MAKING VISIBLE AND AMPLIFYING YOUTH-INITIATED MOMENTS
FOR RIGHTFUL PRESENCE IN INFORMAL STEM LEARNING SPACES

By

Won Jung Kim

A DISSERTATION

Submitted to
Michigan State University
in partial fulfillment of the requirements
for the degree of

Curriculum, Instruction and Teacher Education—Doctor of Philosophy

2021

ABSTRACT

MAKING VISIBLE AND AMPLIFYING YOUTH-INITIATED MOMENTS
FOR RIGHTFUL PRESENCE IN INFORMAL STEM LEARNING SPACES

By

Won Jung Kim

Although informal science, technology, engineering, and mathematics (STEM) learning (ISL) can serve as a critical catalyst for inclusive lifelong STEM education, research indicates that participation in ISL has been inequitable, especially for girls, youths of Color, and youths from low-income communities. To address perpetuated inequities and realize youths' rightful presence in and through ISL, their lives should be placed at the core of informal STEM education knowledge and practice.

This dissertation aims to identify and imagine justice-oriented pedagogical practices by investigating 'youth-initiated moments,' instances in which youths made visible their bids for rightful presence in and through their ISL experiences, and by exploring how their educators supported and amplified these bids. Using a participatory critical ethnography based on a research practice partnership (RPP) project, I generated three sets of data: reflective conversations, educators' portfolios, and researcher ethnographic documentation. I analyzed these data with RPP youths, educators, and researchers.

Each of the youth-initiated moments consists of three features: youths' actions of disruption and transformation, educators' and peers' responses, and bids for rightful presence. I then identified three types of youth-initiated moments: reorganizing social and physical representations within the learning space, creating activities that matter to youths, and foregrounding the sociopolitical dimension of learning. By further examining educators' engagement before, during, and after the moments, I identified pedagogical practices for making

space, which supported the emergence and amplification of youth-initiated moments: educator-designed space making, taking up youths' disruption and reorganizing ISL opportunities with youths, and co-creating new ISL opportunities with youths. I discuss the insights and implications of this study for STEM education research and practice toward the creation of equitable and just ISL spaces in which youths have and expand their rightful presence as legitimate participants, re-organizers, and constructors of their ISL opportunities and future.

To all the youths and educators,
thanks for the wisdom, love, stories, and hopes you shared with me.
To my father in heaven, my mother for her endless prayers, and all my loving family,
thanks for being my reason to live and move on.

ACKNOWLEDGEMENTS

I want to express my sincerest and deepest gratitude to all those who helped me work through this dissertation and my life as a doctoral student. My CITE family—Terry Yuncker, Dr. Anne-Lise Halvorsen, and my cohort—thanks for your support. I value the time I was able to get to know you all.

I would like to acknowledge my dissertation committee: co-directors Dr. Alicia Alonzo and Dr. Angela Calabrese Barton and committee members Dr. Tonya Bartell, Dr. Amelia Gotwals, and Dr. Vaughn Watson. Thank you for supporting me throughout the process of developing my dissertation work. Your insights, questions, and suggestions have been instrumental in strengthening the argument of my dissertation, and will inform my future work contributing to youths' having and expanding rightful presence in and through STEM learning.

In particular, I am grateful for having the opportunity to join Dr. Calabrese Barton's research and practice partnership project, which provided me with life-changing experiences as an educator and a scholar. I will build on my experiences and learning with our partners. Inspired by this work, I will continue to critically reflect on my own practice as an educator. Angie, thank you for your expert guidance in critically reflecting on what it means to teach and learn science and on who young people are in learning spaces. I will remember the spirit and practice of your research toward ensuring just STEM education for minoritized youths and strive to enact them in all areas of my life.

Finally, I am deeply grateful to my invaluable advisor, Dr. Alonzo. Thank you, Alicia, for your persistent support, trust, and sincere investment in my progress for the past five years. I am honored and incredibly lucky to have received your guidance and insights. Your hope for and

vision of my growth and success as a scholar has made it possible for me to be here now. Whether days were joyful or challenging, you have always been there for me so that I could work through the core milestones as a graduate student and grow beyond to walk my own journey as a scholar. I will make every effort to emulate your dedication for students and your critical and penetrating insights on research and practice. Our conversations and times together will always live in my memory.

TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

Chapter One. Introduction

Informal science, technology, engineering, mathematic (STEM[1]) Learning (ISL) has long

been touted as one approach to help level the playing field in STEM education for all (National

Research Council, 2015). ISL experiences, including afterschool programs and clubs, citizen

science programs, STEM festivals and science centers, have served as critical catalysts for

lifelong engagement in STEM (Bevan et al., 2012). However, research indicates that

participation in ISL has been inequitable, especially for girls, youths of Color, and youths from

low-income communities (Dawson et al., 2019).

Despite a few identified programmatic and instructional practices for bridging

experiences over time and across settings (e.g., Birmingham et al., 2017; Shea & Sandoval,

2020), opportunities for minoritized youths to engage in sustained participation in ISL are hit-

and-miss. While being considered open and accessible to different audiences, ISL opportunities

remain relevant to only some participants, because they are by and large designed for white,

English-speaking, and mobile youths and families (Feinstein & Meshoulam, 2014).

To address perpetuated inequities and realize a socially just present and future for

minoritized youths, their lives should be placed at the core of informal STEM education

knowledge and practice. In an effort toward that goal, this dissertation study is concerned with

the ISL experiences of minoritized youths and the pedagogical practices in support of their

sustained equitable learning. Using the term *minoritized* calls attention to how power relations in

learning and society have positioned youths in ways that delimit their freedoms, agency, and

opportunities to learn (Gillborn, 2005). Indeed, minoritized youths have borne the burden of

---

[1] I use the terms science and STEM interchangeably when referring to K-12 science education that includes
engineering (National Research Council, 2012).

inequitable policies and social structures that have limited their access, opportunity, legitimacy, and participation in education (Medin & Bang, 2014). Despite being included as *guests* who have access to the *host* educational institutions, minoritized youths are implicitly expected to reconfigure themselves towards the norms and expectations of the host institutions. For example, when science museum exhibits or programs represent science as part of white, male, middle-class culture and history, they are prone to sideline minoritized youths' ideas and experiences while explicitly or implicitly suggesting that youths assimilate values of the science museum (Calabrese Barton & Yang, 2000; Medin & Bang, 2014).

As a critical justice framework, *rightful presence* has called out the guest-host relationalities that shape minoritized youths' experiences in STEM education. Rightful presence refers to youths legitimately belonging in their learning communities not because of who they should and are expected to be, but because of who they are and want to be (Calabrese Barton & Tan, 2020). Drawing on literature problematizing the hospitality approach of sanctuary cities that focus on including refugees as guests to the host system (Squire & Darling, 2013), the framework of rightful presence in learning spaces explains how young people are prone to remain as permanent guests in ISL institutions. This framework highlights the historicized narratives of systemic injustices in learning and society, which make youths' presence temporary or invisible, particularly based on their presentation of social markers such as race, gender, socioeconomic status, language, and/or culture. This framework calls for pedagogical transformation in support of minoritized youths' rightful presence in ISL, schooling, and society.

However, what such transformative pedagogy would look like and how it helps support youths' rightful presence are yet underexamined. Without educators' pedagogical support, youths' bids for rightful presence may not readily occur or be recognized. In spaces where

2

youths are silenced, even unintentionally, they may self-censor from acting towards their rightful presence. Even in spaces said to be accessible and inclusive, and thus expected to be more likely to support youths' rightful presence, educators and ISL communities may not know how to provide this support. For example, makerspace educators, while committed to offering equitable ISL opportunities by supporting youth-authored design projects, may encounter pedagogical dilemmas when efforts intended to help youths to create better designs end up making youths disengage and leave the makerspace (Shea & Sandoval, 2020).

To create and expand new possibilities for rightful presence, critical attention is required to examine, identify, and enact pedagogical practices that support exposing, disrupting, and transforming dominant institutional narratives. These narratives about learning, STEM, and society shape and limit youths' ISL opportunities. The exposure, disruption, and transformation of dominant institutional narratives are often, and importantly, initiated by youths. In such ("youth-initiated") moments, youths take actions seeking shifts in their learning community's discourse, collective practice, and power relationalities. Youths' bids for rightful presence and for a more just and equitable ISL are made visible through these actions. I argue within this study that these youth-initiated moments should be pedagogically supported to amplify shifts youths seek toward having and expanding rightful presence in ISL spaces.

In this study, therefore, I seek to describe moments that make visible youths' bids for rightful presence in ISL spaces and incorporate insights youths and educators offer in these moments into identifying and imagining justice-oriented pedagogical practices. I ask:

1. How do youths make visible their bids for rightful presence in ISL through "youth-initiated" moments of disruption and transformation?
2. What pedagogical practices may have supported and amplified youth-initiated moments?

I explored these questions using a participatory critical ethnography based on a research practice partnership (RPP) project (Science Learning + Partnerships: Partnering for Equitable STEM Pathways for Minoritized Youth; PI, Angela Calabrese Barton). In this project, informal educators, youths, and researchers have collaborated to create spaces in support of equitable ISL for minoritized youths. Grounded in a critical justice stance on equity, I used a conceptual framework that incorporates rightful presence (Calabrese Barton & Tan, 2020) and local contentious practice (Holland & Lave, 2009). This conceptual framework guided my analysis of actions and interactions of multiple ISL community members in terms of sociocultural and historicized narratives of power and discrimination in learning, STEM, and society. Findings of this dissertation study will help ISL educators, and their administrative and research partners, imagine how to support youth's rightful presence and work toward the creation of equitable and just ISL spaces.

Overview of Chapters

The remainder of this dissertation spans five chapters in which I explore the youth-initiated moments that make visible bids for rightful presence and pedagogical practices in support of youth-initiated moments.

Chapter Two. Literature Review and Conceptual Framework

In this chapter, I establish the need for this study by exploring the literature on different framings of equity. I examine the limitations of approaches that focus on access and inclusion to advance equity in ISL and introduce the critical-justice stance on equity that seeks to address these limitations. Informed by the critical justice stance on equity, I develop a conceptual framework referring to the constructs of rightful presence (Calabrese Barton & Tan., 2020) and local contentious practice (Holland & Lave, 2009). Drawing on the constructs, I frame youth-

initiated moments using rightful presence and frame youths' and educators' actions and interactions manifested in the youth-initiated moments using local contentious practice.

Chapter Three. Methods

This chapter describes the methods of this study. To answer the research questions, I conduct a participatory critical ethnography drawing on a larger RPP project. I elaborate how the method aligns with this study's theoretical and conceptual frameworks. I then describe the contexts (local, research, institutional, and program) and the participants (youth, educator, and researcher partners) of the study. Next, I describe how we generated data through reflective conversations, portfolios educators developed through their implementation of ISL programs, and ethnographic field notes I developed through my engagement in the programs. Finally, I describe how we analyzed data in three phases: open coding, analytic coding, and identifying types of youth-initiated moments and pedagogical practices in support of the moments.

Chapter Four. Youth-Initiated Moments Making Visible Bids for Rightful Presence

In this chapter, I answer the first research question: How do youths make visible their bids for rightful presence in ISL through youth-initiated moments of disruption and transformation? I identified three types of youth-initiated moments: 1) reorganizing physical and social representations within the learning space; 2) creating activities that matter to youths; and 3) foregrounding the sociopolitical dimension of learning. As I examined each of the youth-initiated moments, I identified three features that constitute each of the moments: youths' actions of disruption and transformation, educator and peer responses to the actions, and bids for rightful presence. I illustrate these findings by using examples of youth-initiated moments.

Chapter Five. Pedagogical Practices in Support of Youth-Initiated Moments

In this chapter, I answer the second research question: What pedagogical practices may have supported and amplified youth-initiated moments? I found that educators enacted practices such as designing and facilitating activities that center youths' agentic participation; publicizing ideas and knowledge youths developed and used as they engaged in the activities; recognizing and affirming youths' critique, suggestions, and insights about ISL; and soliciting youths' leading the reorganization and co-creation of ISL opportunities. These practices were grouped into three sets according to how they made space in support of youth-initiated moments. The three sets are: 1) educator-designed space making, 2) taking-up youths' disruption and reorganization of ISL opportunities with youths, and 3) co-creating new ISL opportunities with youths. The pedagogical practices for making space fostered outcomes-in-practice such as youths' questions, critiques, shared experiences, and knowledge and reorganized or newly created routines, activities, and spatial representations. I illustrate these findings using three youth-initiated moments and surrounding pedagogical practices. I then examine the interconnections among the pedagogical practices and the politicalness of youths' presence according to the different sets.

Chapter Six. Discussions and Implications

In this last chapter, I discuss how the findings and the process of conducting this study advances the field of informal STEM education research, particularly work attending to rightful presence, justice-oriented pedagogies, and RPP-based participatory critical ethnography. I then highlight implications of this study for STEM educational research and practice, noting its limitations.

Chapter Two. Literature Review and Conceptual Framework

In this chapter, I establish the need for the study by exploring how different views of social justice have informed dominant equity narratives in ISL. I examine the limitations of approaches to equity in ISL that focus on access and inclusion and introduce the critical-justice stance on equity that seeks to address these limitations. Informed by the critical justice stance on equity, I develop a conceptual framework referring to the constructs of rightful presence (Calabrese Barton & Tan, 2020) and local contentious practice (Holland & Lave, 2009).

Equity in ISL

The dominant narratives of STEM and STEM education in the US and across the globe have centered on achieving economic competitiveness and a highly skilled workforce (Business Roundtable, 2005; Holdren, Marrett, & Suresh, 2013; Organisation for Economic Co-operation and Development, 2016). These narratives have been historically coupled with unjust regimes of racism, sexism, and colonialism (Harding, 2008; Medin & Bang, 2014). They have contributed marginalizing women and people of Color in STEM (National Science Foundation, National Center for Science and Engineering Statistics, 2015), treating inequitable realities as neutral and normal.

Advancing equity and tackling inequitable realities has been emphasized as a main goal of informal STEM education. The field generally agrees that youths from all social backgrounds deserve the right to construct and use STEM knowledge and practices (National Research Council, 2015). Efforts to address inequities that persist in ISL institutions encompass multiple dimensions, from challenges in access and opportunity—e.g., location, costs of entrance, transportation, awareness of the institutions and programs held in the institutions—to challenges related to resources and tools—e.g., available language, programs, facilities, staff, and educators

(Dewitt & Archer, 2017; Feinstein, 2017). However, as I further examine below, the dominant equity discourse in ISL has ended up maintaining historicized systems of discrimination, making ISL far from equitable (Dawson 2017; Philips & Azevedo, 2017).

As Dawson (2017) points out, two perspectives of social justice, redistributive and relational, have largely informed equity discourse in STEM education. The two perspectives propose contrasting arguments for how resources should be distributed. Redistributive justice seeks equal distribution of resources. In this framework, sameness is equated to justice. Equal access and opportunities are vital to ensure justice for individuals. Each individual should be able to use or enjoy the same amounts of the same resources (Rawls, 1971). In contrast, relational justice seeks equitable distribution of resources. Relational justice emphasizes recognizing and accounting for differences between people (Young, 1990). Recognizing difference is important in a highly stratified society like the US, where people's access to resources and opportunities are explicitly or implicitly restricted by race, gender, socioeconomic and linguistic status, among other markers. Fraser (2009) suggested centering both redistribution and recognition of differences and seeking the best outcome of each framework. She used this synthesis view to discuss issues of injustice through inclusionary policies and social change. Despite the need for equal redistribution of resources, she argued, realization of justice becomes illusive without consideration of historically rooted structural conditions.

The two justice frameworks have provided differing logics of equity that lead to different policy decisions in STEM education. One logic of equity centers access, based on the redistributive justice framework, while the other centers inclusion, based on both the redistributive and relational justice frameworks (Dawson, 2017; Philips & Azevedo, 2017).

