who one should be), in which the practices of that community support restructuring power dynamics toward more just ends through making both injustice and social

change visible. This stance calls attention to how legitimately belonging to a community of practice is informed by the historicized injustices outsiders have encountered in relation to participation in community. It also foregrounds the ways in which individual experiences of injustice intersect with systemic injustice through sanctioned power hierarchies and practices (Squire & Darling, 2013). As we discuss later, the framework of rightful presence has emerged from critical justice studies of borderland and refugee communities in welcoming host countries, in which the lens of hospitality does not capture the ongoing social and political struggles for legitimacy by guests in these host settings (Barnett, 2005).

We thus frame our study through the critical justice construct of rightful presence and its implications for how the field may understand consequential theories of learning.

Consequential Learning

We are compelled by the research on consequential learning that examines what matters to people and how associated values and practices, when coordinated through social activity, can allow for imagining new social futures (Gutiérrez, 2012). Consequential learning involves opportunities to author meaningful forms of engagement rooted in both community knowledge, practice and wisdom, and deepening disciplinary engagement (Birmingham et al., 2017). Focused on more than developing from novice to expert, consequential learning calls attention to new forms of hybrid knowledge and practice that arise as people move horizontally, from place to place, widening what counts as expertise (Gutiérrez, 2012). Such practice challenges and changes sanctioned modes of participation for individuals and collectives across scales of activity.

Take, for example, Jurow and Shea's (2015) examination of the involvement of people engaged in the local food justice movement in the western United States. Collaborating with a Mexican immigrant community in an urban food desert, these authors documented how members of a food justice organization and people in the neighborhood authored a set of "contested practices" in social, cultural, and political ways. These practices were contested because they involved interrupting the flows of people, technologies, and practices that comprised entrenched systems that made up the "social, temporal and spatial reach" of the local food economy and how it impacted residents (p. 298). The authors suggested that consequential learning emerged because local cultural and social practices changed with regard to the food economy, precipitating change in the world local residents inhabited, allowing for new forms of success to emerge. As local residents in collaboration with community organizers identified critical leverage points within inequitable systems, they also developed strategies for "remediating scale relations" to include the perspectives of "historically marginalized groups" (p. 300).

Likewise, Gutiérrez (2012) examined the critical literacy practices of migrant youth in Southern California and described how youth authored expansive toolkits comprising linguistic practices of home and community as parts of school-sanctioned disciplinary practices. These hybrid forms of practice enabled the migrant youth to navigate "the paradoxes of migration, immigration, and schooling" in the United States (Gutierrez, 2008, p. 150). They also helped students to link their past and present to an imagined future and to reorganize everyday concepts acquired through social interaction in the joint activities of school-based literacies.

In both examples, the authors illustrate how consequential learning, while occurring within local practice, addresses broader systemic structures, disrupting those that sustain inequality. As these authors imply, understanding consequentiality in learning requires one to pay attention to power dynamics—to how actors are positioned (and by whom) across time and place. Furthermore, in both examples we glean insight into the kinds of practices that disrupt the ways in which systemic inequalities play out in local practice.

Extending Consequentiality Through Rightful Presence

Rightful presence helps to extend how the field understands consequential learning. The idea of rightful presence emerged from critical justice studies of borderland and refugee communities in welcoming host countries (Squire & Darling, 2013). Most host countries have legislation in place that describes and formalizes the rights (or lack thereof) of immigrants and refugees. These are institutional rights. However, how such rights are enacted in practice does not always account for the injustices individuals experience in place or time. For example, a place can legislate access to public commons and services, but atmospheric walls (immaterial walls with material effects) of Whiteness, masculinity, and class privilege can, in practice, mediate access (Vrasti & Dayal, 2016). Although being welcomed as guests in a new place provides forms of access and opportunity otherwise unavailable to immigrants and refugees, it also sets up power dynamics. Hosts may be benevolent and caring in welcoming newcomers. However, by merely extending a static set of institutional rights to newcomers, hosts consign newcomers permanently as guests with attenuated agency (Barnett, 2005).

Rightful presence asserts that legitimately being welcomed in a community requires a change in the guest–host powered relationship. Hosting shifts from having the power to dictate norms for others to having the responsibility to make sense of and value the cultural knowledge and experiences of newcomers as powerful contributions to society. It also involves the responsibility to acknowledge the injustices newcomers have experienced historically and in their new lives as they seek to build a new present and future in their new home. Thus, legitimately belonging means more than expanding who has a right to participate within community. It means understanding and seeing moments of social and political struggle as forms of legitimate presence. We view legitimacy as a crucial form of validation grounded in cultural systems and power and allotted to communities (Gonzales & Terosky, 2016). This stance on legitimacy goes beyond the sociocognitive stance in which legitimate participation is understood in terms of learning the practices and discourses that are central to a community as it is constructed within normative relations of power (Lave & Wenger, 1991).

Thus, theorizing consequential learning through a rightful presence lens forces a recognition of legitimacy on the political process itself, as newcomers resist an unquestioning acceptance of established norms. In addition, a rightful presence lens considers the arc of justice work to encompass the new ways of being and new forms of material inscription that can become symbols of legitimacy. In short, a rightful presence lens is productive in its attention to the importance of scales of activity and its relationship to injustice and social change making.

Scales of Activity and Its Relationship to Injustice and Social Change Making

Studies of consequential learning suggest that engagement across scale—in terms of settings, time, and activity—is key to social change efforts (Jurow & Shea, 2015). One way to think about how systemic injustices impact local practice is through examining how sanctioned power hierarchies operate, such that those who fit the dominant culture are routinely advantaged while simultaneously producing cumulative and chronic adverse outcomes for those who do not (Balibar, Mezzadra, & Samaddar, 2012). This stance is important because studies show that without attention to systemic concerns and how they manifest in local classroom practice, school reform efforts in high-poverty districts fail to have lasting impacts (Milner, 2013).

Take Rubel, Hall-Wieckert, and Lim's (2017) study of youth engaged in spatial justice as an example. In this study, the researchers studied how youth engaged in spatial mapping as part of a 10th-grade mathematics class to learn more about and connect with people in their neighborhood. The goal of the study was to make sense of how spatial mapping tools, by providing hybrid representations of their city's spaces, shaped students' notions of politicization as a part of disciplinary learning. To support students' engagement with notions of politicization within mathematics, the mapping tools were used to engage spatial analyses of persistent inequalities affecting African American and Latinx low-income communities. This included layering race, power, and inequality in what and how "alternative financial institutions" were distributed and described in their city (p. 644).

Rubel et al. cautioned that although the spatial tools worked together to support political formation, this process required students to read maps across scales. Students had to learn not only to read maps but also to enter maps and then read behind, beyond, and within maps (p. 659). When students struggled to do so, their political formation was constricted, as was one young woman's whose "lack of progress in making political arguments about the spatial justice issue … stayed primarily at reading or reading within the map," which implies that she "did not focus on broader processes of exclusion or inequitable access" (p. 677). Furthermore, the authors suggested that in complex settings, like classrooms, multiple political perspectives are present, and learning to leverage spatial tools to read social justice can reproduce a defense of the status quo.

As pointed out by Rubel and her colleagues, systemic injustices are always at play locally in STEM classrooms. Positioned as guests in their classrooms, students are expected to follow majority routines with the threat of social or disciplinary sanctions for noncompliance. Youth historically marginalized in both STEM and schooling, even if positioned as welcomed guests, are expected to reconfigure themselves toward the majority culture. Their participation is always marked as guest—subject to uneven power dynamics in which their welcomed-ness could be undone at any moment. This is an equity concern for youth from nondominant communities whose cultural knowledge and practices have historically been marginal to school and disciplinary knowledge and practices.

This is not to say that guest–host relationships cannot be caring in classrooms. They can be characterized by activities intended to foster relationship building and a sense of welcomed-ness, such as family science nights or culturally responsive activities. However, most often such experiences are not meant to perturb relational hierarchies within schooling (Friese, 2010) or to

historicize inequity. Working toward a more rightful presence involves perturbing relational hierarchies. It involves recognizing the political struggle to make visible the historicized injustices outsiders encounter in relation to participation in community. These political struggles can "facilitate movements and exchanges that were not there before," opening up moments of possible rightful presence (Vrasti and Dayal, 2016, p. 999). Here we see how injustices are always in action as they take shape through institutionalized practices and mandates as well as through power-driven sociocultural norms.

Making Present Practices

We noted earlier that central to studies of consequential learning is attention to practices that disrupt and transform the flows of people, technologies, and practices that comprise entrenched systems. These practices are often contentious and powerfully bridge the world as it is and the world as it could be (Gutiérrez, 2012).

One way to think about how to foster rightful presence in classrooms is through the kinds of practices that help to make people present, or *making present practices*. Making present practices are modes for "making present" those who have been made "missing" (Tedesco & Bagelman, 2017) by systemic oppressions, such as the forms of racialization and colonization that manifest in schooling (Nasir & Vakil, 2017). In studies of sanctuary cities, making present practices take many forms, including displaying artifacts such as jewelry made by refugee women or testimonial narratives about "experiences prior to and on arrival" in host countries (Squire & Darling, 2013, p. 62). Such practices bring to bear lives lived into new spaces in ways that disrupt such spaces. We see three key points here that we bring to our study. First, making present practices symbolically and/or in actuality reflect a struggle to have one's life or lived experiences legitimized. Second, they foreground relationality, linking places (home country and host country) and time (past, present, and future). The connection of places and time in practice is central to authoring a rightful presence because it helps to reconstruct place through the lived experiences of the oppressed (Squire & Darling, 2013). Third, making present practices disrupt binaries between outsider/insider and novice/expert "not by pursuing inclusion into an already established order; rather, [they seek] to assert a new measure of justice even if that means undoing the order we currently exist in and benefit from" (Vrasti & Dayal, 2016, p. 999).

We see similar engagement in such forms of contentious practice in work involving indigenous community-centered partnerships (Bang, Faber, Gurneau, Marin, & Soto, 2016) and youth in community mapping (Taylor, 2017), among other studies. Although these studies do not describe a rightful presence or making present practices, they do illustrate the ways in which the practices of young people in community settings seek to juxtapose their experiences in the world onto institutional practices in ways that challenge those institutions. This provides more power to our framing that such work to make present is active and vital to the learning and development of young people, especially those made most vulnerable in society. As Taylor (2017) wrote about youth engaged in community mapping of locative literacy practices,

> In these final phases of sharing, young people synthetically layered their biographical experiences and their desires for the future on top of a map of the community to create a personal cartography … As a participatory literacy, learning locative digital literacies

along lines also supported youth in disrupting a process of community planning that has historically positioned youth as victims of, or victimizing, community health. (p. 568)

The above studies suggest that leveraging both community knowledge and disciplinary expertise is about more than bridging these worlds—it is about how bridging disrupts and transforms. That is, leveraging both community knowledge and disciplinary expertise is about making possible new and more expansive opportunities to learn and to become in ways that matter across scales of activity. In this way, youths' criticality speaks back against dominant accounts that frame their lives and communities in deficit ways.

METHOD

A Critical and Participatory Design Approach

Being engaged with equity, we took a critical and participatory design approach toward social change making (Bang et al., 2016). Our work is rooted in exposing, critiquing, and transforming inequities associated with social structures and labeling devices as fundamental dimensions of research. Our work is also participatory, as we seek to include multiple voices at the research and design table, including youth, teachers, and community educators (Vakil, McKinney de Royston, Nasir, & Kirshner, 2016). We also assert an assets-based stance toward refusing damage-centered research (Tuck, 2009). This is important for students from nondominant communities, who have largely been framed as in need of repair in STEM education. Our attempts to document youths' making present practices and STEM learning acknowledge the sociohistorical realities that youth face and their wisdom and agency toward social transformation through their making present efforts.

We approach this work knowing that our positionalities lead us to have only partial understandings of the knowledge, practice, wisdom, and experiences of partners. This point furthers our desire to engage in participatory approaches and speaks to why we have also sought to engage in this work in deeply entrenched ways. We have spent time weekly in partner spaces over years to build the kinds of relationships needed to engage justice-oriented work across positionalities and perspectives. The voices, experiences, and lives of those most silenced by institutions need to be at the research and development table if such elevation and transformation are to authentically inform a contextualized, equity agenda. For example, the first author, who is White and female, grew up in a working-class community where STEM learning opportunities were limited to what her local public school offered as part of the standard curriculum. Although she had the freedoms inequitably granted on being White in American society, she also experienced the societally imposed limitations of attending underresourced public schools and being a female in STEM. Although she found excitement in informal explorations of STEM at home, she also experienced having to give up part of her identity to be considered scientific in school settings. The second author is an ethnic minority person who experienced marginalization as one of only two females in a university science research laboratory. An example of such marginalizing practices was the unspoken assumption that she would be responsible for all preparatory work for setting up and taking care of experiments, including overnight stints in the laboratory.

These experiences have helped us to more critically examine how people are positioned as insiders and outsiders to schooling in STEM both through sociocultural and institutional structures and in local practice. They give us an angle to understand what it means to both have and be denied a rightful presence in STEM and to have a desire to engage with others who help us to see and learn beyond our experiences.

Designing for a Rightful Presence

We have been working with teachers and youth in schools that serve nondominant communities on designing for rightful presence. Our goal has been to design for the teaching of disciplinary core content and engineering practices in such a way that pushes back against the assumptions that the knowledge, practices, and experiences of youth from nondominant communities are somehow lesser or deficient. Our design work took place with partners over years. We sought first to cocreate in informal spaces with youth, community educators, and teachers and then to further refine in school spaces with youth and teachers new curriculum materials that historicize youths' experiences toward powerful and transformative engagement in STEM. Youth and community educators played critical design roles through engaging in codesign activities and weekly feedback conversation groups. Their imprints can be seen in the design of activities and in the resources and other images made present in the materials shared with others.

We designed an integrated STEM unit focused on engineering for sustainable communities and grounded in the disciplinary core ideas of energy transformations, sources and systems, and sustainability, alongside engineering practices (see Table 1). Community ethnography was an integral dimension of the engineering design process as a way of soliciting and integrating the knowledge and experiences of members of various communities—including classroom, school, and local/familial communities. We collectively took a nested stance on community. The students in our partner schools were predominantly students from lower income communities, the majority of whom were students of color. In one of our partner schools, there was also a significant emergent bilingual population. The classroom communities themselves reflected the norms and values of schools to an extent, but they also reflected the lives and histories of families and communities historically marginalized in schooling and society. We took the stance that community knowledge is a valuable part of disciplinary knowing and classroom activity and that designing in ways that openly solicit for it could help to critique and transform the knowledge and practice of schooling and STEM.

For example, in one of the main design challenges, students were given a design challenge bounded with the following criteria: Students had to innovate something in the classroom in a way that would address a classroom sustainability concern. They were required to use a renewable energy source, such as solar panels or hand crank generators, 10-mm gumdrop LED lights, copper tape, and any materials available in their classroom in conjunction with multiple forms of evidence reflective of community knowledge and experience.

Table 1. How Can I Make My Classroom More Sustainable? Unit Flow

No.	Lesson	Key Focus	Community Ethnography Integration
1	Introduction	Big Ideas in Engineering for Sustainable Communities Lesson 1: Engineering for Sustainable Communities Introduction	Examining and discussing how youth their age use community ethnography as a part of engineering design

2–3	Iterative Design Cycle 1	Sustainable Electric Art: Using Iterative Design Cycles to Make Electric Art Cards for Family/Friends, Powered With Green Energy Sources
		  Lesson 2: Designing Electric Art
		  Lesson 3: Sustainable Electric Art
			Generating community narratives

4–9	Iterative Design Cycle 2	Sustainable Classrooms: Defining Problems and Designing Solutions Through Community Ethnography
		  Lesson 4: Engineering Design Challenge Intro
		  Lesson 5: Defining the Problem: Using Community Ethnography to Define Engineering Challenges
		  Lesson 6: Initial Design
		  Lesson 7: Optimize Design With Community Feedback
		  Lesson 8: Prototyping
		  Lesson 9: Refining Designs Through Technical Tests and Community Feedback
			Using community ethnography as a part of engineering design
			Surveys and observations of peers and community members
			Dialogues with the community on project ideas/design
			Observation

10	Community Sharing	Lesson 10: Sharing Engineering Designs With the Community	Community narratives

Table 2. Focal Cases

Project	Description	Defining the Problem (Using Students' Words)	Designing a Solution		Students and Classroom
			Social Specifications	**Technical Specifications**	
The Occupied	A lighting system indicating when the classroom bathroom is in use	"Bathroom bullying" by "kids barging in" on others. "Sometimes kids don't look or listen and pay attention if someone is in the bathroom. But some kids will start rumors about being walked in on, especially in the 6th grade hallway."	• Easily understood by and used by sixth graders of all languages • Colorful	• Turns on/off with light switch • Solar powered • Three LEDs in parallel circuit • Does not hurt walls	Ms. J: Mateo, Meg, and Trynn
Welcome Sign	A sign to welcome classroom visitors	A light-up sign "to welcome people to our classroom." Our school has "lots of people from different countries."	• Placed in the window of the door to be seen from inside/outside the classroom • First thing people see when they get to the classroom	• Four LEDs in parallel circuit • Powered by hand crank • "We started with a series circuit then switched to a parallel circuit"	Ms. J: Rifhadha, Jamila, Tania, and Kamani

Project	Description	Defining the Problem (Using Students' Words)	Designing a Solution		Students and Classroom
			Social Specifications	Technical Specifications	
WOW Board	A board to celebrate student accomplishments	"Because some kids do not get the privilege to be celebrated."	• Whiteboard so kids can write ideas • Many lights for attention	• 16 LEDs in parallel circuit • Powered by hand crank • "We changed how many lights we're doing because 40 lights didn't work"	Ms. J: Amalea, Evalie, and Adam
Make-a-Friend Board	A moveable board that provides strategies and recognition for supporting new friendships across linguistic and racial lines	"People kept getting left out of things like games and activities" and "some people are getting bullied."	• Ideas written in eight languages • Placed by principal's office • Ideas for kids, parents, and teachers	• Two LEDs in parallel circuit • Powered by hand crank • "We wanted to have more lights but had to get it working first"	Ms. H: Valia and Deena
PAWS	A motivational board to promote positive classroom culture	The PAWS poster is used to point out "when kids did things wrong." The light-up board celebrates when kids do "good things."	• Built on familiar PAWS board • Focuses on positive messages	• Four multicolored LEDs in parallel circuit • Powered by hand crank • 60" copper tape	Ms. H: Harmony, Amir, and Liam
Happy Box	A mailbox with individual envelopes for students to be checked every morning	To encourage friends and to show appreciation: "The problem is that a lot of people are getting bullied and they're not having a great day. A lot of people are sad. So we came up with this idea of a Happy Box."	• Individualized envelopes • Decorated to show inclusion of all students	• Five LEDs in two parallel circuits • Solar powered	Ms. D: Kristen, Julia and Elsa
No Favoritism	A poster in the teachers' lounge to educate teachers about this problem and offer suggestions	"Kids feeling discouraged, learning is less fun for kids, and favoritism can lead to bullying."	• Illustrates ways teachers show favoritism • Suggestions to address the problem	• Six LEDs in two parallel circuits • Green LED: solutions • Red LED: problems • Solar powered	Ms. D: Dexter, Logan, Jerome, and Zaqi
Light-Up Desk	A portable lighting system to light up the back of the desk	"Sometimes kids get into trouble because they are taking too long to find their stuff."	• Easy to use • Portable	• Foldable L shape • Three LEDs in parallel circuit • Powered by hand crank • Fastener for table leg	Ms. D: June

Note. PAWS = Positive Attitude, Accept Responsibility, Work Together, Show Respect; LED = light-emitting diode.