Framing equity as access

  The redistributive framework of social justice has informed the framing of equity as access. This framing has facilitated shifts in large-scale policy discourse in science and STEM education in the US and around the globe to center equal access, resources, and opportunities (National Research Council, 2000; OECD, 2016). These shifts have led to new policies in support of high-quality, standards-based education to support equal educational opportunities for all students.

  ISL experiences designed from this framework focus on lowering access barriers to ISL institutions and offering diverse on/offline informal opportunities to build bridges to school-based STEM. For example, many ISL institutions have lowered ticket prices or offered free programs (Dawson, 2014). As another example, there has been an expansion of citizen science projects, which have created meaningful access for youths to experience and use science in out-of-school settings (Brossard et al., 2005). Access to citizen science projects may help youths identify with scientific enterprises by participating in research such as observing bird habitats, monitoring air quality, or tracing invader species (e.g., General Services Administration, n.d.).

  However, access-centering approaches do not take into account underlying conditions that cause disproportionate access (Philip & Azevedo, 2017). Efforts to ensure diverse and affordable access to ISL opportunities may end up doing "little to change" the major audience profile that consists mostly of "people from white, middle-class families" (Dawson, 2014, p. 2). Those who already had easy access and opportunities may further benefit from lowered barriers and increased opportunities because they more readily know where and how to gain access and opportunities as compared to those who were (and continue to be) excluded.

Framing equity as inclusion

In response to the limitations of access-centering approaches, the discourse of equity as inclusion has emerged, combining the redistributive and relational perspectives of justice (Dawson, 2017; Philips & Azevedo, 2017). Grounded in the relational justice perspective, equity as inclusion emphasizes recognizing and taking into account differences in people's historicized conditions and disproportionate access to resources (Fraser, 2009). This equity framework focuses on offering high-quality learning opportunities for youths from underserved communities.

Many ISL programs fall into this category, such as science fairs, community outreach, and STEM projects that welcome diverse or minoritized youths as their main audience. Furthermore, crucial policy and institutional efforts have been made to mitigate inclusion challenges faced by institutions—e.g., increase in funding, staff, and programs—and families—e.g., support for transportation, proximity, and language modality (CAISE Broadening Participation Taskforce, 2019; Hill et al., 2018). These efforts have created and expanded multiple entry points into STEM and high-quality education for youths from diverse and minoritized groups.

Despite the important contribution and promise of inclusionary approaches, they may end up only partially addressing systemic injustices. Research has shown that young people continue to experience marginalization even when they have access to inclusive ISL opportunities (Dewitt & Archer, 2017). For example, Dawson et al. (2019) report that girls from low-income, ethnic minority communities, even when included as participants with free access to science museum programs, still experienced different forms of alienation due to racialized and gendered narratives embedded in the museum exhibits and interactions with staff. Some girls tried to find

connections between their identities and science as portrayed in the museum exhibits, but instead they only found content that was "pathologised or narrowly represented in exhibits in racist and sexist ways" (Dawson et al., 2019, p. 675). Furthermore, when the girls talked and often argued loudly about the exhibits with peers, they were more readily disciplined by museum staff than were their white boy peers.

Findings like this indicate that framing equity in ISL as inclusion is insufficient to disrupt systemic injustices that persist in ISL. Dominant discriminatory narratives delimit and sideline values and epistemologies minoritized youths seek to integrate in their learning (Bang & Marin, 2015). In the end, the burden of navigating and resisting dominant narratives and systemic injustices is placed solely on the shoulders of minoritized youths and their parents.

Framing equity with a critical justice stance

While equity as access and inclusion leave intact, reproduce, or reinforce historicized structures and narratives of injustices, intentionally or not (Vossoughi et al., 2016), a critical justice stance suggests a disruptive and transformative frame of equity in STEM education (Calabrese Barton & Tan, 2020; Schenkel et al., 2019; Vossoughi et al., 2013). Framing equity with a critical justice stance places explicit emphasis not only on how people can have access to and be included as members of learning communities but also on how such access and inclusion are mediated or delimited by power dynamics based on systemic injustices including, but not limited to, racism, classism, sexism, and elitism (Nasir & Vakil, 2017). This stance calls for critical analyses of *power* and of the *sociopolitical* dimension of learning in order to understand, disrupt, and transform how injustices have persisted in everyday discourse and practices in ISL institutions (Calabrese Barton & Tan., 2020; Calabrese Barton & Yang, 2000; Tolbert & Bazzul, 2016; Vossoughi et al., 2016). Critical analysis of educational injustices attends to the power-

mediated sociocultural structures and narratives of privilege and discrimination (Vossoughi et al., 2016).

Indeed, power dynamics operate in learning spaces. Delpit (1988) describes such dynamics in learning spaces as the culture of power, which determines rules of who has power and how one may acquire it or not. Importantly, she describes that, in the culture of power, those with less power are more aware of its existence, while those with power are less willing to acknowledge its existence. In a space where youths are positioned with little power, they recognize explicitly, or often implicitly, how their existences are treated by the allowable discourse and practices in the space.

The culture of power in learning spaces, then, is highly likely to reflect sociocultural and historicized narratives of discrimination and privilege. In the US and across the globe, the codes of power and privilege have invented and normalized social constructs such as race, gender, economic status, culture, language, and abilities as markers and tools of discrimination (Tolbert & Bazzul, 2016). Those with privileged markers gain and sustain positions of power, while those without them are marginalized and disadvantaged. Minoritized youths may critically recognize the culture of power, through their repetitive experience of exclusion, often through "self-impose[d] segregation that permeates into almost every facet of their lives" (Calabrese Barton & Yang, 2000, p. 884). For example, Carter Andrews (2012) reports how Black students sense the discriminatory culture from their experiences of microaggressions and racial ignoring in school lives/classrooms, which makes them continuously nervous and upset because such instances recur and persist.

The critical justice stance, focusing on power dynamics and sociocultural and historicized narratives of privilege and discrimination, frames learning as a *sociopolitical* practice (Tolbert &

Bazzul, 2016). By learning as sociopolitical, I am referring both to disrupting the notion of

learning as an individual-cognitive and neutral process and to acknowledging how learning can

provide opportunities to expose and examine sources of racial, environmental, health, economic,

and other types of injustices (Gutiérrez, 2013). Learning takes place in a sociocultural context in

which power relationalities have been historically established in ways that normalize and make

invisible the white, masculine, Eurocentric, and colonial agenda. Learning, in the critical justice

stance, does not occur without redressing historicized injustices and associated discriminatory

narratives in learning—e.g., narratives about who and what are expected to learn and teach.

In ISL spaces, explicating learning as sociopolitical helps to expose, disrupt, and

transform the codes of power and privilege that operate at multiple scales of institutional

narratives from institutional norms to physical and social and historicized narratives (Calabrese

Barton et al., 2019; Feinstein & Meshoulam, 2014). One important way to foreground the

sociopolitical aspect of ISL is building ISL opportunities based on educators' and youths'

"critical understanding of place," where youths are insiders and knowers (Birmingham &

Calabrese Barton, 2014, p. 289). For example, Shea and Sandoval (2020) reported how Latinx

educators foregrounded the sociopolitical aspect of learning through their informal STEM

program for Latinx youths from minoritized communities. In this study, educators had long-term

relationships with community members living in a working-class agricultural town in the US.

They grounded their program in their historical and political understanding of the challenges and

potential of the community. They sought to create affirmative and caring spaces to counter

Latinx youths' narratives of hardship (e.g., food insecurity, exclusionary experiences in school,

parents' long work hours, foster care experiences). In such spaces, the Latinx youths experienced

learning in which they had power to make decisions and take actions by bringing cultural knowledge and practice from their lived lives to the ISL spaces.

In Birmingham and Calabrese Barton (2014), educators more explicitly foregrounded the sociopolitical aspect by engaging Black youths in conversation groups and community ethnography to examine the needs and issues of their families and neighborhood. Critical understanding of place helped youths identify their community's concerns, such as those about neighborhood air quality, people's health, and the cost of electricity. As these examples suggest, foregrounding the sociopolitical aspect of learning may facilitate educators' and youths' critical understanding of community concerns, desires, and needs to identify which STEM learning matters and why.

The critical justice stance on equity in ISL frames learning as a sociopolitical practice. It considers ISL spaces as sites of collective disruption of injustices that operate within the culture of power and privilege (Philip & Azevedo, 2017). Learning as sociopolitical should involve "explicit attention to the rewriting of dominant narratives about youths of color and their communities" (Vossoughi et al., 2016, p. 225). It also "opens the space to imagine and articulate self-determined solutions that diverge from white, middle-class epistemologies and practices" (Vossoughi et al., 2016, p. 228). Arguably, these forms of learning, which foreground the sociocultural aspect, cannot be realized without collective efforts. Those who are engaged in the critical justice work of ISL should create justice-oriented spaces for equitable learning experiences for minoritized youths. Research-educator-youth partners can and should co-work toward equity in ISL by centering analysis of power structures and historicized narratives of injustices and discrimination (CAISE Broadening Participation Taskforce, 2019).

One way to center analysis of power structures and historicized unjust narratives is to engage in collaborative projects of disruption with local community partners based on politicized trust (Vakil et al., 2016). Politicized trust means "actively acknowledg[ing] the racialized tensions and power dynamics inherent in design partnerships" (Vakil et al., 2016, p. 199). The concept of politicized trust is particularly important in collaborative projects between universities and community members (e.g., informal science/community center leaders and educators) because traditional power asymmetries exist in the relationship. Furthermore, these power asymmetries may intersect with collaborators' racial differences and their racialized experiences. Calling out differences in power and race may entail ongoing fragility and negotiation of the dynamics of power and race as part of politicized trust in critical justice-oriented collaborative work (Vakil et al., 2016). Collaborative work based on politicized trust will promote relations between collaborators as whole people, rather than technical or transient relations (CAISE Broadening Participation Taskforce, 2019). Also, it will help researchers recognize and empathize with the tensions, dilemmas, and concerns their partners may encounter during critical justice-informed efforts to create equitable ISL spaces.

Grounding this study in the critical justice stance

Drawing on literature concerning equity as access, inclusion, and critical justice, I ground this study in a critical justice stance on equitable ISL. While I will explore my positionality of this study more in the methods section, it is worth noting how this literature review has informed my own understanding and selection of the critical justice stance for this dissertation.

Through this literature review, I looked back on my life. As the first-born daughter of a family poor for generations within a historically sexist cultural context in Korea, I was poignantly aware of the disadvantage of having a low socioeconomic status and being a girl.

However, my younger self did not name or recognize my condition as a product of unjust systems. I was busy striving for academic achievement, particularly in math and science (subjects said to be for boys), as a tool to gain mobility and recognition. This approach seems to indicate that I operated the logic of redistributive justice (seeking to gain access to the upper class using public education) and relational justice (seeking to be recognized as able in STEM, despite being female) for myself. These historicized conditions of my younger self made me an unknowing representative of sexist and capitalist structures I strove against.

As a Korean public-school science teacher, I purposefully chose to work at schools in underserved communities to support students' academic success and future readiness; this can be viewed as an effort to ensure the students' inclusionary equity. However, as Vossoughi et al. (2016) argue, inclusion is insufficient without critical analysis of systemic injustices:

> Efforts to broaden participation without explicit analysis of such injustices advance the implicit arguments that access to normative making and STEM learning opportunities is sufficient for bringing about equity, and that equity looks like individual success within the current system (e.g., increasing the number of underrepresented students in the STEM pipeline), rather than the collective reimagining and transformation of the system itself (p. 215).

Over the years, I attempted to ensure my students' broadened participation and excellence in science. However, broadening participation does not suffice when it fails to make visible or transform unjust realities. I remember moments in which my students sought to initiate collective reimagining and transformation of the system, by suggesting new ways of learning science, seeking to use science for what mattered to them, and naming the unjust present and future. However, back then I deemed those moments as temporary and sporadic and, while focusing on

my students' short-term academic success and preparation for college, seldom engaged with their attempts at reimagining and transformation.

Along with the literature review, regrets emerged about missed opportunities to amplify these moments, and these regrets motivated me to closely focus on youth-initiated moments during my participation in my RPP partners' ISL programs. More profoundly, the reviewed literature has asked me how I can do less harm with my present and future life as an educator (Fendler, 2012), a researcher, and fundamentally as a learner of young people. By doing less harm, I mean sustaining a critical justice stance on equity. It involves naming educational injustices, acknowledging the power dynamics in educational spaces, and seeking to disrupt and transform unjust narratives about learning, STEM, and society. It also includes supporting minoritized youths to empower their present and future lives by engaging with STEM, critically constructing knowledge in STEM, and using this knowledge to name and resist systemic injustices and narratives. To do less harm by sustaining a critical justice stance, I worked with educators who share this vision and efforts to achieve it, as well as conflicts, mistakes, and regrets in working toward the hoped present and future.

Grounding this study in the critical justice stance on STEM education, I seek to articulate youth-initiated moments of disrupting and transforming experiences in ISL, paying attention to how educators may have supported the moments to emerge and to be amplified and sustained.

Conceptual Framework

The conceptual framework of this dissertation study draws on the constructs of rightful presence (Calabrese Barton & Tan., 2020) and local contentious practice (Holland & Lave, 2009). The coordination of these two constructs is instrumental for this study, which aims to make sense of youth-initiated moments and educators' pedagogical practices supporting and

amplifying the moments. Framing youth-initiated moments as instances that make visible youths' bids for rightful presence, I draw on local contentious practice to identify how youths and educators made visible and amplified the bids through interactions within their ISL community.

Framing youth-initiated moments using rightful presence

There have been increasing efforts to achieve justice-oriented formal and informal STEM education. As an example from formal settings, Morales-Doyle (2017) designed and enacted a high school chemistry curriculum to support Black and Latinx students' annual investigation of their neighborhoods' soil environment. Through the investigation, youths named and exposed "the sad irony of environmental racism: those communities who can least afford to spend scarce time and resources on issues of environmental health are the same communities most afflicted with various forms of pollution" (Morales-Doyle, 2017, p. 1044). Youths amplified their leadership in raising their community members' awareness of the environmental racism and calling for a communal change by foregrounding what the students claimed mattered for their own and their neighbors' lives.

As an example from informal settings, Vossoughi et al. (2013) reported how their partner educators sought to create a justice-oriented space in an afterschool makers' program. They centered youths' meaningful learning opportunities "both in the process of making and as a culminating social activity" for "broader social purpose," and supported youths to create "new roles and practices" as makers and change agents (Vossoughi et al., 2013, p. 3). Youths deepened their engagement in making artifacts (e.g., pinball machines or musical instruments) in ways that reauthored themselves as full of potential in STEM. In doing so, they brought social changes that mattered to their community (e.g., creating a lively space for a pinball arcade, composing and

performing music for community members).

These efforts suggest that justice-oriented STEM education should support youths to empower themselves as authors of learning that matters and to disrupt and transform passive views of who youths are in learning spaces. As a deliberate vision of who youths are in learning spaces, Calabrese Barton and Tan (2020) propose the critical justice framework of rightful presence. Rightful presence refers to youths legitimately belonging in their learning communities because of who they are and who they want to be, not because of who they should be or are expected to be by dominant discriminatory narratives (Calabrese Barton & Tan, 2020). This construct draws from literature problematizing the framework of hospitality in sanctuary cities that serve refugee communities and focus on including refugees as guests to the host system (Barnett, 2005; Squire & Darling, 2013). While it is crucial that cities include refugees and offer institutionalized access to the host communities, refugees' lived lives are prone to remain invisible and excluded due to the guest-host relations of sociohistorical power dynamics dominantly governed by white supremacist, patriarchal, and capitalistic ideas (Squire & Darling, 2013).

The framework of rightful presence problematizes the notion of rights—i.e., who has rights, which forms of rights, to what extent. Historically, normative discourses, practices, and tools of STEM and STEM learning are grounded in white, heteropatriarchal epistemology (Bang et al., 2012; Harding, 2008; Mutegi, 2011). In the white and heteropatriarchal systems of STEM and STEM learning, it is problematic only to extend rights to participate in the system as it is because extension of rights does not necessarily challenge the ideologies underpinning those rights. Rightful presence involves the political struggle to re-author rights in ways that disrupt and transform normative systems of power.

Applying this guest-host framework to youths' positions in ISL spaces helps to explain how youths are prone to remain as guests in ISL institutions. Despite being welcomed to ISL spaces, youths may have only limited membership as temporary, passive, and deficient guests. Youths as guests are expected to follow routines in host ISL institutions or the STEM disciplinary narratives dominant in ISL institutions. They are welcomed when following the routines and dominant narratives, which work as "boundaries that control the borders of acceptable meanings and meaning-making practices" (Bang et al., 2012, p. 303). In such institutional spaces, youths are often simply positioned as knowledge recipients or consumers rather than as producers and critics of knowledge and practice as the values, beliefs, and epistemologies that underlie youths' experiences and lives are sidelined (Feinstein & Meshoulam, 2014). These patterns of exclusion are closely related to youths' race, gender, sexuality, language, and citizenship status (Archer et al., 2020). Indeed, the presence of minoritized youths is often missing, as their knowledge and experiences are deemed non-integral or irrelevant to STEM disciplines (Mutegi, 2011).

Calling attention to youths' rightful presence and seeking to foreground it as the basis of equitable ISL is a justice-oriented political project that requires collective efforts in which ISL community members disrupt and transform the aforementioned discriminatory narratives in education. The critical justice stance of rightful presence aligns with Ladson-Billings' (2006) call for attention to and disruption of education-debt, the damage done to particular groups of youths due to unjust sociocultural and historicized structures. Foregrounding youths' rightful presence requires acknowledging and disrupting these damaging structures. Centering rightful presence involves exposing how youths have been made missing by the sociocultural and historicized structures that shape unjust narratives in society as well as in formal and informal STEM

20

education. The responsibility for centering youths' rightful presence is on those who have participated, knowingly or unknowingly, in reinforcing or benefiting from the unjust structures and narratives, not on those who have been traditionally overlooked in the structures. ISL educational researchers have responsibility for critically transforming structures and narratives. In reimagining the role of ISL in seeking justice, researchers should work with partner institutions and educators to center youths as having rightful presence and coming to ISL spaces as already valuable thought-leaders and action-takers (Birmingham et al., 2017).

Despite the importance of rightful presence, challenges exist in how to systematically and purposefully support and amplify it in ISL spaces. There is an urgent need to identify and enact pedagogies to ensure and sustain youths' rightful presence in ISL spaces, by foregrounding youths' powerful cultural knowledge and values that matter to youths' lives and their communities. As foundational work to address this need, Calabrese Barton and Tan (2020) offer three main tenets of critical justice-oriented pedagogies in support of youths' rightful presence, particularly for those who have been historically minoritized in STEM learning spaces. The tenets are:

1. Allied political struggle is integral to disciplinary learning: the right to reauthor rights.

2. Rightfulness is claimed through presence: making justice/injustice visible.

3. Collective disruption of guest/host classroom relationalities: amplifying the sociopolitical (Calabrese Barton & Tan, 2020, p. 436-437).

The first tenet, allied political struggle, emphasizes that educators and adults participate in reauthoring youths' rights, from limited to fully actualized, in STEM learning spaces. Political struggles refer to the *acts of justice* (de Royston et al., 2017). In these struggles, relationalities in classrooms, which reproduce oppressive modes of power especially along racial lines, are

challenged, disrupted, and potentially restructured" (Calabrese Barton & Tan, 2020, p. 433).

Youths' seeking to reauthor rights for rightful presence becomes a struggle against systemic

injustices, such as antiblack racism, that underlie sociocultural and historicized narratives in ISL

spaces, STEM, and society, as well as against practices that render injustices normal and

invisible. The first tenet requires those who are deemed 'host' in ISL spaces, including

educators, to act as allies of youths' political struggles. The first tenet contends that simply

asking youths what rights they think need reauthoring is insufficient and unjust because the

youths may not know immediately or in advance what rights need reauthoring. Educators,

particularly as those who interact with youths firsthand, should participate in reauthoring youth's

rights, by reflectively questioning and transforming whose voices, knowledge, and experiences

matter and how and why they matter. Educators need to work with youths to challenge, expand,

and humanize forms of participation in STEM learning.

The second tenet, rightfulness through presence, argues that "political struggle in

classroom practice organizes towards *making present* the intersections of contemporary

(in)justices, while orienting towards new, just social futures" (Calabrese Barton & Tan, 2020, p.

436). This tenet calls for ISL that takes into account (in)justice visible in the here-and-now as

much as it ensures a just and sustainable impact on youths in the future. Rightfulness through

presence involves both acknowledging the past/current realities and working towards a desired

future. Acknowledging the historicized narratives of injustices and orienting toward a just future

are instrumental but insufficient without seeking to disrupt the present experience and witness of

injustices. This tenet places the exposure and disruption of current injustices at the core of

learning toward a more just social future. The aforementioned examples from Birmingham and

Calabrese Barton (2014) and Morales-Doyle (2017) are relevant to this tenet. Although the

contexts differed (informal youth community program and formal AP chemistry class, respectively), both studies show how educators and teachers can support young people to use science as a tool for exposing injustices and working toward a more just future by investigating community issues regarding energy consumption and soil pollution, respectively. Youths' investigations consequentially led them to hold community conferences to elevate public awareness about energy and environmental issues affecting their communities and to call for responsible industrial or governmental agents to take mitigating actions.

Lastly, the third tenet, collective disruption of guest/host relationalities, integrates the sociopolitical as an important feature of ISL and of the spaces in which ISL takes place. The sociopolitical dimension of learning is revealed when questioning and seeking to transform the narratives of injustices in ISL institutions that position youths as guests with limited authorship of their learning and becoming in STEM and society (Birmingham & Calabrese Barton, 2014; Tan & Faircloth, 2016). Foregrounding "the need to disrupt normative knowledge/power relationalities in classrooms" (Calabrese Barton & Tan, 2020, p. 437), this tenet requires all ISL community members to take responsibility for exposing and transforming guest-host relationalities. Shared responsibility for disrupting guest-host relationalities (the third tenet) necessitates educators becoming allies of youths' political struggles (the first tenet) through making visible youths' whole lives in-the-moment and over time (the second tenet). I refer to these tenets (allied political struggles, rightfulness as presence, and collective disruption of guest/host relationalities) in order to identify specific ways that youths bid for rightful presence, as well as the practices educators enacted to support these bids.

Framing interactions manifested in youth-initiated moments using local contentious practice

The tenets of rightful presence emphasize educators' and adults' sharing youths' ongoing political struggles against systemic injustices underlying sociocultural and historicized narratives in ISL and society. I use the construct of local contentious practice to further articulate how such political struggles manifest through interactions and emergent tensions between youths and the sociocultural/historicized narratives of ISL spaces/institutions that shape daily discourse, practices, and power relations of the people therein.

The construct of local contentious practice is grounded in social practice theory (Holland & Lave, 2009), which focuses on people's on-going becoming through social practice taking shape in sociocultural-historical and institutional contexts (Holland et al., 1998). The premise of social practice theory is that a person's identity is not individual and fixed, but sociohistorical, on-going, and uncertain. To explain the on-going formation of the sociohistorical self within historicized institutional narratives, Holland and Lave (2009) call attention to two histories: *history in person* and *history in institutionalized* (or *enduring) struggles*.

As a personal narrative of self-making, *history in person* takes shape via interactional practices with others in local spaces (Holland & Lave, 2001). History in person aligns with this study's focus on how youths may come to have more explicit rightful presence in ISL spaces via their actions and interactions. By *history in institutionalized* (or *enduring) struggles*, Holland and Lave (2001) refer to "'Struggles' with a capital S" that involve "social, cultural, economic, and political relations" (p. 21). As institutional narratives are grounded in historicized and trans-local structures, enduring struggles provide resources for people's actions and interactions and leave traces in their formation of history in person. Examples of enduring struggles include the

24

oppression of historically marginalized ethnic groups, gender inequalities, and competing forms of capitalism.

Local contentious practice is the social practice that comes about in the encounter of these two histories in local space and time. History in person and history in enduring struggles are "locally realized" through local contentious practice (Holland & Lave, 2001, p. 6). Local contentious practice takes shape via interactions between people and tensions that arise from people's different positions in sociocultural and historicized narratives. Through local contentious practice, people create and recreate their history in person as well as the historicized narratives of their local spaces by using, resisting, and transforming discourse and practices informed by historicized narratives of enduring struggles. In this regard, local contentious practice can be a means of transformation according to how participants in local institutions create and enact the practice (Calabrese Barton et al., 2020). For example, local contentious practice can take shape as people encounter oppression through local representatives, experience conflict among participants with similar resources but different stakes, or partake in events involving local institutions (Holland & Lave, 2001).

Viewing teaching and learning through the perspective of social practice theory and local contentious practice helps to understand different forms of interactions shaped by multiple actors at different positions of power in their local learning institutions. In their institutional learning spaces (e.g., a school classroom, a science/community center makerspace), multiple actors (e.g., youth, educators) and non-human constituents (e.g., spatial structures, institutional norms, disciplinary knowledge, tools and resources) interact within sociocultural and historicized narratives, dynamic networks of power, and allowable discourse and practices (Gutiérrez et al. 2019; Medin & Bang, 2014; Moje et al., 2004).

In particular, I apply these concepts (history in person, enduring struggles, and local contentious practice) to explain youths' political struggles toward rightful presence in their learning institutions. Youths' political struggles towards rightful presence are considered local contentious practice, emerging in the encounter between youths' history in person and institutional discourse and practices grounded in the historicized narratives of education and STEM (e.g., who should teach, what should be taught, who has authority in education and STEM). In what follows, I consider youths' political struggles toward rightful presence to be local contentious practice and educators' justice-oriented pedagogical practices as ways to participate in youths' political struggles toward rightful presence.

Youths' political struggles toward rightful presence as local contentious practice

Youths bring lived histories to their actions and interactions in institutional spaces. Youths' actions and interactions of exposing, disrupting, and transforming often come to be local contentious practices as they seek to shift dominant narratives in the spaces. Actions and interactions seeking shifts may entail tensions between the youths and sociocultural and historicized narratives represented by daily discourse, practices, and power relationalities within the institution.

I consider youths', particularly, minoritized youths', political struggles toward rightful presence as local contentious practice that emerges in the encounter between youths' lived histories and the sociocultural/historicized and institutional narratives of injustices. Youths' political struggles manifest through their *actions and interactions of exposing, disrupting, and transforming* (local contentious practice) multiple forms of *systemic injustices regarding learning and society* (enduring struggles), which they have *experienced and observed throughout their lives* (youth's history in person). As examples of local contentious practices, youths may

26

question the truth, values, and knowledge prescribed by traditional authorities; resist quotidian practices and discourse that marginalize youths; or challenge systems of class-, gender-, and race-based categorizations (Basu & Calabrese Barton, 2010). Tensions may arise explicitly or implicitly as youths' actions and interactions toward rightful presence challenge and are challenged by historicized institutional narratives of discrimination, such as racism, sexism, classism, and ableism.

Paying attention to youths' political struggles as local contentious practices that manifest as actions/interactions giving rise to tensions is important when seeking ways for educators and researchers to exercise the tenets of rightful presence. Historicized narratives in learning communities have resulted in youths having limited legitimacy in constructing meaningful learning experiences. Youths' actions (e.g., asking educators unexpected sociopolitical questions regarding program content and activities) can become contentious practice as they seek to have rightful presence and change the here-and-now injustices with their STEM learning opportunities (the second tenet, rightfulness as presence). Different members of learning communities, particularly educators, can support and respond to youth's local contentious practice as allies for youth's rightful presence (first tenet) and collectively disrupt guest-host relationalities in learning spaces (third tenet).

As the tenets of rightful presence indicate, youths should not bear the burden of their political struggles alone. Adults (i.e., educators, researchers, and institutional leaders) should participate in disrupting and transforming injustices underlying institutionalized narratives. One way of doing so is attending to how political struggles are made visible through youths' local contentious practices involving their actions and interactions and to emergent tensions between these actions/interactions and injustices underlying institutional narratives. Accordingly, in this

27

study of youth-initiated moments, I pay close attention to youths' political struggles toward rightful presence that manifest through local contentious practice involving actions and interactions that make visible and call for shifts in the institutional narratives.

Educators' justice-oriented pedagogical practices as ways to participate in youths' political struggles toward rightful presence

To educators and community members, youths' local contentious practices may suggest "new possibilities for pedagogical practice" because such practices would make visible "multiple sources of authority and meaning" as "valid and full of potential" (Bang & Vossoughi, 2016, p. 177). In the critical justice stance, referring to valid and potential forms of learning youths seek to make visible is an integral part of identifying new possibilities for pedagogical practices that will help educators participate in youths' having and expanding rightful presence.

While framing and calling attention to youths' political struggles toward rightful presence as their local contentious practice, I also critically note the possibility that *not all* local contentious practices authored by youths are recognized and that recognition, when it does occur, may be deficit-oriented. Educators, as adults interacting firsthand with youths in learning spaces, often unwittingly participate in reinforcing injustices through quotidian practices (Madkins & McKinney de Royston, 2019). Youths' local contentious practice may end up being sidelined within sociocultural and historicized narratives that position youths as temporary guests and knowledge recipients (Dawson, 2019; Howard, 2010). This positioning becomes even more detrimental when minoritized youths internalize such a deficit view, perceiving themselves as less than or irrelevant to dominant sociocultural norms and narratives in STEM disciplines (Rosebery et al., 2015). In this way, educators' practices may help to deprive youths of meaningful opportunities for their local contentious practices to bring transformative changes in

their learning communities. Educators' pedagogical practices bear both danger and potential (Fendler, 2012). While pedagogical practices can reinforce systemic injustices, they can also contribute to youths' political struggles to disrupt injustices. Amplifying the potential for dismantling injustices requires further examination of which pedagogical practices may help dismantle injustices, which tensions may arise in enacting those practices, and how educators may negotiate those tensions.

Emphasizing the importance of educators' roles, I frame educators' justice-oriented pedagogical practices as ways to participate in youths' political struggles manifested as local contentious practice. I envision those pedagogical practices as working toward realizing different possibilities of justice and expanding youths' rightful presence in learning spaces. Pedagogical practices may involve recognizing and supporting youths' political struggles and amplify youths' rightful presence.

Studies show how educators participate in youths' political struggles by enacting justice-oriented pedagogical practices in ISL spaces. One way is educators centering the epistemologies and values youths bring to ISL communities. For example, in their work with Indigenous community members and youths, Bang and Medin (2010) foregrounded Indigenous communities' ways of knowing, valuing, and living with Nature in support of indigenous youths' robust and sustainable engagement with STEM. Another way of participating in youths' political struggles is by seeking to affirm and care for the learning that matters to youths and for youths' agentic actions in pursuit of such learnings. Shea and Sandoval (2020) found that Latinx community educators created a caring space that embraced youths' choice of "when to stay and when to leave" and how to use STEM for whom, without educators' prescribing "what was scientific, political, or cultural" (p. 42).

Enacting justice-oriented pedagogical practices in ISL spaces would involve recognizing and negotiating tensions that arise from youths' political struggles against different forms of systemic injustices embedded in learning, ISL, and society. Educators may notice tensions between institutional narratives and youths' rightful presence when institutional expectations and norms about program designs and goals delimit youths' lives and knowledge due to their racial, socioeconomic, or linguistic status (Feinstein, 2017). Educators also may encounter tensions between their own pedagogical commitments, grounded in normative narratives in STEM, and youths' seeking to construct knowledge and practices that matter to them. For example, tensions can emerge between makerspace educators' wanting to support youths and youths' authoring design work when educators apply a normative view of success in design to point out "flaws or conceptual misunderstandings" from youths' work without "offer[ing] affirmations and multiple paths for inquiry" (Shea & Sandoval, 2020, p. 42). Tensions like these that educators notice and encounter require ongoing negotiation and reflection on who counts in ISL spaces, whose knowledge and ideas matters, and which learning counts for whom (Tan et al., 2019).