At various points in their design work, students were scaffolded in leveraging systemic approaches to the generation and sense making of community insights. For example, we worked with the teachers to incorporate community dialogue throughout the design process, including observations, surveys, and conversations. Youth surveyed members of their school and neighborhood community on what concerns they had about the health and happiness of their communities. The goal was to support students in thinking beyond themselves in the problems they might solve and how. Students also interviewed peers, family members, and other adults at school and around their neighborhoods. We worked with teachers to create opportunities for students to weave in and collectively analyze their stories, interactions, and other data they collected, discussing patterns and exploring stand-out ideas together as learning partners. By engaging in dialogue, students could learn more about the challenges others faced and the advice/ideas they had for solving those problems and how those views intersected with their own.

We also worked with teachers to plan feedback cycles with community constituents and coordinated these sessions with different points in the design cycle. The goal was to support students in gaining access to different types of STEM and/or social input that could help them advance their design work. For example, youth presented their projects to various stakeholders (e.g., local engineers, parents, community members, and peers) who provided written or oral feedback or involved community members as prototype testers.

The Teachers and Schools

The aspect of our work that we report on in this article took place in two different school settings—one in the upper Midwest and the other in the southeastern United States.

Wilkenson Road, in Great Lakes City, was a fourth- through sixth-grade Science, Technology, Engineering, Art and Mathematics (STEAM) school converted 4 years prior from a standard elementary school to stanch the flow of students from the district into the local charter system and other districts allowed by state policies. Students identified as 32% White, 28% Latinx, 8% Asian, 22% Black, 9% two or more races, and 1% Native American. The school also served the local refugee center, which made the school home to students from many countries around the globe. By district accountability policies, the school did not have a strong reputation for academic success, with 11% of students annually meeting passing levels on state exams (compared with the state average of 33%). Ms. J, who was White and monolingual, had been teaching for 33 years, but only the last 3 years had been at Wilkenson School. Ms. H, who was also White and monolingual, had been teaching for 7 years.

Sage Middle School, located in a midsize southeastern city, served a diverse student body (43% Black, 38% White, 11% Latinx, 5% biracial, 3% Asian, and less than 1% Native American). The majority of the students came from low-income families. A total of 21% of students served by the school had a range of disabilities. Led by a dynamic school principal, Sage won the Most Improved Middle School award in the district in the year of this study for most improved test scores. Ms. D had taught sixth-grade science and social studies at Sage for 12 years.

Data Generation

We examined data from three classrooms generated during and after the implementation of the Engineering for Sustainable Communities unit over the course of about 26 instructional hours during Spring 2017. Each session took about 90–120 min.

Detailed field notes of classroom interactions were kept, along with video recordings of selected lessons and group interactions. Field notes were kept by more than one researcher for all class sessions to allow multiple perspectives to inform how we understood the contexts and interactions. Mid-unit and end-of-unit artifact interviews were conducted with all focal groups. Here the artifacts were engineering designs youth prototyped and included their design sketches, actual prototypes, and written reflections about their prototypes. Interviews lasted about 90 min per team and covered four categories of questions: (a) understanding the artifact (what is it, how it works, what problem it solves, etc.; materials used and why, etc.), (b) participation and engagement (behind the scenes, including a step-by-step description of the process; descriptions of interactions/support youth received from peers, educators, and community members; resources used), (c) knowledge and practices (STEM knowledge and practice needed [prior and what was learned] and funds of knowledge), and (d) meaning and value (what this project says about oneself, etc.). We also conducted informal weekly conversations with the teachers to make sense of ongoing questions, concerns, and the feel of the enactments, with a formal interview at the end of the enactment.

The eight focal team projects, described in Table 2, reflect half of the 17 projects across the three classrooms. Teams comprised about four students each, and in each classroom teams were assembled through self-selection based on project interest and friendship groups. Projects reflect the work of the focal groups in the three classrooms. The eight focal groups were selected based on which groups had full sets of institutional review board permissions as well as to ensure representation across classroom demographics, including gender, race/ethnicity, and language.

Data Analysis

We analyzed data in the grounded theory tradition using a constant comparative approach (Strauss & Corbin, 1988). The primary analytic grain size was the group project: how students settled on a problem to be addressed and the solutions they developed, and how and why. We also focused secondarily on how the process of defining problems and designing solutions for the groups shaped discourse threads allowable and legitimized in the classroom.

The first phase of analysis involved open coding by perusing all generated data to surface critical episodes of engagement in youths' design work (e.g., group activities during lessons that featured salient performances, in talk and actions, by the youth and their dialogue with the teacher that were further invoked by the youth subsequently in time/space). Delving deeper into these episodes, we sought to describe (a) the knowledge and practices youth drew on during critical episodes, (b) how they iteratively defined the problems they were seeking to solve, and (c) the role of community ethnography in the episode. Weekly conversations were held between ourselves as a way to work toward a more expansive consensus. Any differences in view were debated until new meanings were generated as a result of our differences. For example, during this initial phase of coding, when locating critical moments, we looked closely at focal group

project work to make sense of when a group seemed stuck, had conflicts, made shifts in direction, sought out help from others, or sought to provide help to others. We then looked closely at what forms of knowledge and practice were leveraged in these moments, by whom, and to what ends.

With the help of our theoretical framework, we then worked to make sense of these episodes described above. We sought to make sense of making present practices in two ways: (a) as practices that bridged disciplinary and cultural knowledge, practice, people and locations; and (b) as practices that disrupted and/or restructured normative power hierarchies in classrooms, such as knowledge and relational hierarchies.

During this second phase we generated a table in which we indicated practices that bridged and that disrupted as linked to particular project groups. We also noted when youth engaged in more traditional STEM practices in ways that did not bridge or disrupt, and we sought to examine what that meant for their use of community ethnography in their designs. In so doing, we looked closely within these practices around why youth took the actions that they did and the meanings the artifacts youth produced had for them, individually and collectively. We also analyzed the data records and tables to find disconfirming evidence for our emerging assertions (Erickson, 1986). Such disconfirming evidence helped to flesh out the tensions and challenges emergent in designing and working toward rightful presence in classrooms. To be clear, we are not seeking to prove that some projects successfully promoted rightful presence and others did not. Our goal is to understand the phenomenon in its various instantiations.

This axial phase of coding was used to uncover relationships and connections between the youths' science and community knowledge and practice and their efforts to solve problems with their knowledge/practice for themselves and their community. Across these phases, the analysis was member-checked with both teacher and student participants. For example, during a series of research+practice meetings we shared analyses of student projects and classroom discourses toward collaborative conversation and shared understandings of student work and practice.

EMERGENT MAKING PRESENT PRACTICES

We build our findings around two related making present practices that emerged during the 4-week design challenge: (a) modeling ethnographic data and (b) reperforming injustices. We describe how these practices emerged and the discourses they supported—discourses that contributed to restructuring epistemological hierarchies among community, students, teacher, and science—and how these practices supported moments of rightful presence.

Modeling Ethnographic Data

By modeling ethnographic data, we refer to the ways in which students structured and made sense of community ethnographic data both in terms of how they sorted and represented data (e.g., pie chart, bar graphs, bubble maps) as well as in the emergent discourse threads as they talked about what these representations meant.

Surveys, Interviews, and Observations Toward Naming and Making Visible Lived Experiences

Community ethnography was used throughout the design challenge in numerous ways. In the initial phases of design work, as the students sought to define problems to solve, they conducted surveys and interviews with school peers and staff and family members on community sustainability concerns, what those concerns meant to them, and why. In all three classrooms, students and teachers codesigned survey questions: "What challenges do you think are most important to class morale? To classroom sustainability?" "Why do these problems matter to you? Your friends? Your family?" and "What ideas do you have to solve these problems?" Classroom time was allotted for students to complete the surveys on their own and to discuss their responses to the questions and for the class to visit neighboring classrooms to survey other students. Both Ms. J and Ms. H allowed students to also walk around the school during class, lunch, and recess to further gain input from school staff, visiting parents, and other children. Students in all three classrooms brought surveys home to gain input from families, friends, and neighbors on classroom sustainability issues.

The students were tasked with disaggregating survey results by key constituency group (e.g., peers, school staff, community members). They then graphed the disaggregated results to identify and prioritize issues that mattered most and to whom. As part of this work, they were tasked with "reading beyond and behind" their graphs (Rubel et al., 2017, p. 669) by analyzing comments made by the people they surveyed and interviewed in ways that supported, deepened, and/or challenged the patterns they observed in the graphs. That is, in addition to making sense of the specific patterns in their data set, the students sought to extend connections beyond these patterns into other practices in schooling and community and how they impacted specific groups of people. They also began to offer explanations for these patterns, often tied to an awareness of justice-oriented concerns and why these concerns may matter particularly to some groups of people.

For example, in The Occupied project, after the three team members graphed their results, they determined that they "need more chances to do something important" … "because 45% of the kids" thought that was most important (Trynn, analysis worksheet). This finding led the group members to decide to "figure out" what could be important to their class because they wanted to "raise class morale" and "show what they could accomplish" (Meg, analysis worksheet).

When students conducted content analysis of open-ended survey items and interviews, the detailed comments provided by peers and community members offered them the language to describe ideas for doing something important with greater specificity. When Trynn reported that one of their survey participants indicated that "people were worried about people just barging in our classroom," the three students began a conversation about how "barging in" was a "big problem." Here the youth connected the pattern of barging in as identified in their graphs to other forms of barging in that mattered to them, such as barging into bathrooms. Mateo further pointed out, by way of explanation, that kids barged in the bathroom and that this targeted specific groups of kids, leading to the purposeful spread of untrue rumors in the sixth-grade hallway. As he stated in his interview, "It [the survey] got us thinking about how the bathroom, it is a real problem," and "kids were getting walked in on in the bathroom. It's terrible. It's a big problem" (see Figure 1).
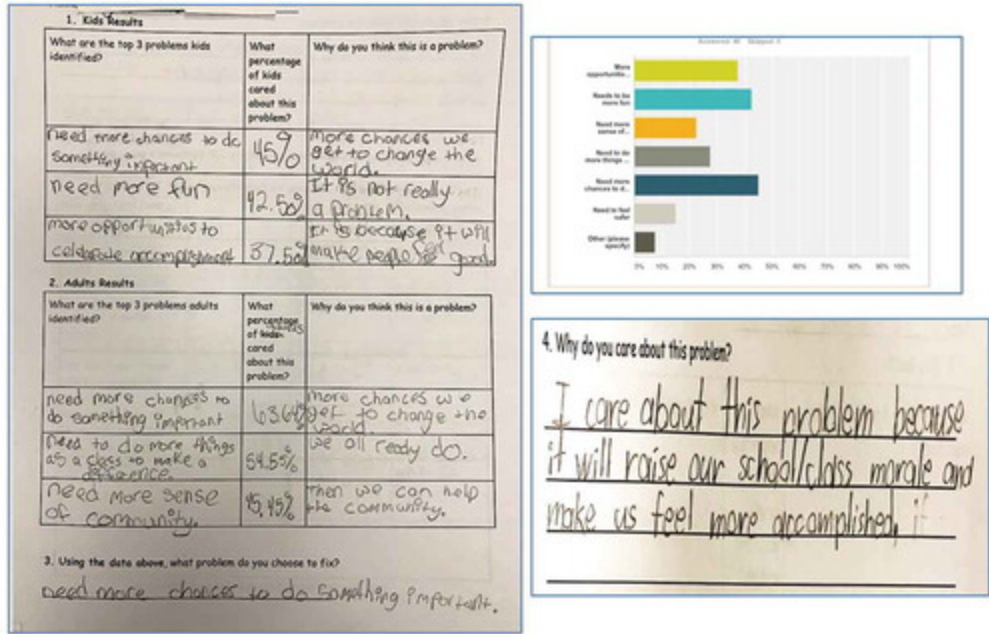
Figure 1. The Occupied data.

The Occupied was first and foremost a design to prevent bathroom barge-ins. However, as the team members indicated, the barge-ins were symptomatic of a larger problem of bullying boys of color through the spread of rumors. As illustrated in this example, students drew on narratives provided by peers and community members through interviews and open-ended questions to offer contextualized, yet evidence-based, explanations for the patterns they noticed about bullying. Studies reveal that bullying in kindergarten–Grade 12 schooling is most prevalent at the middle school level, and students from marginalized groups are most at risk, with significant negative physical and mental consequences (Hicks, Jennings, Jennings, Berry, & Green, 2018). Furthermore, spreading rumors is a significant form of relational bullying, which can lead to "peer victimization" and "higher levels of depression, increased injuries and medicine use" (Wang, Iannotti, Luk, & Nansel, 2010, p. 1110).

Students also drew on these narratives to explain why some ideas that were not represented strongly in patterns were still important to consider. For example, consider the No Favoritism group, whose students indicated that their surveys showed them that "the problem of favoritism" was a concern by citing that "16% of respondents said we need a greater sense of community and also 16% said school needs to feel safer." They also noted that their peers told them that favoritism, although not a main survey category, was still very important because "kids were feeling discouraged, learning is less fun for kids, and favoritism can lead to bullying." Consequently, the group decided,

> We felt we should speak to the school counselor and that educators need to be more accepting of student accommodations. We thought an idea for fixing the problem was a sign that would promote equality in our community. We had the idea that educators could give every student the opportunity to try something.

Eventually the group members designed a poster that they hung in the teachers' lounge to educate teachers "of this problem and offer suggestions." Their poster contained two parallel circuits with three green LED lights for solutions and three red LED lights for problems.

We view the surveys with community members as tools that hold possibilities for opening up new discourse threads for making visible and elevating students' lives within the STEM classroom and as a part of STEM discourse. Although all groups were required to draw on community ethnographic data, they did so to varying degrees of criticality and with different concerns and experiences in mind. Both The Occupied and the No Favoritism group addressed the problem of bullying. Whereas The Occupied sought to actively disrupt the act of bullying, the No Favoritism group sought to produce an educational poster aimed at teachers to help them think more about how they interact with students. These moves made students' lives visible in different ways. In both cases, however, the surveys served as launching points for further dialogue with community members on how and why particular issues mattered to them. This is important because the scientific analysis of community experiences positioned these experiences as powerful inputs to engineering design. Furthermore, because these representations launched dialogue, they supported the increasing presence of students and their lives in legitimized scientific classroom talk.

Figure 2. Make-a-Friend Board.

We turn to the Make-a-Friend Board example to explore this point about community insights as launching points in more detail. Valia and Deena, both White and English-speaking girls (although it is important to note that Valia identified herself as an immigrant from an English-speaking country), designed the Make-a-Friend Board as a way to push back against the bullying they witnessed their English language learner peers receiving. The Make-a-Friend Board was a large board (36 × 24") covered in colorful construction paper and blinking LED lights powered by a hand crank generator "to get everyone's attention." The board also contained suggestions to help people make friends, star-shaped ribbons cut from gold construction paper for when people make friends, and welcoming notes written in the many languages spoken at the school. The girls

argued that they thought that by helping people make friends, they would reduce the amount of bullying. Valia stated that bullying happens because kids "do not want to try" to understand someone "who is different" from them (see Figure 2).

The girls were initially supported in identifying design problems to solve through the surveys described above. Over the course of 2 days, Ms. H's students buddied up with fifth graders to record their ideas and in teams roamed the school to talk with other teachers; school staff such as cafeteria workers, custodians, and administrative support workers; as well as parents. Ms. H explained what happened this way:

> They took surveys in their class to figure out the greatest needs in our school. How we could improve the school. So we collected that data. This group, in particular, did a good job of walking around and getting adults in the building. I know they surveyed the principal and cafeteria workers. They went into classrooms and asked if teachers were available, the garden club, and visitors in our room and the building. They surveyed a class—they actually invited a whole 5th grade class to our room, and they surveyed them … So they got input from the whole building and some community members.

When they completed the surveys, Ms. H had her students examine graphs of the surveys. She asked, "Which problems received votes?" Students were animated in this discussion, noting that the "lack of fun" and "a need for inclusive classrooms" were the number one concerns, followed closely by a need to "be able to do things to make a difference." The students noted that 67% of the respondents indicated that a more inclusive school was their main concern.

Having opportunities to reflect on survey results, and how this mattered in their lives at school, students raised problems that reflected critical power dynamics that played out not only in their classroom but across the school. Ms. H explained how having these insights supported the Make-a-Friend Board group to "dig into" the technical and social dimensions of its design:

> They needed to know their purpose so they had to survey the school to learn more about what was important. One of the things they thought was a problem in our school was getting to know people because we have a high population of immigrants and refugees. They wanted to reach out to new people and try to form friendships … They took time to go around to other classes to ask how to say friend in many different languages, so they have it in Arabic, Burmese, Swahili. They wanted the Board to attract attention, so they had to know about different energy sources and particular renewable ones. They used the hand crank because they thought that would last longer than the other ones.

As Ms. H's quote illustrates that the survey patterns served as a launching point for dialogue with the classroom and school community on how friendships were supported or constrained at their school because of the politics around immigration and refugee experiences as part of STEM design. These concerns regarding bullying and immigration reflect a broader systemic problem nationally (Chacón, 2016). The quote also shows how the girls leveraged their concerns to advance their scientific thinking around energy sources.

The two girls came up with the idea after brainstorming different ideas related to their survey results. Valia argued that the surveys gave her a way to talk about what she was "feeling inside" as an immigrant herself:

> 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. And when the survey showed that everyone cares about like if we are inclusive, like, it was just, it was just like what I was feeling. It was like we had to do something.

These layered analyses allowed students to build connections across broad patterns and specific experiences. For Valia and Deena, the discourses surrounding immigrant and refugee students and their citizen-classmates, with their attending prejudice and stereotyping assumptions, became relevant to middle school engineering. Indeed, they sought to make these discourses an important part of their larger school community as well. The girls' use of the phrase *Make-a-Friend* was about educating peers on how to learn to engage others across linguistic and cultural differences—something they felt was a prime contributor to bullying at their school. If they could help their peers to make friends in this specific way, they could productively tackle and potentially reduce the causes of bullying. By modeling their ethnographic data in ways that allowed them to read beyond and behind their graphs and tables, students had opportunities to make present their experiences in their classrooms and community in engineering design.

Community Dialogues Toward Refining Responsive Solutions

There were other ways in which teachers and students modeled ethnographic data toward making present their lives and experiences. For example, during the designing (sketch-up) and building (prototyping) phases, youth engaged in semistructured dialogues with community members to solicit input on their design in terms of both social and technical design features.

Consider the following dialogue between a classroom visitor and the two girls who innovated the Make-a-Friend Board, which took place during a community feedback cycle. (After each of the project groups completed a sketch-up of their proposed solution, which included a diagram of the design and information about both technical and social specifications, community members were invited to the classroom to learn about the sketch-ups and to offer their feedback.) Valia first described their sketched-up idea (see Figure 2) this way to their visitor:

> We thought that it wasn't fair that a lot of kids are left out, and that the [English language learner] getting bullied and pushed around and nobody talks to them because they can't speak English. We thought if we made this people would start making more friends.

Then the following exchange occurred:

> *Community visitor:* What if I am shy because I don't know how to make a friend …?
> *Deena:* We could write, like, we could put suggestions around the board.
> *Valia:* Like take a risk and sit next to a new person at lunch, share your snack.
> *Community visitor:* How many times do I get to crank it if I make a friend?