While these examples show how educators should/can enact justice-oriented pedagogical practices in support of youths' political struggles and negotiate emergent tensions, identifying and enacting those practices in local ISL spaces is a challenging task. Even if ideas about justice-oriented pedagogical practices are largely shared by educators and researchers, these ideas are inevitably abstract until educators enact and sustain them in their daily lives with youths in local ISL institutions/programs. The varying forms of enacted practices and tensions require educators and their partner researchers to engage in on-going critical reflection on their work toward just ends. For example, when educators seek to disrupt hierarchical power relationalities, they need to

examine and reflect on how their practice differs from relinquishing educators' pedagogical efforts and taking peripheral positions (Chazan & Ball, 1999; Furtak, 2006).

Identifying and enacting justice-oriented pedagogical practices with on-going reflections between educators and researchers has centered the RPP project this study draws on. These reflections also represent collective efforts for educators and researchers to become allies who participate in "the political struggles as a shared burden" (Calabrese Barton & Tan, 2020, p. 436). Framing educators' justice-oriented pedagogical practices as ways to participate in youths' political struggles toward rightful presence, I attend to educators' enactment of pedagogical practices as they foster and respond to youths' actions of seeking shifts in discourse, practices, and power relationalities in ways to create ISL opportunities that matter to youths. This will help to suggest how youths and educators can open possibilities to act as allies for realizing and expanding rightful presence in ISL spaces.

Visual representation of conceptual framework

Figure 2-1 represents a visualization of the conceptual framework informed by the constructs of rightful presence and local contentious practice. Youth-initiated moments make visible youth's bids for rightful presence. These bids are made through political struggles, manifested as local contentious practice taking shape in contentious encounters between youths and those, often including educators, who enact or represent the sociocultural historicized institutional narratives. As educators recognize how youths' actions/interactions seek to expose, disrupt, and transform injustices underlying such narratives, they may enact pedagogical practices that support youths' political struggles and co-create with youths equitable ISL foregrounding rightful presence. Drawing on this framework, my analyses focus on how youth-

initiated moments make visible rightful presence and how educators' pedagogical practices may

support and amplify youths' rightful presence.

Figure 2-1 Visual representation of conceptual framework
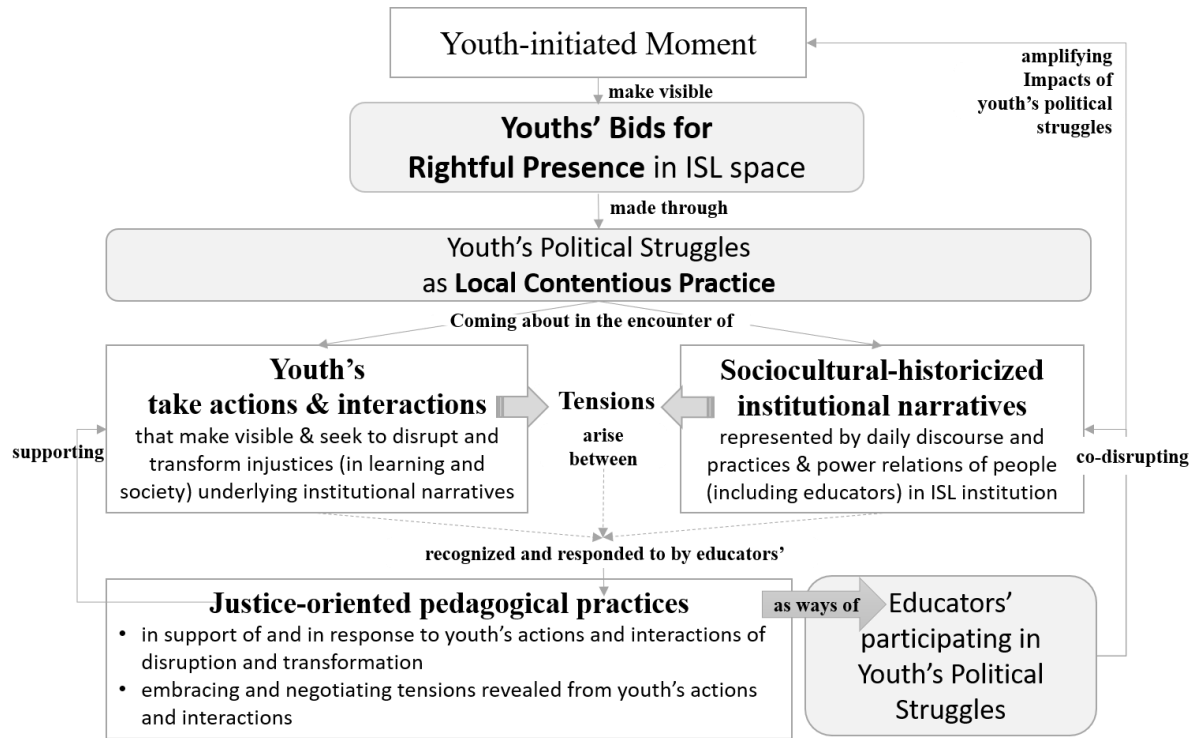
Chapter Three. Methods

To investigate youth-initiated moments and associated pedagogical practices, this dissertation study takes a participatory critical ethnographic approach. Critical ethnography is a method that highlights exposure, critique, and transformation of injustices rooted in power inequalities and social markers of privilege and discrimination (e.g., race, gender, class, ability, language) as fundamental and consequential dimensions of analysis (Calabrese Barton & Tan, 2010). The method aligns with this study's critical justice stance on equity in ISL. In this stance, the sociocultural and historicized narratives of injustices are exposed, and the codes of power and discrimination are called into question. Critical ethnography supports the exposure of injustices because it places power relationalities and their discriminatory operations at the center of analysis (Trueba, 1999). Using this method helps this critical justice-oriented study to account for the unjust, power-related, and discriminatory narratives that may have impacted ISL experiences of minoritized youths.

In particular, I utilized participatory critical ethnography by grounding this study in a larger RPP project aimed at identifying and enacting justice-oriented pedagogical practices for informal STEM education. A participatory critical ethnographic approach disrupts the traditional researcher-researched hierarchical binary and centers on politicized trust that emphasizes multiple perspectives and experiences across those who differ in sociopolitical status in research, i.e., youth, educators, and researchers (Vakil et al., 2016). This approach allowed me to generate data from multiple participants and ensure trustworthiness of analysis and findings by placing youths' and educators' perspectives and voices at the center of research to identify pedagogical practices that matter to and work for youths and educators.

Furthermore, RPP-based participatory critical ethnography aligns with the conceptual framework and research questions of this study. While engaging in the larger RPP project, RPP educators and researchers (including me) increasingly noticed the importance of moments in which youths initiated discursive and embodied actions and interactions that seemed to be critical calls for change in ISL discourse and practices. We considered that focusing on these moments would help us investigate, reimagine, and transform pedagogical practices. The need for further investigation of such moments and associated pedagogical practices prompted me to design this study and navigate literature to capture our initial noticing. The literature search led me to establish a conceptual framework grounded in rightful presence and local contentious practice. These constructs, respectively, describe youths' legitimate belonging and their social actions/interactions manifested in relation to power dynamics.

Given its alignment with theoretical and conceptual stances of this study, the methodological stance of participatory critical ethnography is appropriate for answering the research questions. This method facilitates the articulation of youths' and educators' practices by taking into account the narratives of power and privilege, due to which youths' ISL experiences can never be neutral or essentialized.

In addition, I make two additional points about how I conduct this participatory critical ethnography study. First, I critically acknowledge the challenges and tensions that may still remain, even when conducting a participatory study that seeks to dismantle the power imbalance between the researcher and the researched. Seeking to create and develop politicized trust with my RPP partners during our data co-generation and co-analysis, I tried to be critical, honest, and brave, such that we were vulnerable (e.g., acknowledging mistakes, not knowing, confusions, regrets) within the inevitable power dynamics among us. I kept myself in check if I was aware

of, and sought to expose and disrupt power hierarchies that otherwise would be easily normalized.

Second, taking a critical justice stance in a participatory critical ethnography does/should not mean that I take a deficit-oriented approach that highlights solely missed opportunities. While critically analyzing the historicized narratives of injustices that *underlie* ISL opportunities, I have placed the utmost emphasis on the presence and possibilities of equitable ISL made visible by youths and educators in the moment. This focus on the presence and possibilities has led us, as RPP educators and researchers, to reflect on pedagogical and institutional practices normalized in ISL spaces and how to transform the practices in a more just direction. Participatory critical ethnography focusing on possibilities for the just present and future is paramount to transform practices and culture of institutions in which the lives of youths, educators, directors, and research partners are under on-going (re)creation.

Context

This study takes place within multi-layered contexts of the local (Great Lakes City), research (research practice partnership project), institutional (community center and science center), and program (three in the community center and three in the science center).

Local context

This study takes place in Great Lakes City, a medium-sized city located in the Midwest of the United States. Despite being impacted by an economic recession and declining population, the city has local educational infrastructures that facilitate youth's ISL experiences such as a community college, nearby university, refugee resettlement center, and the two focal institutions of this study: the community center and the science center. These contextual realities, both the

35

socioeconomic challenges the city experiences, as well as the facilities it has access to, contribute to local youths' learning experiences and opportunities.

Research context

This participatory critical ethnography is grounded in a larger research practice partnership project (Science Learning + Partnerships: Partnering for Equitable STEM Pathways for Minoritized Youth; PI, Angela Calabrese Barton). Research practice partnership (RPP) is theory-driven and practice-grounded collaborative work toward shared goals of transformation (e.g., Ryoo & Kekelis, 2016). Over four years, we partnered with a community center and science center described below. We worked closely with directors of the two institutions, 14 educators who implemented at least one of 12 informal STEM programs held in the institutions, and 67 RPP partner youths (RPP youths, hereafter). By RPP youths, I am referring to the youths who consented to our project and participated in data generation (among over 200 youths who attended at least one of the informal STEM programs). Some RPP youths, educators, researchers participated in multiple ISL programs.

We grounded our work in politicized trust, which allowed us to be vulnerable and honest in navigating the tensions and dilemmas that may arise from institutional norms or power relations that intersect with our partnership work (Kaijser & Kronsell, 2014; Vakil et al., 2016; Weis & Fine, 2012). RPP partners collaborated throughout different facets of research, such as designing, enacting, and reflecting on justice-oriented pedagogies, as well as drawing on multiple actors' perspectives and interpretations to co-identify and analyze the youth-initiated moments. Youths generated data and offered suggestions and critiques necessary for conducting the project. Educators not only generated data but also participated in analysis, discussed our findings, and suggested practical implications of the findings (Cammarota & Fine, 2010).

Researchers co-developed, observed, and assisted the programs and facilitated intra- and inter-institutional dialogues among multiple actors. This dissertation study attends to a subset of the RPP project data to investigate the insights youth-initiated moments offer regarding justice-oriented pedagogies in support of rightful presence in ISL.

Institutional contexts

community center

Located in Great Lakes City, the community center is a vibrant after-school center serving over 350 predominantly Black youths daily (pre-COVID). Staff and educators are racially diverse, reflecting demographics of the neighborhood of the community center (majority Black with some white, Latinx, and Asian staff members). The community center is a familial and communal place. Many youths, educators, and staff have known one another for a long time and have close relationships, such that many youths feel at home in the community center, as one of our RPP youths stated. The director of the community center launched the RPP project with the project PI. Three programs in this study took place in the community center's makerspace (STEM Club, STEM Summer Camp, and Mash-up Forensics). The makerspace, which was co-designed by youths at the Club, is furnished with tools and resources (e.g., sewing machines, electric circuit tools, 3D printer, drills, soldering tools, laptops) to support youths' design and making projects. The makerspace is also full of not only finalized projects but also on-going design work that celebrates the making process itself.

science center

Located in Great Lakes City, the science center offers annual STEM programs and exhibits. It serves as the main science center for the mid-region of the state. The science center collaborates with other organizations in the local community. It has held exhibits in collaboration

with the local refugee developmental center, and the nearby community college and university. It also offers youth programs in collaboration with K-12 schools such as field trips, seasonal programs, and camp nights with parents. Staff and educators are predominantly white, but the educators actively engaging in our RPP project are women of Color (Ms. O, Ms. A, and Ms. Ti) and white (Mr. C, Mr. E, and Ms. S) educators seeking to learn more and disrupt racial and gender inequities embedded in their programs and their center. Ms. O, the lead educator of the science center, launched the RPP project with the project PI. Three programs in this study (Youth Action Council, Forensics, and Robotics Camp) took place in the makerspace and other rooms in the science center. The makerspace is furnished with tools and resources to support youths' design and making projects (e.g., wood cutting tools, robotic kits, electric circuit tools, drills, soldering tools, laptops). The makerspace displays both finalized projects and on-going design work, representing the value placed on the process of making.

Program context

For this study, I focus on 6 (of the 12) programs that were part of the RPP project (2017-2019); these were selected because they were the ones I participated in as a research assistant and/or educator. The RPP partners[2] engaging in at least one of the 6 programs were 48 youths (out of a total of 159 youth participants), 6 educators, and 5 researchers. The 6 programs are STEM Club and STEM Summer Camp from the community center; Youth Action Council, Forensics, and Robotics Camp from the science center; and Mash-up Forensics from a collaboration between the science center and the community center (see Table 3-1).

---

[2] Throughout the dissertation, all RPP partners' names are self-selected pseudonyms.

Table 3-1 Description of programs and key features

Partner Institution	Program	RPP partners	Key Features
community center	STEM Club	• Youths: 18 (across the years); Ages 11-15; Demographically diverse • Educators/researchers [a]: Ms. M, Ms. T	• Twice a week after school (Oct-May, 2017-2019) • Project-based
	STEM Summer Camp	• Youths: 6; Ages 11-15; All Black • Educators/researchers: me, Ms. M	• Weeklong summer camp (August, 2019) • Project-based
science center	Youth Action Council (YAC)	• Youths: 20 (across the years); Ages 10-16; Demographically diverse • Educators: Ms. O, Ms. A, Mr. C • Researchers: Ms. M, Ms. T, Ms. St, Ms. Si, me	• Once a month on Saturdays (Oct- May, 2017-2019) and Weeklong summer camp (2017, 2018) • Youth co-design of science center experiences
	Forensics	• Youths: 15 (out of 120 total participants, across 6 terms for 3 years); Ages 12-14; Demographically diverse • Educators: Mr. E, Mr. C, Ms. Ti, Ms. Cl, Ms. A • Researcher: me	• On Fridays for five weeks (two terms a year, Sep-Dec, 2017-2019) • Inquiry-based • District partnership program
	Robotics camp	• Youths: 6 (out of 11 total participants); Ages 12-14; Demographically diverse • Educator: Mr. C • Researcher: me	• Weeklong summer camps (June, 2019) • Project-based
community center + science center collaboration	Mash-up Forensics	• Youth: 12; Ages 10-12; All Black • Educator: Ms. A • Researcher: Ms. Si, me	• Held at the community center; Taught by Ms. A, the science center educator • Once a week (Oct-Dec, 2018) • Inquiry-based

Note.

[a] By educators/researchers, I am referring to researchers who also served as educators implementing the program.

These programs were broadly aimed at providing youths with varied knowledge and practices that could help them to author equitable STEM experiences. Below I briefly describe the features of each program.

STEM Club (community center, 2017-2019)

The goal of the STEM Club was engaging youths in locally relevant and globally important design work by supporting youths in developing deep understandings of science and leveraging their community expertise to take action. Youths engineered and programmed environmentally friendly devices and engaged in projects to educate their local community members about environmental sustainability by holding community conferences or producing documentaries. The youths' STEM projects followed from youth-authored community ethnography to foreground familial, communal, and cultural knowledge and practices as the foundation of their engineering work. For this study, I draw on data generated by Ms. M (a white educator) and Ms. T (a Black educator), who both are RPP researchers as well as educators. They engaged with 18 RPP youths in this program.