> *Valia:* We thought if you and A know each other, if you made her your friend. You would be able to crank but also A would be able to crank it. You both get to crank it together.
> *Community visitor:* Where will you put the board?
> *Deena:* At first, we thought we would put it by the office so that everyone has access to it.
> *Community visitor:* Oh! Wow! I was thinking it was going to be in the classroom, but it is for the school. If you did it by the office, maybe you could get the principal to make an announcement to announce who got to make friends that day … and in a place where the most kids could see.
> *Valia:* It would be good if parents come in and make friends with each other. My friend, T, she came over and my mom was like I don't know her mom. I think that is a good idea because if we make it so that parents can meet then friends can come over.
> *Community visitor:* Can teachers participate too?

In this community dialogue exchange, the girls had their ideas about their board both validated and extended. The community visitor suggested that they might consider adding strategies for making friends across cultural and linguistic differences but also noted that if the principal made schoolwide announcements about the board, it may help the board to become a more widely used tool to improve relations among students, parents, and staff.

Furthermore, when the community visitor asked questions about their board, the girls were asked to think about who else in their school might benefit from their board and why. Consequently, the girls revised the project to also offer suggestions for making friends to teachers and parents. In the end, they wished to locate their board outside the main office in the school's welcoming hallway. Ms. H pointed out to us that she used the Make-a-Friend Board to promote whole-class discussions on how to welcome immigrant students and how their design was creating schoolwide awareness. Valia noted at the STEM showcase that she never imagined she could get such a "hard" project done. She said she surprised herself by helping "invent something totally new."

In the next example, we show how community dialogues created tensions between engineering design and students' desires to address the injustices they felt were propagated by gendered norms. Constructed in Ms. D's classroom, the Happy Box was a light-up messaging system that reminded all students that they were welcomed and valued in their classroom and that social issues that concerned students (beyond test scores and traditionally valued achievements) were relevant in the classroom. Given both the known social challenges that transgender students face in schools, and the fact that these students attend school in a state openly hostile toward transgender youth in schools (Watkins & Moreno, 2017), this project idea powerfully mapped their social concerns of belonging with STEM design in transformative ways. The Happy Box group wished to create a classroom culture that valued students in ways that extended beyond traditional schooling outcomes. The group also wished to disrupt dominant messages that unfairly positioned students as marginal because of their gender identity. When analyzing their community survey data, the group members were compelled by two particular responses: (a) "Classrooms can be a problem because I don't feel safe being an open gay student in my school"

and (b) "LGBTQ+ (Lesbian, Gay, Bisexual, Transgender, and Queer or Questioning) students need to finally feel accepted, we need equality not exclusion, please."

Powered by two solar panels that lit up a design on the cover, the Happy Box featured five LED lights, with three lights on one parallel circuit and the remaining two on another. It functioned as a classroom mailbox with individualized envelopes for each of the 28 students. Teachers and students could use the Happy Box to write encouraging notes to particular students. The girls intended the Happy Box mailbox to be checked after morning announcements by the principal, which typically followed the script detailing upcoming exams and school achievements.

The girls made sure that the cover design featuring girls (pink), boys (blue), and transgender students (pink and blue) around a globe was lit up, with the transgender child's LED in the center. This required them to experiment with different circuit types so that they could light five LEDs with one hand crank generator, their first choice of a renewable energy source. Julia tried out three different versions of parallel circuits in a circular shape. After building three different parallel circuits because of the positioning of the lights (which had to light up the heads of the children in the design), the group managed to get three of the five lights to light up with a hand crank. Although encouraged that with each iteration of work more LED lights were powered, the group was disappointed that it could not get all five LEDs lit.

After receiving input from community dialogue during feedback sessions, the girls determined that the lights really needed to stay lit all of the time "to remind people everyone matters in our class all the time," rather than only lighting up when a student was turning the hand crank. Moreover, the hand crank only lit three of the five lights they needed. Through further dialogue, the group concluded that Ms. D was more liable to keep the Happy Box in use when it could be done with minimal disruption, and having a student leave his or her seat to crank the generator was disruptive. These considerations, both social and technical, led the girls to change their power source to solar. However, this change presented further technical problems around how to keep the lights lit given the total energy load required and the capacity of the solar panels available. The group then had to build two separate parallel circuits instead of one. The final design split the lights into two parallel circuits to meet the power demands of five lights with two solar panels (see Figure 3).

Girls' colored design of the shoe box

Solar panels taped to back of box to be placed against window

Circuitry inside box lid

Figure 3. Happy Box.

In these examples, modeling community ethnographic data by layering new technical and social specifications onto their initial sketch-ups and prototypes provided tools that (a) offered groups productive navigational directions in project next steps while also (b) elevating and legitimizing community (parent, school peers, friends) experience as a necessary part of framing design

solutions. This is important from an engineering standpoint in that these community perspectives mattered in refining design criteria and in highlighting design constraints. Communicating with various stakeholders (e.g., engineers, community members) required the students to reorganize their understanding of the problem and its solutions in ways that attended to multiple perspectives. Such dialogue positioned students as community and engineering experts, potentially breaking down the binaries between outsider/insider and novice/expert that can position students without a rightful presence in STEM.

In this way, both students and teachers had access to new discourses for naming some of the classroom community inequities they could address as well as what knowledge mattered in engineering design. The two girls in the Make-a-Friend group shared similar sentiments, noting that once they had gone all around the school to get ideas and suggestions for their board in "so many languages" they "had to get it to work!" This was not easy for this group. The girls originally had imagined many LED lights around their board but settled for two lights just to make sure that their board worked. This incorporation of community language and discourse into engineering design further helped to position the students with the authority, in collaboration with their community, to name the problems worth solving and their viable solutions in STEM class.

Imbuing Power and Legitimacy to Invisible Social Issues

Another form of this practice focused on how modeling ethnographic data imbued power and legitimacy to the often invisible social issues with which youth were concerned. Having opportunities to generate and reflect on ethnographic data in structured, layered, and highly visible ways provided the students and their teachers with opportunities to model their experiences in both conceptual and empirical ways. This was important because while the broad categories of concerns challenged normative views of schooling, establishing relationships between these categories and experiences opened up classroom discourse on more entrenched issues that were often invisible on the surface.

During a teacher reflection conversation, Ms. J along with another teacher discussed tensions they felt in the issues raised by the surveys and taken up by students. When their classes' surveys indicated that a lack of fun was a significant concern, Ms. J and her colleague discussed how, although they understood the concern, they were bound by district requirements and a desire to ensure that their students succeeded on mandatory tests. Ms. J was not surprised that her students found school to be un-fun. She too found aspects of schooling un-fun but necessary. In navigating this tension, she indicated that she asked herself "What did fun mean?" in the context of classroom learning. She noted that she turned that question over to her class for them to wrestle with ("Why would 42.5% of you think school was not fun?") while also encouraging her students for being members of such a caring group of students ("You'd think 6th graders don't care that much but I think this shows how much you care"). By acknowledging the tensions, she felt, Ms. J further helped to make visible the dominant discourse that students of color do not care while further elevating the stance that they *do* in a way that did not trivialize their concern in light of the realities of mandated testing. Ms. J indicated that "having the ethnography and survey, and putting it in the spotlight, their interests and everyday concerns, I was surprised." With regard to the bathroom problem, Ms. J reflected that she knew some kids did not pay

attention to classroom rules and carelessly walked in on others. However, when faced with the patterned evidence that this issue was real for the boys of color in her classroom, she realized the targeted nature of this bullying and agreed with the students that it was an important problem to solve. Ms. J began to rethink how she considered not only the bathroom problem but also other problems around the classroom. Thus, modeling the ethnographic data became an important tool for making visible students' concerns as current and salient issues to be tackled in STEM class.

Summary

Across the cases studied, modeling ethnographic data provided students with structured visual representations, evidence from multiple perspectives, and new discourses to help them name categories of concerns that mattered to them and to layer specific lived experiences that impacted them personally. Students gained access to ideas and discourses that centralized their knowledge and experience as important to solving these problems with workable prototypes. This is a powerful making present practice because these tools and discourses helped the students and teachers to name and push back against the dominant narrative that there were no issues, let alone real injustices that were solvable in the classroom. They also provided a way for the youth to connect problems within classrooms to broader problems within the school and community in disciplinarily rigorous ways. At the same time, modeling ethnographic data led both youth and teachers to experience tensions in how they sought to make sense of the issues that emerged, in terms of both how those issues played out in classroom life and how they could be integrated into engineering design.

Reperforming Injustices Toward Understanding and Solidarity

As students imagined and designed projects that might solve some of the problems they identified, they used their ethnographic data to reperform the injustice documented. By *reperform* we refer to students enacting moments of injustice in an effort to better understand them—how they operate and how they might be disrupted. Students used these reperformances to figure out how and why their projects might work to mitigate injustice as well as to garner support from their peers in doing so. We see this idea of reperforming injustices toward understanding and solidarity as another making present practice. This practice supported learning in how it involved both teachers and students using hybrid discourses to explain or justify design considerations, such as oral testimonies and narratives of personal experience.

Legitimizing Experiences Through Different Forms of Reperformances

Reperformances, which took the form of dramatic reenactments, role playing, and testimony, legitimized students' experiences of success and oppression as a part of STEM design, connecting their experiences with engaging in STEM. Consider the WOW Board group, built by three students in Ms. H's classroom at Wilkenson. This group involved three students: Amalea, who had never moved in her life; Evalie, who had been to "almost 20 different schools"; and Adam, who had been to "a few" schools. The group members felt that this combination gave them a "unique" view of schools. The group decided on the WOW Board because, as Amalea stated, the group wanted to "celebrate accomplishments." The students had observed in their data that 15 of the 40 kids they surveyed thought that their accomplishments were not recognized.

Amalea was further concerned that some kids in her class missed out on opportunities to be celebrated because their families may not have had the resources, as she noted, "because some kids do not get the privilege to be celebrated at home, so they could get it at school." The group members wanted a way to celebrate one another's accomplishments in their classroom that was "affordable," "fun," and "for everyone." This point on having affordable ways to support accomplishments is significant given that the school served a significant population living in poverty.

When a community member was visiting the group to provide input on the project, she asked how the WOW Board worked. Amalea and Evalie began to role-play their board. Evalie acted sad because she had done well on a project at school but she could not go bowling with her friends. Amalea then invited her to crank the light while clapping for her accomplishment. Adam chimed in at that point, describing how different kids can get recognized for different things. Accomplishments involved more than grades. Both Adam and Amalea recounted stories of different things their peers did in class that could be recognized, such as helping a friend or cleaning up without being asked. They pointed out that for some kids this is important because they are mostly recognized for getting into trouble.

In the case of the WOW Board, the three students wanted to acknowledge the wide range of contributions their peers made at school while also noting that the more typical ways of recognizing accomplishments required resources that some families did not have. When they began to tell narratives in their role play about the kinds of things that kids do that could be recognized by their board, they also used these role plays to further discuss what is worthy of recognition in classroom settings.

We note that reperformances can have a material dimension. With the Happy Box, such reperformances directly included the illustrations on the box. When choosing a box from the recycled boxes available, the girls chose a children's shoe box that had a whimsical design on the box cover. Kristen and Elsa really liked the design and proclaimed it "Happy!" They were drawn to the globe image with children surrounding it in a circle.

Here the girls sought to reenact their desire to be happy, and to help others to be happy, by centralizing a playful design in their reenactments. As the design featured line drawings of children around the globe, the girls sought to further connect their desires to be happy with children globally, signaling a concern much bigger than their classroom. They liked that the "children around the earth means everyone is important." Later the girls spent time decorating the front of the Happy Box by choosing which of the patterns to color in and highlight to draw attention to specific features. Although the girls did not seem to question the gendered color representation that they utilized (blue for boys, pink for girls), the fact that they included a transgender child was significant. Perhaps utilizing the normalized color associations in this case was strategic, as a half blue (for boy), half pink (for girl) figure would be an obvious symbol to the general public, used to gendered color norms, of a transgender figure. Elsa pointed out,

> See these children around the globe? There are 11 of them. We colored 5 pink for the girls, and 5 blue for the boys, and the one right on top is half pink and half blue, for

transgender kids, because you gotta include everybody. Everyone is important. We want to light up the kids, maybe a few of the boys and girls but *definitely* the transgender kid.

As this quote indicates, reperformances made visible—and easily accessible to others who may not have experienced the same kind of injustice—the struggle of young people to belong in their classroom community. They not only linked places, such as classrooms, with local and state politics but also put in productive tension the oppressions the students sought to flee and their refusal to be victimized. With the Happy Box, the girls gave witness to emotional needs of transgender children.

Ms. D kept the Happy Box in her classroom the following school year. Two new cohorts of students have since used the Happy Box as the student innovators intended. Ms. D herself appreciated the Happy Box as "an actual, solid reminder to be positive and take time to remind the kids to be positive." Elsa and her friends' reperformances, materialized with the functionality of the Happy Box, carried across time and settings, with new cohorts of students.

Building Solidarity

Reperformances helped to build solidarity among the students and others. We see these reperformances as reflecting a collectively experienced reality or response to a shared injustice rather than a singular, individual account. Such forms of solidarity not only legitimized discourses of resistance and belonging but also created alliances in support of STEM engagement.

The Welcome Sign group presents an interesting case because the students struggled to work together. The Welcome Sign was a colorful sign on the classroom door that read "WELCOME" in blue capital letters. It was surround by a parallel circuit made of four LED lights and powered by a hand crank generator. These group members were only partially successful in getting their project to work as they wished. They were only able to light two of the four LEDs in their circuit and ran out of class time to troubleshoot the problem further.

The four students in the group were inspired by the community input that people consistently barged into classrooms. They wanted a system that would alert the class to visitors in a nonintrusive way while helping people feel welcomed when they arrived at their classroom. This was important to the group because there were so many different visitors, and the school had families from many different countries.

The group itself reflected the diversity of the school, with two students recently having emigrated from African countries (Rifhadha and Jamila) and two students who were long-term U.S. residents (one White and one Black, Tania and Kamani). However, the group struggled with power dynamics along this line. Tania, often with Kamani, took the lead on the technical aspects of building the circuits, while Rifhadha and Jamila often worked on the artistic side of the project, reinforcing, to an extent, linguistic power dynamics in STEM. When the group ran into the problem of a series circuit not working for their four lights, Tania complained that she and Kamani "did most of the work because two of the other girls didn't speak our same language."

When the group was a few days into building their actual prototype onto the door, Ms. J directed the class to "try to figure out how your project really works in real life." The group reenacted the problem it was trying to solve. In that moment, all four youth came together, playfully enacting different scenarios: barging in, being bothered by it, and feeling either welcomed or unwelcomed. These reenactments helped to bridge the challenging differences this group sought to negotiate in its work. It was during these reenactments that one of the girls, Rifhadha, bent the lights in the circuit toward the window, allowing the classroom visitors to see a better display of lights, an important technical modification. Later Tania commented that "the way our window is shaped, if we wanted our lights to show we had to put them at an angle," appropriating the design decision as something powerful about their design.

This example illustrates how building solidarity through reperformances helped the group to work past challenging power differentials that can limit meaningful participation, especially among the most marginalized students.

Solidarity building through reperformances also created spaces for youth to leverage critical justice concerns toward deeper engagement in STEM. Such practices created spaces for these experiences to become a part of their scientific explanations of how things worked in their project designs.

Let us return to The Occupied to expand this point. The bathroom occupied system was built to address bathroom bullying and the ensuing rumors. Although the system also served to prevent incidental walk-ins, the students' concern was to stop the lies and stories told about kids in the sixth-grade hallway. When The Occupied shared its sketch-up with visiting community members in order to solicit feedback, each of the three youth, as they pointed out different parts of their sketch, offered corroborating testimony about how the bigger—and hidden—problem of bathroom bullying was the rumors that bathroom bullies start in school hallways about what they purported to witness in the walk-ins. Mateo explained,

> Our bathroom does not have a lock and kids get walked in on. Tomas got walked in on twice! And now he never goes to the bathroom during the day anymore … People will start trends around the school like in the 6th grade hallway. They will make up rumors. It's either that or they make up rumors. It's ridiculous. We wanted to try to stop or prevent that from happening.

We see this kind of collaborative talk about injustices taken up by The Occupied group as a form of reperformance in the same way that *testimonio* or counterstories have served to recount collective experiences of the marginalized. This kind of talk positions such stories as powerful, visible tools that can be used to problematize master narratives (Beverly, 2004).

As The Occupied sought to explain how bathroom bullying worked so that they could attend to technical design features, they further reenacted narratives of their experiences of being barged in on, relaying how that made them feel. Mateo and Meg dramatically reenacted the strategies that bathroom bullies used to walk in on their peers. In one reenactment, Meg entered the bathroom, and Mateo knocked on the door. He then put his ear to the door. As he did this he narrated his actions:

See, the rule is that we have to knock on the door, and put our ear to the door to hear if anyone is in there. If we don't hear anything it's clear to go in. But, some kids pretend like they don't hear nothing, and they walk in.

He then opened the door and walked in on Meg, who reenacted the humiliation of being walked in on.

In these reenactments, which involved using their developing prototype (as they performed their project for community visitors), The Occupied learned that some students were concerned that the one LED light would not be visible enough to alert classroom members that the bathroom was occupied. The group decided to add two additional lights (forcing a move from a simple to a parallel circuit) and black construction paper as a background. This required the group to figure out how to assemble a parallel circuit in real life (as opposed to simply drawing it on paper) and to test multiple solar panel styles to find one that generated enough voltage for three LEDs and that would not melt when placed so close to the incandescent lightbulb in the bathroom. This was a challenge for the group members, for they had to consider the relationship between the load and power source in their circuit, a new idea for them and their teacher.

Reperformances can be generative in further affording opportunities for individual students to reshape their identities as particular kinds of learners in STEM. As the students were encouraged to solicit community ideas from home and community as homework each night, we noticed that Mateo, one of the creators of The Occupied and a student who struggled to find success in school, started bringing in electrician supplies from home. He started role-playing the master electrician, wearing his uncle's electrician shirt. He brought in electrical tape and began to tell stories of learning to build circuits from the age of 3 with gummy worms as he went on the job with his uncle. We see his actions as building on connections between his STEM project and his cultural knowledge and practices that the ethnographic activities opened up. Furthermore, his peers enjoyed his stories, laughing along with his tales. They also commented on how cool his shirt was and purposefully sought him out for help.

Likewise, as Mateo moved about in these reperformances, Ms. J noticed that some of the students began to ask Mateo for help when their circuits were not working. She began to position him as an expert, especially when she got stuck: "It's wonderful for kids too. I can say, 'I don't get this. Mateo could you look at this.' Sometimes you can find student experts." Not only was Mateo recognized for his expertise, but his freedom of movement opened up in the classroom. As a student whom Ms. J initially described as a troublemaker, Mateo's emerging identity as an expert in circuits gained a rightful presence in the classroom, overshadowing his "sad student" identity that Ms. J had thus far held as Mateo's sole identifier. Moving as a STEM expert across the classroom to work on his "site" (the bathroom) further solidified Mateo's rightful presence as a classroom electrical engineer.

Summary

Reperforming injustices was an ongoing and iterative practice that not only opened up opportunities for the youths' experiences of historicized injustice to be challenged in the

classroom but also worked to position the youth as highly capable and creative with their STEM knowledge toward social redesign. Legitimizing experiences, building solidarity, and supporting hybrid discourses toward making visible social change all created spaces for students' lives and experiences to be made present in their classroom. At the same time, reperforming injustices was risky and filled with tension. It is an example of how students engaged in political struggle as they tried out new ways of being and new modes of participating in the STEM classroom by exposing and naming particular ways in which they and their peers were unfairly oppressed by and in the school environment.