STEM Summer Camp (community center, 2019)

The goal of the STEM Summer Camp was engaging youths in participatory design and implementation of engineering activities during a week-long summer camp. Drawing on the youths' interest and expertise in visual technologies, Ms. M and I, as co-educators as well as researchers, sketched initial ideas for activities in which youths would investigate STEM-related aspects of different visual devices from the past to the present (e.g., pinhole, film, and digital cameras). The initial ideas for activities were refined with youth campers into the activities such as making pinhole cameras from recyclable materials, dissecting film cameras, mounting portable digital cameras on remote-controlled toy cars to video-record the inside of the

community center, and operating drones to video-record the outside of the community center. Using the photos or videos they took with the devices they produced and reproduced, the youths developed GIS maps of their community center using an online application. We collaborated with 6 RPP youths in this program.

Youth Action Council (YAC; science center, 2017-2019)

The goal of the YAC was engaging youths in designing and redesigning the science center's space, activities, and programs with science center educators (Ms. O, Ms. A, and Mr. C) and researchers (Ms. M, T, St, Si, and me). 20 RPP youths engaged with these educators and researchers in critical examination of spatial and social representations in the science center, developed and prototyped programs, and proposed community outreach projects that the science center educators could choose to implement. Youths and educators co-designed the new science center makerspace, which the youths named 'Think Tank.' I joined the YAC after Think Tank had been created. At that time, the YAC was undertaking a new project referred to as 'reclaiming the science center.' Through the reclaiming the science center project, youths examined the injustices made (in)visible in the social and spatial representation of the science center and renamed and redesigned the instructional spaces of the science center.

Forensics (science center, 2017-2019)

The goal of Forensics was engaging youths in forensics knowledge and practices to enhance youths' identities and aspirations in STEM. Youths explored activities regarding forensic science for five Fridays, in three sessions per day. The main activities of sessions include individual and class evidence, fingerprinting, blood testing, DNA extraction, liquid chromatography, and—on the last day—a mock crime scene investigation. In addition to the

main activities, youths engaged in a wrap-up activity, 'conclusion writing,' at the end of each day, in which youths individually reflected on what they learned that day.

This program, as a collaboration between the nearby school district and the science center, had an instructional format similar to school in several ways. First, the program lessons were based on a curriculum pre-designed by the science center educators and approved by the school district supervisors. Second, youth participants were recruited from middle schools in a nearby district, and one supervisor teacher from the school district brought the youths to the science center on a school bus. Third, the supervisor from the school district oversaw the sessions. The five-week Forensic program took place twice during the fall in each of the three years I participated (a total of six terms for three years).

Although a total of 120 youths participated across all six instantiations of the program, my access to the youths was limited due to the unique nature of the program implemented through the science center and school district partnership. During the first year, I was not allowed to distribute consent forms. In the second and third years, I was allowed to distribute consent forms, but the return rate was low. Only 15 youths consented and temporarily participated in data generation as RPP youths.

While I had limited and temporary access to youths, I was able to develop and sustain a partnership with five educators who implemented the program between 2017 and 2019. During this time, the educators tried to enact pedagogical practices that could create more equitable ISL opportunities in a context similar to the youths' schooling.

Robotics Camp (science center, 2019)

The goal of the Robotics Camp was engaging youths in designing robots using recyclable resources and programming codes to operate the robots over a week. The initial curriculum was

developed by the educator Mr. C drawing on prior years' curricula implemented by other educators. Youths explored microchips, Sphero robots, and LEGO robots. They applied these experiences to create their own robots using recyclable materials and showcased the robots they created to their peers, other educators, and their parents. Among a total of 11 youth campers, 6 youths participated in data generation and offered their feedback and insights to advance the program and the educator's practices.

Mash-up Forensics (Community-science centers collaboration, 2018)

This program was an outcome of a collaboration between the community center and the science center mediated through our RPP project. The two institutions' directors and the RPP project PI had discussed ways to institutionally support the inter-institutional sharing of programs, practices, and resources. As the first attempt at collaboration, the aforementioned Forensics program from the science center was implemented in the community center makerspace. We named the program 'Mash-up' Forensics as it brought together an educator from the science center (Ms. A) with youths in the community center, placing the science center program in and adjusting it to the new context of the community center.

The goal of Mash-up Forensics was engaging youths in forensic knowledge and practices and application of the knowledge and practices to solve imaginary crime problems. Ms. A, as one of the educators who led the Forensics program in the science center, brought the program to the community center makerspace. 12 RPP youths participated in the program and helped Ms. A critically reflect on and revise the program content and activities by directly communicating with her about their experience of the program activities. The youths who participated in this program also had engaged in the STEM Club. Ms. Si and I participated in the three-month collaboration

initiative as researchers. We supported Ms. A's reflection on and gradual transformation of the Mash-up Forensics program.

Participants

This study draws on data generated by RPP partners: 48 youth, 6 educators, and 5 researchers (three of whom, including me, also served in an educator role). In particular, by RPP youths, I mean the youths who consented to our RPP project and participated in data generation and in identifying moments that mattered to them (data analysis phase 1). The science center Forensic program involved 15 RPP youths out of a total 120 youth participants between the years 2017 and 2019. The science center Robotics Camp implemented in 2019 involved 6 RPP youths out of a total 11 youths In the other four programs, all youth participants consented to the RPP and engaged in data generation. Table 3-2 provides demographic information about the RPP educators and researchers.

RPP youths, educators, and researchers participated in at least one of the six programs, and some of them participated in multiple programs. For example, youths who participated in the Mash-up Forensics also participated in the STEM club. Ms. A participated in the science center Forensics as well as Mash-up Forensics as an educator. I participated in STEM Summer Camp as an educator/researcher and took on the role of a researcher in the science center Forensics. Participation in multiple programs offered comparative perspectives, which were valuable for us in reflecting on differences in practices involving different educators, programs, and institutions.

Table 3-2 RPP Partner educators and researchers

RPP Educators	Racial identity (educator: years of informal STEM teaching)	STEM Club	STEM Summer Camp	YAC	Forensics	Robotics Camp	Mash-up Forensics
Ms. O	Latina (20+)			○[a]			
Ms. A	South Asian (6)			○	○		○
Mr. C	White (2)			○	○	○	
Mr. E	White (5)				○		
Ms. Ti	Black (6),				○		
Ms. S	White (2)				○		
RPP Researchers	Racial identity (years of informal STEM teaching/research)	STEM Club	STEM Summer Camp	YAC	Forensics	Robotics Camp	Mash-up Forensics
Ms. M	White (20+)	○ (E/R)[b]	○ (E/R)	○			
Ms. R	Black (5)	○ (E/R)		○			
Ms. St	White (6)			○			
Ms. Si	White (3)			○			○
Me	Korean (3)		○ (E/R)	○	○	○	○

Note.
[a] '○' means that the educator or researcher participated in the program as an educator or researcher, respectively.
[b] '○ (E/R)' means that the researcher participated in the program as an educator.

Positionality

I ground this study in a critical justice stance on equity. This stance validates my researcher positionality shaped by my being a Korean woman foreigner in the US and provided the possibility for me to become a learner, researcher, and educator in the RPP project. Before joining the project, I had worked as a secondary science teacher in Korean public schools for more than a decade. I tried hard to support my students' rigorous engagement in science and help them find relevance of science in their lives; however, since I became a doctoral student and engaged in critical reflections of my teaching, I have realized that back then I did not take the stance on and practices for equity and justice to the core of my teaching. I felt not only regretful about the missed opportunities for my past students' equitable learning but also vulnerable and ineligible as an RPP member just beginning her work toward justice-oriented education research.

However, by engaging with the RPP work, the culture of which offered space for embracing such feelings, for critical reflections, and for politicized trust, I have empowered myself to become a vigilant asker and an engaged learner with and from youths, educators, and research colleagues. In this study, therefore, I position myself as a learner, researcher, and educator. With this positionality, I consider this study to be my way of becoming an ally with youths expanding rightful presence in STEM education and with educators seeking to support youths. Profound learning with and from RPP partners prompted me to conduct this study by highlighting the moments we had affectionately called 'youth-initiated' and by foregrounding youths' and educators' insights—their wisdom, knowledge, practices, critiques, questions, and tensions—in analyses, findings, and discussion.

Data Generation

This study draws on three sets of participatory ethnographic data: reflective conversations, educator portfolios, and researcher's ethnographic documentation. As shown in Table 3-3, kinds and amounts of data generated differed according to the duration, purposes, and context of each program. Below I briefly describe each of data generated.

Reflective conversations

Different forms of reflective conversations served as the source of initial data to answer research questions (RQs) on instantiations of moments (RQ 1) and enactment of pedagogical practices (RQ 2): group conversations (between youths and educators), end-of-day interviews (researchers with individual youths and educators), follow-up meetings (between educators and researchers, after a program completion), and RPP meetings (between educators and researchers, across programs/institutions).

Group conversations

Youth-educator group conversations took place in three programs: the two center programs (STEM Club and STEM Summer Camp) and one science center program (YAC). The group conversations were video/audio recorded and lasted 15-20 minutes each. The community center group conversations took place in what the youths called *Circle Time on the Red Couch,* which has been developed as an important cultural-historical practice over the years by the youths and educators/researchers. Similar group conversations took place in the science center YAC.

Table 3-3 Data generation

Partner institution	Program	Reflective conversations	Educator portfolios	Ethnographic documentation	Researchers mainly engaged in data generation
community center	STEM Club	• Group conversations between youths and educators (144 times, 36 hours) • Individual interviews (18 RPP youths, 18 hours) • RPP meetings (12 times, 12 hours) [a]	• Educator/researcher: Ms. M, Ms. R • Lesson plans • Youths' work (texts, drawings, design artifacts) • Photos/videos of youth participation	• Field notes (written or oral) from 144 contact hours • Institutional context analysis table	Ms. M Ms. R
	STEM Summer Camp	• Group conversations between youths and educators (10 times, 5 hours) • Individual interviews with youths (6 RPP youths, 3 hours) • Individual interviews Ms. M (5 times, 2.5 hours) • Follow-up meetings with educators (3 times, 6 hours). • RPP meetings (2 times, 2 hours) [b]	• Educator/researcher: Ms. M, Ms. J • Lesson plans • Youths' work (texts, drawings, design artifacts) • Photos/videos of youth participation	• Field notes (written) from 20 contact hours • Institutional context analysis table	Ms. M me
science center	Youth Action Council (YAC)	• Group conversations involving 20 youths (48 times, 24 hours) • Individual interviews with youths (20 RPP youths, 20 hours) • Individual interviews with educators (3 educators, 24 times, 12 hours) • Follow-up meetings with educators (6 times, 6 hours). • RPP meetings with educators (12 times, 12 hours) [a]	• Educators: Ms. O, Ms. A, Mr. C • Lesson plans • Youths' work (texts, drawings, design artifacts) • Photos/videos of youth participation • Exit survey	• Field notes (written/oral) from 72 contact hours • Institutional context analysis table	Ms. M Ms. R Ms. St Ms. Si me

Table 3-3 (cont'd)

science center	Forensics	• Individual interviews with youths (5 RPP youths, 2 hours) • Individual interviews with educators (5 educators, 90 times, 45 hours) • Follow-up meetings with educators (6 times, 6 hours). • RPP meetings with educators (12 times, 12 hours) [a]	• Educators: Mr. E, Mr. C, Ms. A, Ms. Cl, Ms. Ti • Lesson plans • Photos/videos of youth participation • Exit survey	• Field notes (written) • from 160 contact hours • Institutional context analysis table	Ms. J
	Robotics Camp	• Individual interviews with youths (6 RPP youths, 3 hours) • Individual interviews with Mr. C (7 times, 8 hours) • Follow-up meetings with educators (2 times, 3 hours). • RPP meetings with educators (2 times, 2 hours)	• Educators: Mr. C • Lesson plans • Photos/videos of youth participation • Exit survey	• Field notes (written) • from 40 contact hours • Institutional context analysis table	Ms. J
community center + science center Collaboration	Mash-up Forensics	• Group conversations between youths and educators (12 times, 6 hours) • Individual interviews with Ms. A (6 times, 3 hours) • Follow-up meetings with educators (2 times, 3 hours). • RPP meetings with educators (6 times, 6 hours) [a]	• Educator: Ms. A • Lesson plans • Photos/videos of youths engaging with each other	• Field notes (written) from 24 contact hours • Institutional context analysis table	Ms. Si Ms. J

Note.

[a] In these RPP meetings, we primarily attended to three programs (STEM Club, YAC, and Forensics) that took place in the same academic years (2017-2019). We also discussed the Mash-up Forensics during its enactment in 2018.

[b] In these RPP meetings, we attended to two programs (STEM Summer Camp and Robotics Camp) that took place in the same period (summer, 2019).

Group conversations typically took place twice a day: at the beginning of the program session to orient and refine plans for the day and at the end of the session to reflect on the session's activities to plan next steps. During the latter type of conversation, educators usually began with questions from the Youth Conversation Protocol (see Appendix A). We asked about which moments stood out or mattered to the youths (RQ1). We also asked how the educators and activities had (or could have) helped their designing/making work (RQ2). We discussed activities of the day, future directions, feedback on each other's design/making artifacts; the conversations often organically flowed to include youths' sharing how their (school) days were going.

End-of-day individual interviews

Individual interviews took place after each day of the programs, using the Youth Conversation Protocol (see Appendix A) or Educator Interview Protocol (see Appendix B). For RPP youths who were willing to be interviewed (N=38), interviews took 15-60 or more minutes; interviews with educators lasted 30-60 minutes. These individual interviews were audio recorded.

The initial and central questions to youths and educators alike focused on eliciting what moments stood out to them regarding youths' learning and why (RQ 1). In interviews with youths, we additionally asked for direct critiques and suggestions about the activities or program so that the youths could inform reflections and transformations at the levels of individual educators, the program, the institution, and the RPP (RQ 2). In interviews with educators, we asked how they recognized and responded to the moments (RQ 1). We also asked educators to reflect on the moments and their responses to the moments in terms of how their daily practices may have supported the emergence of the moments (RQ 2).

Follow-up meetings with educators

I conducted post-program follow-up meetings at least twice per program with individual educators (or with multiple educators in the same program). Each meeting lasted approximately one hour. These meetings were usually not video/audio-recorded, but we developed documents using tools such as Google documents or Google slides. During these meetings, we talked in more detail about the moments initially identified in group conversations and end-of-day individual interviews (RQ 1). We particularly attended to the practices educators enacted before, during, and after the moments and the commitments or concerns that undergirded these practices (RQ 2).

Researcher and educator RPP meetings

RPP researchers and educators at each institution had biweekly meetings to share reflections on program implementation and to design future programs. During the RPP meetings, we also designed (and later implemented) professional development sessions to involve not only our RPP educators but also other educators in the institutions. We also had across-institution RPP meetings once a semester. In each of these meetings, researchers brought documents that would facilitate discussions about designing and enacting justice-oriented pedagogical practices in the institution(s). These documents included descriptions of the moments we had been identifying and analytic tables with ethnographic observations of the programs and institutions, generated drawing on the end-of-day reflections, follow-up meetings with educators, and researcher field notes.

Educators' portfolios

Individual educators who participated in the RPP project were asked to create individual portfolios with researcher assistance (see Appendix C for the Educator Portfolio Generation

Protocol). By portfolios, I mean collections of teaching practice-related materials. The six

partner educators as well as the three researchers who served as educators (Ms. M, Ms. T, and

me) generated portfolios for programs they designed and implemented. Each portfolio includes

teaching plan documents, videos and/or audios of program implementation, exit surveys received

from youth participants at the end of each day of teaching or of the program, and

autobiographical documents about their becoming ISL educators. Depending on how many

programs the educators engaged in, they developed one to three sets of portfolios.

Researcher ethnographic documentation

I generated a set of data to inform ethnographic analysis of the moments within multiple

layers, starting from individual youth's/educator's perspectives of institutions and program

features.