How Practices Make Present: Working Toward a Rightful Presence

Making present practices reflect the ongoing struggle students face in their lives as well as their efforts to project their lives onto learning and doing STEM in consequential ways. These practices inscribed youths' marginalizing school experiences as a part of classroom discourse and co-opted school STEM tasks as tools for exposing, critiquing, and addressing these unjust experiences. That which was silent and previously concealed from school authority figures gained a rightful place through the voices and scientific actions of the oppressed youth and their allies. When youth lives come to matter in these ways in classroom settings—as a part of rigorous disciplinary learning—learning becomes consequential.

There are both symbolic and material inequities in classrooms and in STEM that deny youth a rightful presence there. Symbolic inequities operate materially, the same way the oppression is enacted through tangible actions. Denying, for example, the presence of other languages like Spanish, Arabic, and Swahili is the material manifestation of symbolic violence, positioning certain students as other and illegitimate. For example, the Make-a-Friend Board reinstated legitimacy through materially countering such symbolic violence. Other inequities exist in classrooms that further position students as other and name students in their engineering designs, such as the binaries that operate relationally and through discourse (e.g., insider/outsider, expert/nonexpert) that take form through the official records of learning and practice as publicly displayed and shared, disciplinary approaches and practices related to school norms and how people are actively welcomed or not into the classroom.

As students took up the making present practices and their attendant discourses, discussed above as part of engineering design, they also transformed the materiality of the classroom, producing new physical artifacts and forms of interaction that worked to redress both symbolic and material inequities. We see these making present practices opening up rightful presence along two lines: in their (a) production of highly public visible tools, which made both injustice and social change visible across settings and time; and (b) disruption of marginalizing binaries and restructuring of epistemological hierarchies and social relationships toward more just ends.

Production of Public Tools Toward Making Visible Injustice and Social Change

Rightful presence calls attention to power-mediated relationality across such scales in terms of time (past/present/future) and place (previous/current home). Ways of being and markers of legitimacy in social activity systems can be symbolically egalitarian yet realistically oppressive. The making present practices we observed worked together to reorient the classroom community

by making tangible both the experiences of injustice across scales of activity and relationalities that the youth encountered in their daily lives in schooling. They also made visible possibilities for change making through new forms of legitimate knowledge and practice (Rubel et al., 2017). As student projects became a part of classroom life, they introduced new tools that, as they became public and shared, allowed a shift in how student experiences were taken up discursively and in practice. These working artifacts all became integral tools in classroom practice and acknowledged how and why some students were not valued within current culture while also serving as a projection onto new and more equitable ways of being and learning together. The projects, as cultural tools, were visible disruptions of local manifestations of systemic oppressions.

In some of the cases, such as with The Occupied, the Happy Box, and the Make-a-Friend group, the making present practice of modeling ethnographic data played a particularly important role in contributing to a more rightful presence for these students. These representations of lived experiences made visible classroom and school norms and routines that the students found oppressive, and they helped to illustrate the scales of activity at which they occurred, such as the physical barge-in, the hallway rumors, how those rumors shaped social relations over time, and the tension that surrounded students when their school day began invariably with a rhetoric of high-stakes exams and test scores. Furthermore, modeling the ethnographic data helped the students to see how their own experiences aligned (or not) with these patterns. Students could see their own experiences (personal scale) within the broader classroom and community data (local scale) when they examined the graphs. When they layered onto the graphs the interview data, they began to link their concerns with broader systemic practices (systemic scale) operating in their school, such as the kind of racism the youth noted regarding sixth-grade hallway rumors about boys of color or the targeted bullying of immigrants and transgender youth.

We also found that the practices of reperforming injustices, and how that took shape over time, became public symbols of rightful presence in how they engendered new ways for students and teachers to enact new social futures in practice. Recall the WOW Board, in which the three students, who themselves had experienced transience in their lives, sought to role-play how traditional forms of school celebrations of accomplishments diminish students who may not have the cultural, material, or social resources for doing school well. Their role play was meant to communicate to others why their project mattered and how it worked to solve the problem they sought to address. By including the role play as a powerful part of design-based work in engineering, they made their own histories in schooling a part of their project. Their project in turn became a witness to their lives and their efforts to transform the value of their lives in their classroom setting. Each time their board was used, new enactments became layered onto their original reperformance, expanding the narrative about who and what may be worthy of celebration. Here we see a redefining of the very idea of accomplishments in school settings.

The students' projects, as public tools, supported a more collective effort to promote rightful presence. For example, each time the bathroom was used in Ms. J's classroom, The Occupied lit up, a visible reminder of the groups' innovation and expertise, and the class had the opportunity to collectively monitor the bullying situation. About a month after the unit was completed, one of us (Angie) stopped in the classroom to talk with the teacher and stayed to help some students with their work. A student had gone to use the bathroom. Another student tried to barge in, at

which point several students hollered in unison "The lights are on!" When we asked a student whether The Occupied always worked so well, he responded, "We've gotten the bullying problem down by about 90 or 95%.… The Occupied is an amazing project."

When fifth graders visited Ms. J's classroom, both visiting teachers and students pointed to the design as something they needed for their own classrooms. Soon many teachers were requesting that the same system be installed in their classroom. Here we see how these making present practices legitimize change as an important outcome of STEM learning.

We also believe that the visible presence of the designs calls attention to how rightful presence attends to how students relate in STEM classrooms across settings and time. Students have complicated lives, and many have stressful family situations. Students should not have to feel bad about being sad and not ready to learn. Being cranky in the sixth grade should be a legitimate feeling that is acknowledged and empathized with, not punished. The purpose of the Happy Box was to transform the punitive, un-fun, test-scores-first school culture. Ms. D put the mailbox to work immediately. Both Ms. D and one of us (Edna) wrote notes to the students after the unit, with Ms. D and the students themselves continuing to do so thereafter. Symbols of rightful presence extended beyond the box to the notes that students stuck onto their school laptops, notebooks, and lockers, extending this presence into the hallway and other classrooms.

The Happy Box group was clear that it wanted the box to contain messages of encouragement and solidarity that were shared in the morning when the school day began, right after morning announcements from the principal. The girls pushed for the rightful presence of relationality to be acknowledged from the start of the school day: relationality between friends; relationality among the home, out-of-school, and school worlds that students were required to traverse and negotiate; relationality among the students, teachers, and administrators about whose voice mattered in shaping classroom and school culture. As it was made very clear to the students at Sage, low test scores were unacceptable. The Happy Box girls sought to counter that it was equally unacceptable for a student to feel bad and stay sad because of something that happened at home before he or she came to school. Walking into the classroom and seeing the lit-up Happy Box is a tangible and visible symbol and reminder of the rightful presence of children's emotions, youth turmoil, connected lives, and friendship in Ms. D's sixth-grade science classroom.

Disruption of Marginalizing Binaries and Restructuring of Epistemological Hierarchies and Social Relationships

We concur with the stance that as people learn, their activity reshapes the social contexts in which they participate, just as the social contexts contribute to what they learn (Allen & Eisenhart, 2017). Here we see reshaping contexts as involving the hierarchies that structure classroom life (Bang et al., 2016). Our findings suggest that important to restructuring epistemological hierarchies are opportunities for students to deepen engagement in STEM through shared discourses and practices. The making present practices of modeling community ethnographic data and reperforming injustices offered opportunities for youth to author meaningful forms of engagement rooted in both community knowledge, practice, and wisdom, toward new forms of deepening disciplinary engagement. These practices provided opportunities

for students to build on and share knowledge and practices brought from communities and home. Having opportunities for community knowledge and practice to enrich and broaden the boundaries of official school STEM practice is significant. Not giving students opportunities to have their own and their community's expert knowledge legitimately a part of classroom practice toward deepening science understandings and social transformation is to position them without epistemic authority (Lee, 2006).

How this process transpired is important. Merging disciplinary and community knowledge involves different and sometimes conflicting epistemologies (e.g., Bang et al., 2016). Making present practices legitimize the value of multiple perspectives in engineering design—including how to navigate conflict—and how those perspectives and conflicts can deepen the process. Such practices challenge and change sanctioned modes of participation for individuals and collectives within communities of practice (Jurow & Shea, 2015). For example, the Make-a-Friend group members began to think more about how, in addition to actually getting their lighting system to light up, they needed to configure it, along with other accoutrement, in ways that garnered attention so that they could share information and include more people (e.g., include multiple languages, locate the board by the main office). Similar considerations arose for the other groups that required the students to negotiate both scientific/technical and community knowledge, weaving them together in ways that positioned their projects as important, powerful, and transformative.

Also important to restructuring epistemological hierarchies are opportunities and structures for being recognized for their experience and having legitimized spaces for doing so. Here we see how making present practices opened up new modes of previously unsanctioned relationality among students, teachers, community, and disciplinary knowledge and practice. Students had new opportunities and structures for being recognized for their experience and legitimized spaces for doing so. Students were not welcomed as fuller members of the STEM classroom simply because their science/engineering expertise grew. Other forms of expertise also became important levers in locally important ways. Having multiple forms of expertise and ways to enact them toward solving injustices was the process and product of STEM learning, a vastly different scenario than is typical in most STEM classrooms.

DISCUSSION

We have argued that opportunities to learn in consequential ways are shaped by the historicized injustices students encounter in relation to their participation in STEM and schooling. Whether and how students are recognized and valued for what they bring to learning as well as how they are supported in more expansive outcomes of learning all are shaped by, and shape, the extent to which they have a rightful presence in the STEM classroom. Rightful presence is a powerful frame for advancing the field's understandings of consequential learning.

In the literature on borderland and refugee/immigrant experiences, making present practices have been described as public and shared by those willing to take them up. However, classrooms operate differently from public spaces, with mandated relationships and clear power hierarchies. In our study, the making present practices enacted by youth and their teachers were enacted directionally toward social change making in schooling with attempts to interrupt these

hierarchies. These practices were enacted in part in solidarity with the teacher, a specific point of power in the classroom and a potentially important ally who may be able to enact more equitable practices.

We see such intentional directionality as critical to framing what it might mean to design for consequential learning toward increasing opportunities to broker for rightful presence. Although rightful presence emerged in moments, it is how these moments build over time that makes possible transformed social futures. These moments are often transient. Rightful presence is tenuous at best for some youth. Perhaps, optimistically, we can argue that such visibility opens up moments of rightful presence that can and must be built on.

The emergence of making present practices supported the youth upending standard expectations of learning in STEM or producing school-based artifacts. As the histories and geographies of the youth shaped the ways in which they defined the problems and the solutions they developed, the youth disrupted, in their learning in the moment, and in the use of their projects over time, the historically established notion of what counts as STEM in school settings and whose knowledge or practices mattered in STEM. Consequentiality needs to attend to how social change making is made possible in moments and the fact that such moments require collective and directional organization to sustain them.

A focus on rightful presence and the importance of making present practices in support of it helps to further consider the possibilities for consequential learning in STEM classrooms. At its core, consequential learning is concerned with issues of power (Jurow, Teeters, Shea, & Van Steenis, 2016). Consequential learning is also concerned with the reorganization of people's participation in social practices that allow them to be recognized as competent and valued participants in practice (Rubel et al., 2017). Making present practices and their attendant discourses broadened what counted as legitimate practices of knowledge production and whose expertise mattered. Through these practices, youth and teachers strategically brought new and diverse people into the design conversation, incorporating the technical and social concerns discussed into their designs while socially transforming the space of STEM learning. This allowed the youth to advance the technical quality of their innovations while deeply ensconcing themselves as an integral part of their design. The deterritorialization of STEM design paved the way for the deterritorialization of other spaces in which youth from nondominant communities have been historically marginalized.

However, the reorganization of people's participation in social practices that may allow them to be recognized as competent and valued participants can be a treacherous process, especially when (or because) it involves reorienting power and presence. Indeed, working toward a rightful presence through enacting making present practices, although potentially empowering, is fraught with risk and tension. Whereas refugees and immigrants physically flee places of oppression in hopes of safety and acceptance in foreign sanctuary cites, students in classrooms are bound, literally and figuratively, to reinhabit their physical school spaces, struggling for rightful presence through moment-to-moment efforts. For many students, especially those with whom we most closely work—students of color and students in poverty—a rightful presence in the STEM classroom is not guaranteed. The current structures of schooling and STEM actively work against it (Nasir & Vakil, 2017).

CONCLUSIONS

Equity-oriented teaching in school STEM must seek to promote a rightful presence for all students, but especially those who have been denied such presence through sociohistorical and institutionalized practice. The dominant equity narrative in STEM education is problematic because it does not align with the goals of critical justice. It positions youth, especially those from nondominant communities, as in need of remediation if or when they lack what the field has framed as counting as STEM.

Bringing rightful presence to bear on consequential learning provides new tools for considering how learning opportunities can alter historicized and power-brokered patterns of participation to expand on who and what areas of expertise are recognized and valued within and across networks of practice. Organizing for rightful presence and enacting making present practices may support new patterns of participation, expanding on who and what is recognized in order to disrupt participation boundaries and knowledge hierarchies. Although often filled with tension, the youth in this study engaged in design work that leveraged what they learned in their class, bent toward justice but also unpredictable ends—but ends that opened dialogue around the problems they collectively faced and their capabilities in responding to them.

References

Allen, C. D., & Eisenhart, M. (2017). Fighting for desired versions of a future self: How young women negotiated STEM-related identities in the discursive landscape of educational opportunity. *Journal of the Learning Sciences*, 26(3), 407–436. doi:10.1080/10508406.2017.1294985

Balibar, E., Mezzadra, S., & Samaddar, R. (2012). *Borders of justice*. Philadelphia, PA: Temple University Press.

Bang, M., Faber, L., Gurneau, J., Marin, A., & Soto, C. (2016). Community-based design research: Learning across generations and strategic transformations of institutional relations toward axiological innovations. *Mind, Culture, and Activity*, 23(1), 28–41. doi:10.1080/10749039.2015.1087572

Bang, M., & Medin, D. (2010). Cultural processes in science education: Supporting the navigation of multiple epistemologies. *Science Education*, 94(6), 1008–1026.

Barnett, C. (2005). Ways of relating: Hospitality and the acknowledgement of otherness. *Progress in Human Geography*, 29(1), 5–21. doi:10.1191/0309132505ph535oa

Beverly, J. (2004). *Testimonio: On the politics of truth*. Minneapolis: University of Minnesota.

Birmingham, D., Calabrese Barton, A., McDaniel, A., Jones, J., Turner, C., & Rogers, A. (2017). "But the science we do here matters": Youth-authored cases of consequential learning. *Science Education*, 101(5), 818–844. doi:10.1002/sce.21293

Calabrese Barton, A., & Tan, E. (2018). A longitudinal study of equity-oriented STEM-rich making among youth from historically marginalized communities. *American Education Research Journal*, 56(4), 761–800. doi:10.3102/0002831218758668

Chacón, J. M. (2016). Immigration and the bully pulpit. *Harvard Law Review*, 130, 243.

Erickson, F. (1986). Qualitative methods in research on teaching. In M. C. Wittrock (Ed.), *Handbook of research on teaching* (pp. 119–161). New York, NY: Macmillan.

Friese, H. (2010). The limits of hospitality: Political philosophy, undocumented migration and the local arena. *European Journal of Social Theory*, 13(3), 323–341. doi:10.1177/1368431010371755

Gonzales, L. D., & Terosky, A. L. (2016). From the faculty perspective: Defining, earning, and maintaining legitimacy across academia. *Teachers College Record*, 18(6), 1–44.

Gutiérrez, K. (2008). Developing a sociocritical literacy in the third space. *Reading Research Quarterly*, 42, 148–164.

Gutiérrez, K. D. (2012). Re-mediating current activity for the future. *Mind, Culture, and Activity*, 19(1), 17–21. doi:10.1080/10749039.2011.632056

Hicks, J., Jennings, L., Jennings, S., Berry, S., & Green, D. (2018). Middle school bullying: Student perceptions and prevalence. *Journal of Child & Adolescent Counseling*, 4, 1–14.

Jurow, A. S., & Shea, M. (2015). Learning in equity-oriented scale-making projects. *Journal of the Learning Sciences*, 24(2), 286–307. doi:10.1080/10508406.2015.1004677

Jurow, A. S., Teeters, L., Shea, M., & Van Steenis, E. (2016). Extending the consequentiality of "invisible work" in the food justice movement. *Cognition and Instruction*, 34(3), 210–221. doi:10.1080/07370008.2016.1172833

Ladson-Billings, G. (2006). From the achievement gap to the education debt: Understanding achievement in US schools. *Educational Researcher*, 35(7), 3–12.

Lave, J., & Wenger, E. (1991). *Situated learning: Legitimate peripheral participation*. Cambridge, MA: Cambridge University Press.

Lee, C. (2006). 'Every good-bye ain't gone': Analyzing the cultural underpinnings of classroom talk.". *International Journal of Qualitative Studies in Education*, 19(3), 305–327. doi:10.1080/09518390600696729

Milner, H. R. (2013). Analyzing poverty, learning, and teaching through a critical race theory lens. *Review of Research in Education*, 37(1), 1–53. doi:10.3102/0091732X12459720

Nasir, N. I. S., & Vakil, S. (2017). STEM-focused academies in urban schools: Tensions and possibilities. *Journal of the Learning Sciences*, 26(3), 376–406. doi:10.1080/10508406.2017.1314215

National Science Foundation (2014). Science & Engineering Indicators. http://www.nsf.gov/statistics/seind14/content/etc/nsb1401.pdf. Accessed Nov, 2017.

Rubel, L., Hall-Wieckert, M., & Lim, V. (2017). Making space for place: Mapping tools and practices to teach for spatial justice. *Journal of the Learning Sciences*, 26(4), 643–687. doi:10.1080/10508406.2017.1336440

Squire, V., & Darling, J. (2013). The "minor" politics of rightful presence: Justice and relationality in city of sanctuary. *International Political Sociology*, 7(1), 59–74. doi:10.1111/ips.2013.7.issue-1

Strauss, A. C., & Corbin, J. (1988). *Basics of qualitative research*. Thousand Oaks, CA: Sage Inc.

Taylor, K. H. (2017). Learning along lines: Locative literacies for reading and writing the city. *Journal of the Learning Sciences*, 26(4), 533–574. doi:10.1080/10508406.2017.1307198

Tedesco, D., & Bagelman, J. (2017). The 'Missing 'Politics of whiteness and rightful presence in the Settler Colonial City. *Millennium*, 45(3), 380–402. doi:10.1177/0305829817712075

Tuck, E. (2009). Suspending damage: A letter to communities. *Harvard Educational Review*, 79(3), 409–428. doi:10.17763/haer.79.3.n0016675661t3n15

Vakil, S., McKinney de Royston, M., Nasir, N., & Kirshner, B. (2016). Rethinking race and power in design-based research. *Cognition and Instruction*, 34(3), 194–209. doi:10.1080/07370008.2016.1169817

Vrasti, W., & Dayal, S. (2016). Cityzenship: Rightful presence and the urban commons. *Citizenship Studies*, 20(8), 994–1011. doi:10.1080/13621025.2016.1229196

Wang, J., Iannotti, R. J., Luk, J. W., & Nansel, T. R. (2010). Co-occurrence of victimization from five subtypes of bullying. *Journal of Pediatric Psychology*, 35(10), 1103–1112. doi:10.1093/jpepsy/jsq048

Watkins, P., & Moreno, E. (2017). Bathrooms without borders: Transgender students argue separate is not equal. *The Clearing House*, 90(5–6), 166–171. doi:10.1080/00098655.2017.1361285