Field notes (program observations)

I developed ethnographic data composed of daily field notes in either written or audio

form (see Appendix D for the Field Note Protocol). The field notes focused on actions and

interactions of youths and educators, impressions of institutional contexts, and power dynamics,

if observable. The field notes also included information on attendance, reflections on informal

conversations with youths or educators, and norms and routines of the program.

Open source about programs and institutions

I added descriptions of social and spatial features of the institutions to my field notes. I

referred to publicly available sources of information such as websites for the science center and

community center that introduce their respective educational goals, programs, and events, and

pamphlets that announce their new programs and recruit participants. I also made observations in

and outside of the centers to describe their spatial features. These contextual data were used to

understand the institutional culture and assumptions, as they can inform daily routine practices, discourse, and decisions of individual actors.

Data Analysis

I answer the two research questions through three phases of data analysis with RPP youths, educators, and researchers. First, I describe how the analytic heuristic was co-developed to correspond to the conceptual framework and allow the research questions to be answered. I then elaborate on the analysis phases.

Developing an analytic heuristic

As an important part of the participatory data generation and analysis, RPP researchers and educators co-developed an analytic heuristic that facilitated identification of youth-initiated moments and pedagogical practices in support of the moments. Developing an analytic heuristic was necessary to ensure transparency and address challenges of inter-partner communication that stem from conducting multiple stakeholders' participatory research (Henrick et al., 2017). The heuristic provided questions for us to consider as we identified the moments and pedagogical practices, and articulated their details during reflective conversations, such as individual interviews, follow-up meetings, and RPP meetings.

The initial version of analytic heuristic was developed during the early phase of data generation when we, researchers and educators, met to discuss how to generate data, such as individual interviews and educators' portfolios. We formulated guiding questions that would help us and youths identify the moments important in terms of youths' equitable learning experiences and educators' pedagogical practices in support of equitable learning. As we used the guiding questions as an analytic heuristic, we refined and revised the questions when necessary. For example, among the many moments that were considered important for creating

and supporting youths' equitable ISL, we became increasingly interested in the moments in which youth-initiated actions and interactions sought to disrupt and transform discourse, practices, and/or relationalities normalized in their ISL spaces. Thus, while attending to all of the moments that stood out to any RPP partner, the moments in which youths sought disruption or transformation became the foundation of this study.

Building on this initial identification of moments we called youth-initiated, I referred to the literature to explain and explore youth-initiated actions and relate the actions to youths' political struggles towards rightful presence and local contentious practices. I also conceptualized educators' justice-oriented pedagogical practices as ways to participate in youths' political struggles. Informed by this framework, we formulated guiding questions to help us identify moments that were seemingly important in terms of youths seeking equitable learning experiences and educators enacting pedagogical practices in support of equitable learning (see Table 3-4). The analytic heuristic involves questions to identify youths' *actions and interactions* with peers and educators (as evidence of how local contentious practice was initiated and manifested) that attempted a shift in the discourse and practices of their learning communities situated in *the local ISL contexts* (as evidence of how the local contentious practice may have disrupted and transformed locally realized institutional narratives of learning and society). It also attends to educators' *pedagogical practices* in support of and in response to youths' actions and interactions (as evidence of how educators supported and amplified the shifts that youths sought). The analytic heuristic was refined to reflect this study's conceptual framework and research questions (see Table 3-4 for the resulting analytic heuristic).

Table 3-4 Analytic heuristic to answer research questions

Research Questions	Conceptual Framework	Guiding Questions from Analytic Heuristic
1. How do youths make visible their bids for rightful presence in ISL through "youth-initiated" moments of disruption and transformation?	Youths make visible their political struggles toward rightful presence as local contentious practice that involves actions and interactions of disrupting and transforming dominant institutional narratives experienced in learning and society.	**Actions and Interactions**? • What happened in each moment in detail? • What actions and interactions do youths take? (e.g., suggestion, question, critique, movement, activities) • What did youths seek to disrupt and transform with the actions and interactions? (e.g., discourse on what is meant by STEM, discourse on how youths learn STEM, patterns of participation, spatial configuration, relationships)
		ISL institutional context? • What tensions, dilemmas, and questions, if any, appeared in the moments? • Are power hierarchies/dynamics observable? How? • Which institutional narratives and tools and resources of learning shaped the educators' practices? • Which social/spatial features of the institutions (i.e., science center, community center) were observable?
2. What pedagogical practices may have supported and amplified youth-initiated moments?	Educators enact justice-oriented pedagogical practices of supporting, recognizing, and amplifying youths' actions/ interactions as ways to participate in youths' political struggles.	• What are the lesson, program, institutional features? (e.g., types of activity and participation, program goals, tools and resources, cultural routines and norms) • Who designed the activities and programs?
		Educator practices? • Which practices do educators enact in their daily routines? • What tensions, dilemmas, and questions, if any, do educators encounter or notice? Why? • How do educators respond to the moments or the tensions? • How may the educator practices have helped the moments to emerge? • Which pedagogical practices do educators reflect on, if any? • Which pedagogical practices do educators seek to transform, if any?

As the Table 3-4 shows, the guiding questions of the heuristic fall into three categories:

1. actions and interactions of youths as evidence of how local contentious practice was initiated and manifested (RQ1),

2. institutional context of ISL (RQ1) as evidence of how the local contentious practice may have shifted institutional narratives about learning and society

3. educator practices as evidence of how educators supported the youth-initiated moments to emerge (RQ2)

Table 3-5 Data analysis overview

Research Questions	Phase 1. Open coding of moments and associated educator practices	Phase 2. Analytic coding of youth-initiated moments and pedagogical practices	Phase 3. Identifying types of youth-initiated moments and sets of pedagogical practices
1. How do youths make visible their bids for rightful presence in ISL through "youth-initiated" moments of disruption and transformation?	Identify with youths and educators: • Moments that stood out and mattered to them, including moments in which youths seemed to disrupt and transform discourse, practice, and/or power relationalities.	Identify with RPP researchers: • Youths' and educators' actions and interactions • What the actions and interactions sought to shift and make visible	Identify with RPP researchers: • Types of youths' actions of disruption and transformation
2. What pedagogical practices may have supported and amplified youth-initiated moments?		Identify with RPP educators and researchers: • Pedagogical practices enacted surrounding the moments (before, during, and after)	Identify with RPP researchers: • Sets of pedagogical practices • How different pedagogical practices are connected to one another

Table 3-5 overviews three phases of data analysis I conducted building on the analytic heuristic, by taking a constant comparative approach (Strauss & Corbin, 1998) in the grounded-theory tradition (Bryant & Charmaz, 2007): 1) open coding of moments and associated educator

practices, 2) analytic coding of youth-initiated moments and pedagogical practices, and 3) identifying types of youth-initiated moments and sets of pedagogical practices.

Analysis phase 1. Open-coding moments and associated practices

Moments generally refer to salient instances where there is a particular change in discourse, practice, and/or relationality (Schon, 1983). Moments offer important entry points to what researchers seek to notice, address, and transform, as well as to understanding of the sociocultural, historical, and political worlds in which the moments emerge (Eisenhart, 2001; Luna, 2018). In our RPP data generation and analysis, we attended to moments noted as salient by youths, educators, and researchers as one of the entry points that informed our RPP project, which aimed to identify and enact justice-oriented pedagogical practices for creating more just and equitable ISL opportunities.

Identification of moments and educators' practices manifested in the moments took place during the different forms of reflective conversations (i.e., group conversations, end-of-day individual interviews, post-program follow-up meetings with educators, and RPP meetings between researchers and educators across programs and institutions). The initial identification mostly occurred in the group conversations that took place during sessions or end-of-day individual interviews immediately following sessions. During the group conversations and interviews, we reflected on the identified moments, attending to when the youths or educators felt the moment began, what they felt was happening, and why it was important to them (RQ 1) and how educators supported or responded to the moments (RQ 2). Educators and youths were asked to point out particular moments of the day that stood out to them and what they did in the moments and with whom. Moments and pedagogical practices in the moments were further identified during researchers' reflections, follow-up meetings with educators, and RPP meetings.

Researchers later identified additional moments through analytic review of educator portfolios and interview/session transcripts.

Drawing on the transcripts and documents generated from these reflective conversations, I developed a table that lists and describes all of the moments identified as important by youths, educators, and researchers. This table was used during our regular RPP meetings when we, RPP educators and researcher, identified which of these moments were youth-initiated. Youth-initiated moments are those that RPP partners considered important because youths' calls for shift in discourse, practices, and relations were evident. In such moments, youths used discursive and embodied actions of disruption and transformation, such as critiquing particular aspects of activities, suggesting new ways of ISL, or seeking to change the physical configuration of their ISL spaces. Through this process, currently a total of 143 moments were identified (STEM Club, 35; STEM Summer Camp, 12; YAC, 23; Forensics, 56; Robotics Camp, 10; Mash-up, 7), of which 56 moments were further coded as youth-initiated moments (STEM Club, 7; STEM Summer Camp, 6; YAC, 10; Forensics, 24; Robotics Camp, 6; Mash-up, 3). See Appendix E for a summary table of all youth-initiated moments.

Analysis phase 2. Analytic coding the features of youth-initiated moments

The second coding phase was to identify features of youth-initiated moments and associated pedagogical practices. Based on the descriptive table (see Appendix E) of 56 moments identified as youth-initiated, I developed 'postcards,' narrative descriptions of each moment, drawing on transcripts of reflective conversations, educator portfolios, and my field notes. The purpose of the postcards was to create a shared analytic summary of each moment to foster deeper discussion of collective insights in RPP sessions.

A postcard has two sides. The front side contains the moment's title and vignette (Figure 3-1). Informed by the conceptual framework, the back side contains my initial analysis of key actions/interactions and practices, shift(s)[3], if any, made in the learning community, and the program/institutional context in which the moment took place (Figure 3-2).

Figure 3-1 Postcard front side (the title and vignette of the moment)[4]
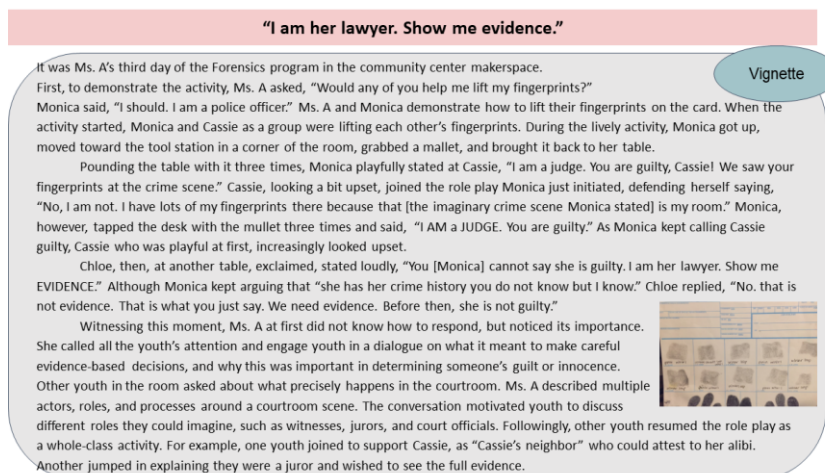
Figure 3-2 Postcard back side (key actions/interactions & practices; impact on learning community, ISL context)

---
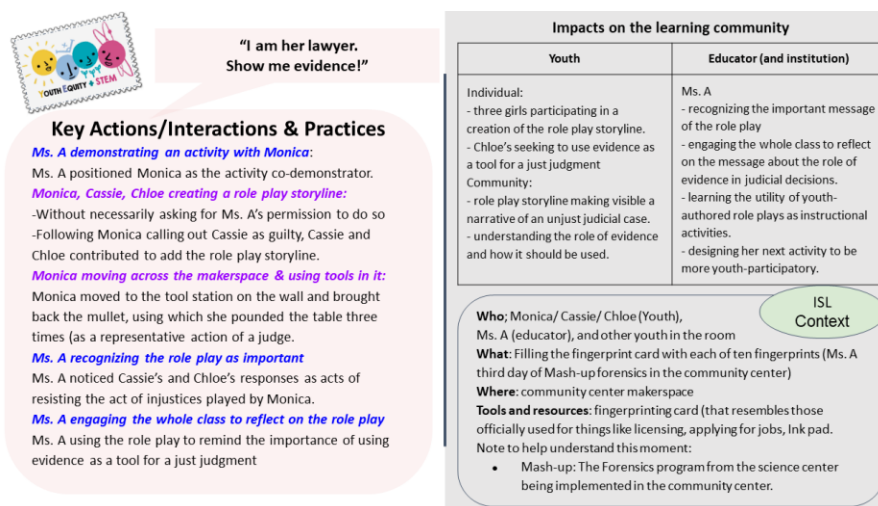
[3] When I first developed the postcards, I used the term 'impact,' as obvious changes made in youths' individual and communal learning experiences. As we continued our analysis, we used the term 'shift' so that we could encompass a wide range of changes not only made but also sought for youths' learning, educators' practices, and their learning communities' discourse, practices, and power relationalities.

[4] This is a revised postcard. After RPP discussions, postcards were revised to reflect new insights.

This study's conceptual framework, incorporating rightful presence with local contentious practice, offered a rationale for how I organized the back side. I framed youth-initiated moments as instances in which youths' political struggles toward rightful presence are made visible. The construct of local contentious practice helped identify youths' political struggles and educators' responses or participation in the struggles by examining youths' and educators' actions and interactions. The construct of local contentious practice also allowed me to pay attention to shifts in learning communities' discourse, practices, and power relationalities--shifts that were either made or sought through the actions and interactions.

The postcards and other data were further analyzed with RPP researchers and educators. We used a shared Google spreadsheet to identify the following:

1. features of youth-initiated moments (RQ1) and

2. educators' pedagogical actions in support of youth-initiated moments (RQ2).

We engaged in data analysis, as described below, until consensus among RPP educators and researcher partners was met on the features of the youth-initiated moments and the kinds of educators' pedagogical practices. As elaborated below, we identified each of these through analytic coding. Informed by the conceptual framework, analytic coding focused on the actions and interactions, institutional narratives that were made visible and that youths sought to disrupt and transform, and tensions that may have emerged in the encounter between actions, interactions, and the narratives.

Identifying features of youth-initiated moments

By features, I refer to the components that characterize youth-initiated moments as they appear commonly across individual youth-initiated moments. To identify the features, we, RPP researchers and educators, undertook an iterative data co-analysis process in which we used postcards (the narrative description of the moments and my initial analysis of the moments) to chronologically code the actions and interactions observable in each moment as well as what youths sought to shift and make visible (attending to both institutional narratives and their presence in learning spaces). Table 3-6 shows the coding for three youth-initiated moments, facilitated by the educator Ms. A in three different programs (YAC, Mash-up Forensics, and Forensics).

Looking across the codes, we grouped the codes for youth/educator actions and interactions and what youths sought to shift and made visible. Through iterative grouping, three features were identified:

- Youths' actions of disrupting and transforming normalized narratives in learning spaces,
- Educators' and peers' responses to youths' actions, and
- Bids for rightful presence.

For example, the codes identified from the three youth-initiated moments in Table 3-6 were grouped into the three features as shown in Table 3-7. These features will be further articulated in Chapter Four.

Table 3-6 Analytic coding of youth-initiated moments: examples from the programs facilitated by Ms. A

Youth initiating the moment (Program)	Brief description of the moment	Coding youth and educator actions/interactions	Coding what youths' actions sought to shift and make visible
Ivy & Rose (YAC)	Singing a song together and moving bodies across the room	• Ivy and Rose singing a song, 'Let It Go,' as they released the frustration coming from their challenging project • Ivy and Rose taking up space by singing and moving their bodies across the room • Ms. A playing the song from her phone • Ivy's and Rose' peers immediate participation in singing the song, moving their bodies freely in the room	• Making visible and releasing emotions coming from engaging in challenging STEM projects • Humanizing community in which youths feel free to express, release, and share frustration and excitement coming with STEM projects
Monica, Cassie, Chloe (Mash-up Forensics) [a]	Improvising a role play an activity that matters in the Forensic science learning	• Monica, Cassie, and Chloe improvising the role play developed from fingerprinting activity • Monica, Cassie, and Chloe taking up space by moving their bodies across the room for the role play • Ms. A noticing and verbally stating the powerful message of the role play • Ms. A facilitating other youth's participation in the role play • Monica, Cassie, Chole, and peers joining the role play, positioning themselves with new roles (lawyers, witnesses, and jurors)	• Humanizing communities (trying to defend their peer unduly accused in the role play storyline) • Seeking to expose/disrupt unjust narratives of unfair judicial decision making • Being experts (judges, lawyers)
Amir, (Forensics)	Critiquing and revising interrogative questions	• Amir critiquing the biased assumption revealed from interrogative questions his peers and Ms. A were brainstorming • Ms. A affirming Amir's critique and acknowledging the assumption • Ms. A asking Amir and other youths how to improve the interrogative questions they made • Amir and peers revising interrogative questions carefully	• Seeking to expose and critique presumption that underlie the discourse • Being legitimate members who critique and revise ideas and discourse presented in the learning community

Note.
[a] See Figures 3.1. and 3.2. for the postcard of this moment.

Table 3-7. Identifying features of youth-initiated moments: examples from the programs facilitated by Ms. A

Features of youth-initiated moments	Codes falling into each feature
Youths' actions of disrupting and transforming normalized narratives in learning spaces	• Ivy and Rose initiating singing a song, 'let it go' • Ivy and Rose taking up space by singing and moving body across the room • Monica, Cassie, and Chloe improvising the role play developed from fingerprinting activity • Monica, Cassie, and Chloe taking up space by moving their bodies across the room for the role play • Amir critiquing the biased assumption revealed from interrogative questions his peers and Ms. C were brainstorming
Educators' and peers' responses to youths' actions	• Ms. A playing the song from her phone • Ivy's and Rose' peers immediate participation in singing the song, moving their bodies freely in the room • Ms. A noticing and verbally stating the powerful message of the role play Ms. A facilitating other youth's participation in the role play Monica, Cassie, Chole, and peers joining the role play, positioning themselves with new roles (lawyers, witnesses, and jurors) • Ms. A affirming Amir's critique and acknowledging the assumption • Ms. A asking Amir and other youths how to improve the interrogative questions they made Amir and peers revising interrogative questions carefully
Bids for rightful presence	• Making visible and releasing tension from engaging in challenging STEM projects • Humanizing community in which youths feel free to express, release, and share frustration and excitement coming with STEM projects • Humanizing communities (trying to defend their peer unduly accused in the role play storyline) • Seeking to expose/disrupt unjust narratives of unfair judicial decision making • Being experts (judges, lawyers) • Seeking to expose and critique presumption that underlie the discourse • Youths are legitimate members who critique and revise ideas and discourse presented in the learning community

Identifying pedagogical practices in support of youth-initiated moments

Analytic coding of the features of youth-initiated moments led us to further examine pedagogical practices educators enacted before, during, and after the moments. One of the youth-initiated moment features is 'educators' and peers' responses,' and educators' responses are also considered part of their pedagogical practices. As such, during our analysis of pedagogical practices, we considered educator responses to the moments as entry points to further examine which pedagogical practices educators enacted surrounding the moments.

Analytic coding of pedagogical practices with RPP educators and researchers took place during the pandemic, which prevented in-person meetings. We had virtual meetings to add codes to educators' pedagogical practices. The iterative analysis process with RPP educators and researchers allowed me to refine codes as I recognized unattended areas that turned out to be critical to understand the moments and practices.

To identify the pedagogical practices, we undertook an iterative data co-analysis process in which we used postcards to chronologically code educators' pedagogical actions before, during, and after the youth-initiated moments. Table 3-8 shows the coding for pedagogical actions enacted before, during, and after three youth-initiated moments, facilitated by the educator Ms. A in three different programs (YAC, Mash-up Forensics, and Forensics).

Through iterative grouping of educators' pedagogical actions, six pedagogical practices in support of youth-initiated moments were identified:

- Designing ISL opportunities
- Facilitating youths' agentic participation
- Publicizing youths' ideas and knowledge developed and used during ISL
- Recognizing youths' critique and new ISL possibilities youths suggested

- Affirming youths' critique and suggestions

- Soliciting for youths to reorganize and co-create ISL opportunities

For example, the codes for educators' pedagogical actions identified from the three youth-initiated moments in Table 3-8 were grouped into the six practices as shown in Table 3-9. These features will be further articulated in Chapter Five.

Table 3-8 Analytic coding of educators' pedagogical practices: examples from the programs facilitated by Ms. A

Youth initiating the moment (Program)	Brief description of the moment	Before the moment was initiated	During and after the moment
Ivy & Rose (YAC)	Singing together for 'Let It Go'	• Planning to engage youths in makers' projects that youths design, prototype, and propose as activities potentially usable in the science center STEM programs • Facilitating youths' maker projects with abundant materials and resources • Offering times for youths to share their design ideas and offer comments to one another	• Recognizing youths' frustration in the middle of engaging in the projects that became to be challenging as youths tried to realize their design ideas • Immediately responding to Ivy and Rose singing a song by playing the song from her phone • Singing together with Ivy, Rose, and other youths and helping youths take time to release their frustration and refresh the atmosphere with laughter and free movement • In the following YAC sessions, playing the music became a routine during youths' making projects
Monica, Cassie, Chloe (Mash-up Forensics)	Improvising a role play an activity that matters in the Forensic science learning	• Planning the pair activity of lifting up fingerprints on to the fingerprint cards • Facilitating youths' lead by asking for youths to be co-teacher of the activity	• Recognizing and verbally stating the powerful message of the role play • Opening up discussion about fair judicial decision making and the use of forensic evidence

Table 3-8 (cont'd)

Monica, Cassie, Chloe (Mash-up Forensics)	Improvising a role play an activity that matters in the Forensic science learning	• Sharing the fingerprint cards when youths approached her and showcased their accomplishment of lifting up fingerprints	• Facilitating other youth's participation in the role play • Incorporating the scenario-based activity for the following Forensic sessions
Amir, (Forensics)	Critiquing and revising interrogative questions	• Planning a scenario-based activity of creating interrogative questions • Facilitating the activity by casting an Adult educator member who will play the role as an imaginary person who would be interrogated by youths (giving the sense of real interrogation) • Showcasing youths ideas of interrogative questions on the whiteboard	• Acknowledging that she was not aware of how the interrogative questions sound biased • Affirming Amir's critique and acknowledging the assumption • Asking Amir and other youths for how to improve the interrogative questions they made • Revising educator prompts facilitating the interrogation activity for the following sessions, drawing on her reflection of the day

Table 3-9 Identifying educators' pedagogical practices: examples from the programs facilitated by Ms. A

Pedagogical practices	Codes for actions falling into each practice
Designing ISL opportunities	• Planning to engage youths in makers' projects that youths design, prototype, and propose as activities potentially usable in the science center STEM programs • Planning the pair activity of lifting up fingerprints on to the fingerprint cards • Planning a scenario-based activity of creating interrogative questions
Facilitating youths' agentic participation	• Facilitating youths' maker projects with abundant materials and resources • Facilitating youths' lead by asking for youths to be co-teacher of the activity • Facilitating the activity by casting an Adult educator member who will play the role as an imaginary person who would be interrogated by youths (giving the sense of real interrogation)
Publicizing youths' ideas and knowledge	• Offering times for youths to share their design ideas and offer comments to one another • Sharing the fingerprint cards when youths approached her and showcased their accomplishment of lifting up fingerprints • Showcasing youths ideas of interrogative questions on the whiteboard

Table 3-9 (cont'd)

Recognizing youths' critique and new ISL possibilities youths suggested	• Recognizing youths' frustration in the middle of engaging in the projects that became to be challenging as youths tried to realize their design ideas • Recognizing and verbally stating the powerful message of the role play • Acknowledging that she was not aware of how the interrogative questions that were being made could be biased
Affirming youths' critique and suggestions	*Affirming immediately* • Responding to Ivy and Rose singing a song by playing the song from her phone • Singing together with Ivy, Rose, and other youths • Affirming Amir's critique and acknowledging the assumption *Affirming over time* • In the following YAC sessions, playing the music through a speaker that became a routine when youths worked on making projects. • Incorporating the scenario-based activity for the following Forensic sessions, drawing on her reflection of the day • Revising educator prompts facilitating the interrogation activity for the following sessions, drawing on her reflection of the day
Soliciting for youths to reorganize and co-create ISL opportunities	• Having youths take time to release their frustration and refresh the atmosphere with laughter and free movement in the room • Opening up discussion about fair judicial decision making and the use of forensic evidence in doing so • Facilitating other youth's participation in the role play • Asking Amir and other youths how to improve the interrogative questions they made

Analysis phase 3. Identifying types of youth-initiated moments and sets of pedagogical practices

In the third coding phase, I identified types of youth-initiated moments and sets of educators' pedagogical practices associated with the youth-initiated moments. To inform this phase, I developed a coding framework by referring to Calabrese Barton and Tan's (2020) three tenets of rightful presence. Three tenets of rightful presence describe what youths and educators can work together toward to realize and expand youths' rightful presence in learning spaces. As such, I examined the tenets and identified their descriptions of youths' actions biding for and exercising rightful presence and educators' actions in support of such actions (Table 3-10).

Table 3-10 Coding framework to identify types of youth-initiated moments and sets of pedagogical practices, grounded in the tenets of rightful presence

Tenets of rightful presence		1. Allied political struggle is integral to disciplinary learning: right to reauthor rights.	2. Rightfulness is claimed through presence: making justice and injustice visible.	3. Collective disruption of guest/host relationalities: amplifying the sociopolitical.
Youths: How these tenets describe youths' actions and interactions	I use these tenets' description of youths' actions and interactions to identify types of youth-initiated moments making visible youths' rightful presence.	• Youths seek to author their rights in shaping and reshaping their ISL opportunities with their educators and peers.	• Youths seek to make justice/ injustice visible through ISL.	• Youths seek to disrupt guest and host relationalities in classroom. • Youths amplify the sociopolitical dimension of learning.
Educators: How these tenets describe the ways in which educators support youths' actions and interactions of disruption and transformation	I use these tenets' description of educators' actions and interactions to identify sets of pedagogical practices that supported and amplified the shifts youths sought with actions and interactions they initiated in the moments.	• Educators support and amplify youths' actions and interactions seeking to reauthor their rights through ISL	• Educators support and amplify youths' actions and interactions seeking to make visible (in)justices through ISL	• Educators support and amplify youths' actions and interactions seeking to disrupt power relationalities among ISL community members including youths and educators.

Using this framework, I looked across the youth-initiated moments and pedagogical practices examined during analytic coding (phase 2). As described in Chapters Four and Five, respectively, I was able to identify three types of youth-initiated moments (i.e., ways in which youth-initiated moments seem to make visible rightful presence) and three sets of pedagogical

practices (i.e., ways in which educators' pedagogical practices seem to support youth-initiated moments). Below, I describe the process of identifying each.

Identifying types of youth-initiated moments

I analyzed the youth-initiated moments according to the 'youths' row in Table 3-10. I identified three types of youth-initiated moments, which will be further articulated in Chapter Four. To show how the types relate to the tenets in Table 3-10, Table 3-11 describes each type in terms of its respective tenets of rightful presence, along with example moments from Table 3-6.

Table 3-11 Identifying types of youth-initiated moments: examples from programs facilitated by Ms. A

Types of youth-initiated moments	Describing each type drawing on the tenets of rightful presence	Example moment
Reorganizing physical and social representation	• **Tenet 1:** Youths seek to author their rights in shaping and reshaping their ISL opportunities with their educators and peers. In this type, youths sought to reauthor their rights by reorganizing physical and social representation through moving their bodies and furniture, and shifting the social relationalities in the space. • **Tenet 3:** Reorganizing physical and social representation with educators and peers, youths disrupted the normalized relationalities in learning spaces, which positions youths as guests who temporarily visit the space established by educator hosts.	• The moment of Ivy & Rose (YAC) singing 'Let It Go'; • Shifting the physical and social representation of the room as a humanizing space where youths can express their in-the-moment frustration of engaging in challenging maker projects by moving freely in the room and loudly singing together the song 'Let It Go'
Creating ISL activities that matter	• **Tenet 1:** Youths seek to author their rights in shaping and reshaping their ISL opportunities with their educators and peers. In this type, youths sought to reauthor their rights by creating ISL activities that matter • **Tenet 3:** Creating new activities with educators and peers, youths disrupted the normalized relationalities in learning spaces, which positions youths as guests who consume the activities designed and facilitated by educator hosts.	• The moment of Monica, Cassie, & Chloe, (Mash-up Forensics) improvising a role play; • In the moment, youths created an activity where youths could experience the real world (courtroom) context in which their learning is applied (finger printing's utility as individual evidence)

Table 3-11 (cont'd)

Foregrounding the physical and social dimension of learning	• **Tenet 1:** Youths seek to author their rights in shaping and reshaping their ISL opportunities with their educators and peers. In this type, youths sought to reauthor their rights by disrupting the neutral discourse and practice and highlighting the physical and social dimension of learning. • **Tenet 3:** Youths seek to make learning to be physical and social by grounding it on their lived experiences -including the experiences and observations of oppressions and discriminations. In doing so, youths seek to legitimize their presence in learning spaces. • **Tenet 2:** Furthermore, foregrounding the physical and social dimension of learning often involves naming and resisting injustices youths would experience and observe in their lives.	• The moment of Amir critiquing the interrogative questions his peers and Ms. A were brainstorming: • Amir seeking to make visible the biased assumption underlying interrogative questions and revising the questions with peers and Ms. A • Amir's critique drawing on discriminatory narratives in law enforcement system against people of Color and poor people, the narratives he observed from watching *CSI* tv show

Identifying sets of pedagogical practices in support of youth-initiated moments

I analyzed educators' pedagogical practices surrounding the youth-initiated moments according to the three 'educators' cells (i.e., How these tenets describe the ways in which educators support youths' actions and interactions of disruption and transformation) in Table 3-10. I identified three sets of pedagogical practices for making space, which will be articulated in Chapter Five. Table 3-12 describes the three sets and uses practices from Table 3-8 as examples of each.

Table 3-12. Identifying sets of pedagogical practices: examples from programs facilitated by Ms. A

Sets of pedagogical practices	Describing each set drawing on the tenets of rightful presence	Example practices
Educator-designed space making	• **Tenet 1:** Educators support and amplify youths' reauthoring rights by *designing* ISL opportunities that youths find relevant to their lived experiences, knowledge, and	• Before the emergence of the moment in which Ivy and Rose (YAC) sang 'Let It Go', Ms. A enacted practices such as

Table 3-12 (cont'd)

Educator-designed space making	expertise, *facilitating* youths' agentic participation; and *publicizing* youths' ideas and expertise exhibited through ISL.	• *Designing:* Planning to engage youths in makers' projects that youths design, prototype, and propose as activities potentially usable in the science center STEM programs • *Facilitating:* Making sure to support youths' maker projects with abundant materials and resources • *Publicizing:* Offering times for youths to share their design ideas and offer comments to one another
Taking-up youths' disruption and reorganizing ISL opportunities with youths	• **Tenet 1:** Educators support and amplify youths' reauthoring rights through ISL by *recognizing youths' disruption* of institutional narratives, including educator-designed activities; *affirming youths' disruption*; and *soliciting youth-led reorganization* of ISL opportunities. • **Tenet 3:** Enacting this type of practices helped disrupt power relationalities among ISL community members as youths were positioned as legitimate critics and reorganizers of ISL opportunities. • **Tenet 2:** Some educators enacted this type of practices so that they could amplify youths seeking to make visible (in)justices through critiquing and reorganizing ISL opportunities.	• In response to the moment in which Amir critiqued the interrogative questions his peers and Ms. A were brainstorming, Ms. A enacted practices such as: • *Recognizing disruption*: Acknowledging that she was not aware of how the interrogative questions that were being made could be biased • *Affirming disruption*: validating Amir's critique and acknowledging the assumption; Revising educator prompts facilitating the interrogation activity for the following sessions, drawing on her reflection of the day • *Soliciting youth-led reorganization* of ISL: Asking Amir and other youths how to improve the interrogative questions they made
Co-creating new ISL opportunities with youths	• **Tenet 1:** Educators support and amplify youths' reauthoring rights through ISL by *recognizing* and *affirming youths' critique and imagination* of new ISL and *soliciting for* youth-led design and actualization of ISL that matters to them.	• In response to the moment in which Monica, Cassie, & Chloe, (Mash-up Forensics) improvised a role play, Ms. A enacted practices such as: • *Recognizing the new ISL opportunity youths suggest*: Verbally stating the powerful message of the role play

Table 3-12 (cont'd)

Co-creating new ISL opportunities with youths	• **Tenet 3:** Enacting this type of practices helped disrupt power relationalities among ISL community members because youths were positioned as legitimate constructors of ISL opportunities • **Tenet 2:** Some educators enacted this type of practices so that they could amplify youths seeking to make visible (in)justices through creating new ISL opportunities.	• *Affirming the new ISL opportunity youths suggest*: Opening up discussion about fair judicial decision making and the use of forensic evidence in doing so; Incorporating the scenario-based activity for the following Forensic sessions, drawing on her reflection of the day • *Soliciting youth-led co-creation of ISL*: Facilitating other youth's participation in the role play

Limitations

Concluding this chapter, I note some limitations of this study mainly regarding the relationalities of RPP partners and data generation. Although our RPP project is grounded in politicized trust and solidarity, RPP partners may have still encountered tensions about how and the extent to which they should share their experiences with me and other researchers. Moreover, there were a small number of instances in which I was not able to communicate directly with the youths involved in a given moment (for example, the youths did not consent). In such instances, I could only infer youth's actions/interactions from the perspective of their educators. Also, I was not physically present for some of the moments. While the RPP project allowed me to access the data and other RPP partners' documents, my understanding of the secondhand moments is inevitably limited. Furthermore, some important moments were not recorded because they took place spontaneously, were identified retrospectively, or because visual recordings were limited due to unconsented youth. While acknowledging these limitations, I note that the methodological approach of this study helped me mitigate these limitations. By utilizing the rich set of data

generated from multiple participants, I kept engaged in cautious analysis and interpretation of the moments and practices through consultation with RPP educators and researchers.

Institutional Review Board

This study is part of a larger study conducted as an RPP aimed at identifying and enacting pedagogical practices in support of equitable informal STEM learning for minoritized youths (National Science Foundation DRL grant 2016707/1647033, 2017 to 2021). RPP partner youths' and educators' participation in this project was voluntary. They were assured of their right to withdraw from the study at any time without consequence or to refuse to comment or answer any questions during their participation. Participants selected their own pseudonyms to protect their identities, and their institutions were de-identified. Raw data remain confidential and were (and will be) only shared with researchers in the larger project.

Chapter Four. Youth-Initiated Moments Making Visible Bids for Rightful Presence

This chapter answers the first research question: *How do youths make visible their bids for rightful presence in ISL through "youth-initiated" moments of disruption and transformation?* Across the six ISL programs in this study, fifty-six moments were identified as youth-initiated (see Appendix E). Initial identification of youth-initiated moments took place as youth, educator, and researcher partners participated in open coding moments during reflective conversations (analysis phase 1). We considered moments to be youth-initiated when they were salient because youths' actions called for shifts in (i.e., making explicit, disrupting, and/or transforming) institutional narratives (including discourse, practices, physical representations, and power relationalities youths would experience and observe as they engaged in ISL programs and activities).

Drawing on the iterative analysis of what makes moments youth-initiated (analysis phase 2), I identified *three features that constitute each of the moments*: youths' actions of disruption and transformation, educator and peer responses to the actions, and bids for rightful presence. As youths initiated moments with actions of disruption and transformation and their educators and peers responded to those actions, different bids for rightful presence were made visible.

Drawing on the different ways in which features manifested in the moments, I further identified *three types of moments* (analysis phase 3): 1) reorganizing physical and social representations within the learning space; 2) creating activities that matter to youths; and 3) foregrounding the sociopolitical dimension of learning. These types show how institutional narratives represented by physical and social, activities in ISL programs, and discourse about learning, respectively, were exposed by youths' actions, and how youths were able to work with peers and educators toward reorganizing the narratives and creating and foregrounding new ones.

In what follows, I first describe each of the three types by using a set of example youth-initiated moments. I then further articulate how the three features constituting each youth-initiated moment (i.e., youths' actions, educators' and peers' responses, and bids for rightful presence) across the three types of moments.

How youths initiated the moments

In this section, I describe three types of youth-initiated moments in which youths sought to:

1. reorganize physical and social representation within the learning space,

2. create activities that matter to youth, and

3. foreground the sociopolitical dimension of learning.

I explain and warrant each type with a set of example youth-initiated moments: one moment with features illustrated in detail and two or three additional less detailed moments to further support each type.

First type of youth-initiated moment: Reorganizing social and physical representations within the learning space

Twenty of the 56 moments (see Appendix E) involved youths taking actions that made visible their desire for a more rightful presence, calling for shifts in physical and social representations of their learning spaces. The physical representation and organization of space shape and are shaped by social interactions and relationalities in the space (Massey, 2013; Soja, 2010). In this type, youths sought shifts in institutional narratives about what the physical and social representation would look like (e.g., which layout of furniture would make youths feel included, where youths have their group works and how they can move around, where educators and youths usually sit in the room and how they interact across the seats). Youths reorganized the physical and social representations with their peers and educators, which fostered their

rightful presence in the learning spaces. To illustrate this type, I explore in detail a moment that involves a youth, Louise, and her peers and the educator Ms. M. I then describe three more moments to further exemplify this type of youth-initiated moments.

Illustrative moment: "Feeling Included."

To illustrate this type, I describe in-depth one moment from the STEM Club, where Louise initiated a shift in the physical representation of the room by rearranging furniture to create a place for circle time, a daily activity of discussion and community building. In this illustration, I attend to how the three features constituting this youth-initiated moment were presented. During circle time, Louise moved to and laid herself on a red couch at a corner of the room, claiming the red couch as a space where she felt included and was able to be herself (feature 1, Louise's action initiating the moment). Louise's action led her peers and the educator, Ms. M, to amplify Louise's imagination of a space where youths want to belong by immediately rearranging furniture in the room so that they could sit on and around the red couch (feature 2, peers' and Ms. M's response to Louise's action). Following the shift in the physical representation of their learning space, Louise, her peers, and Ms. M further publicized transformative discourse about whose expertise and knowledge counted in their STEM club (feature 3, bids for rightful presence made visible by Louise and her peers). In the following sub-sections, I further elaborate on each of these features.

How Louise initiated the moment with an action of disruption and transformation. This moment took place during the STEM Club's circle time, when youths and educators engage in a dialogue about STEM Club experiences. During circle time, all of the club members sit together at the beginning and end of each session, and any member is welcome to take the lead. Youths and educators recognize one another's progress, share knowledge generated, and discuss

problems identified during the making process. They solidify and expand relationships by sharing one another's daily experiences and emotions and by making important decisions and actions for the community. Circle time is also used for youths and educators alike to create, plan, and revise programs and activities.

During circle time one day, Ms. M asked, "What helps you to feel included or excluded here?" Louise immediately got up from her chair and moved to the red couch in the corner of the room, which was surprising to Ms. M because Louise during previous circle times had mostly been a listener and, if she spoke, she made it briefly. Louise's apparent body move captured everyone's attention. I view her move as an action that initiated a moment expanding the space allowable for the community members' circle time.

As she moved her body toward the red couch, Louise called attention to her desire for more humanizing space by proclaiming how she felt included on the red couch. She said she "could be myself" as she sat on the red couch, which was different from school where she felt like someone "no one liked in my classroom." Louise's statement was immediately greeted by agreement from her peers. For example, her peers shared that the red couch was "their space," "more like home," and "not like school" and that "it was the kids' idea to have a couch in here." I infer these statements to be descriptions of the type of ISL spaces where the youths wanted to be.

Educator and peer responses. Ms. M had been aware that the youths loved the couch but had not previously considered how it might be important to physically and explicitly include the couch in club activities, such as circle time. During the reflective conversation that took place after this Louise-initiated moment, Ms. M stated:

[I] thought about the red couch as a place the youths enjoyed, to take a break, or just

enjoy themselves. I thought about it as a part of our room but not as centrally a part of our

STEM activity together.

Through Louise's idea and bodily movement, Ms. M had an opportunity to better understand

how and why the red couch symbolized youths' belonging in the space. She further reflected:

That moment when Louise got up and stretched her body onto the couch, hugged

herself, and said "this is when I feel included," I began to see the youth's yearning

for a place that did reflect home. A place that welcomed them for who they are as

young people, who've just spent 8+ hours in school being quiet, sitting in chairs.

They were, in part, asking to be realized for their desire to just be. However, I think

the red couch also symbolized a more powerful message of what it meant to fully

welcome young people in our space together.

Ms. M's reflection on the red couch suggests that the youths experience the culture of schooling

in ways that may make them feel excluded and constrained. She considered Louise's and her

peers' ownership of the red couch and feelings of inclusion when sitting on it to be a critical

message about how youths want to be present and welcomed in their learning spaces.

Drawing on her noticing of the critical message relayed by the youths, Ms. M asked if

they wanted to rearrange the room to reorient their circle time, physically, around the couch. She

stood back as the youths moved the furniture around, asking if they needed help and what they

would like her to do. In less than 10 minutes, the couch was moved from the corner to the middle

of the wall. Chairs were placed around the couch to complete the circle. From then on, the couch

has served as the organizing point of their circle time.

Bids for rightful presence. Louise's movement to the red couch and subsequent rearrangement of the room with peers and Ms. M fostered dialogue that made visible the youths' bid for rightful presence of building a humanizing community where youths' lived knowledge and experiences are legitimized. Immediately after the room was re-arranged, youths crammed onto the couch, and youths who didn't fit onto the couch stretched across the floor, with only a couple of youths electing to sit in the chairs (see Figures 4-1). More playful spontaneous moments emerged, such as four of the girls using each other as pillows to take a short and giggle-filled rest. As youths re-arranged their bodies in the space, they shifted how they related not only to each other but also to the space itself.

Figure 4-1 Youths on the red couch in STEM Club of community center

When Ms. M re-started the conversation about how youths felt included, Louise, who was now leaning back on the red couch and swinging her legs back and forth, narrated a past moment in which Ms. M's pedagogical move positioned Louise as an expert with knowledge of sewing she learned from her auntie at home; this pedagogical move helped Louise to make new friends in the STEM club. As she stated with authority:

> I remember last week when you [Ms. M] asked if anyone knew how to sew? I raised
> my hand and other kids did, too. You said, "Look around and see everyone with their
> hands up? They are experts at sewing and can help us today." That made me feel

included because it was important and felt good. My Auntie taught me how to sew,

and when I could help others I got to know them better and make new friends.

Louise explained that it was important for educators to ask about youths' experiences and

expertise, which I view made explicit her bid for rightful presence through the legitimization of

youths' experiences and expertise into ISL. She was proud that she could share knowledge of

sewing that she learned from her auntie and of how that helped her to build new relationships.

Resonating with Louise's story, other youths shared moments when they discovered their peers'

and their own expertise in making and the joy and feeling of solidarity.

This moment illustrates how one youth, Louise, initiated a shift in the physical

representation of the STEM Club space, following which youths engaged in a dialogue making

explicit their bids for rightful presence. Louise's action of moving her body toward the red couch

was symbolic of youths' desires to not only be themselves but to have ownership of the space. In

the shifted space, the discourse unfolded in ways that publicized youths' ideas about what it

looked like to be a maker (i.e., youths themselves who bring knowledge from home) and what

expertise mattered (e.g., Louise's sewing learned from her Auntie).

Furthermore, the red couch has become a place that represents youths' legitimate

belonging in the STEM club. Louise's reflection a year later acknowledges how the physical

arrangement of the room around the red couch was sustained to make the room youths' place:

> We moved the couch over here when Ms. M was asking us about feeling included. It was
>
> like "duh" of course we'll move the couch. The couch is special. It's that place where
>
> anyone can go to just take a break from it, from anything, from [our STEM Club], from
>
> other kids, or from life. It's like the couch, well the carpet too, is our place.

Because Louise took the action of moving her body to the red couch, and her peers and educator immediately re-arranged the room, the already-present red couch became much more visible as evidence of youth's rightful being and becoming in their STEM Club, as their "special" "our place" "where anyone can go."

Since the moment Louise initiated, the red couch has been a 'youths' place' in different ways. It has offered a place of flattening power when youths want to work with adult mentors (Figures 4-2 and 4-3). In this way, educators are not towering over youths, or sitting at tables or desks, which may feel more like school. The red couch also offers a place for youths to work through challenges they encounter during their STEM projects as they let go of the frustrations coming from their challenges by putting themselves in relaxed and comfortable postures (Figure 4-4).

Figure 4-2 Youth and educator brainstorming design ideas on the red couch

Figure 4-3 Youths leading a group discussion sitting on and around the red couch

Figure 4-4 Youths working through STEM projects as a pair

Additional moments of reorganizing social and spatial representations within the learning space

Across the nineteen moments of this type, including Louise's moment described above, youths actively shifted social and physical representations in efforts to make their lived experiences, knowledge, and emotions, at the center of their ISL experiences. To further exemplify this type, I introduce three additional moments: Ivy and Rose singing "Let It Go" in a YAC summer camp, Bella and Jazmyn moving out of the YAC room to create a girl-only space for working on their feminine hygiene project, and Benson and his peers moving to Chill Zone during a Forensic program.

Ivy and Rose singing "Let It Go." Two youths, Ivy and Rose, singing "Let It Go" during one day of YAC summer camp is an example of how youths initiated moments seeking a shift in social representation (see Table 4-1). Ivy and Rose initiated the moment by spontaneously singing a song, "Let It Go" (from the Disney movie, *Frozen*), performing and moving their bodies. In a later reflection, Ivy said this song was playing in her "head because the project was just kinda hard." Ms. A, who was facilitating the camp, immediately responded to the spontaneous singing by playing the song from her phone. She wished to express that she was

aware of escalating frustration youths expressed with sighs or crying and that she was there with the youths to support them to work through the challenges in making. Other youths and educators joined in singing the verses together loudly, with passion, and with lots of laughter and smiles. STEM work tables were pushed aside as youths and educators symbolically pushed aside the momentary frustrations of project work. This collective action was crucial at the moment as it shifted the momentary frustration when encountering challenging parts of STEM projects. This spontaneous choir made explicit their rightful presence by expressing and sharing emotions together as a community and cheering up one another to realize their imagined STEM project.

Bella and Jazmyn moving out of the YAC room to create a girl-only space for fostering their feminine hygiene project. This moment, also identified from the YAC summer camp, is an example of youths shifting social and physical representations by moving their project ideas and materials out of the room to create a safer space, fostering their engagement in activities or projects (Table 4-1). During their group STEM project work time, Bella and Jazmyn asked Ms. O if they could move their work on feminine hygiene justice for youths of Color outside of their YAC room. The youths wanted to record testimonials without the worry of interference by boys. Ms. O not only encouraged this idea but also secured an independent space for Bella and Jazmyn to more actively undertake the project. As Bella explained, "We just wanted our own space to work without boys laughing." To the girls, "it's not fair that it is made to be an embarrassing issue to talk about." Seeking an independent and protected space was a disruptive and transformative action that made explicit youths' bids for rightful presence by making their lived experiences of feminine hygiene concerns at the center of their STEM projects.

Benson and his peers moving to Chill Zone during a Forensic program. Another

example of youths' moving into a safe and comfortable space to facilitate their activity occurred

in a moment Benson initiated during a Forensic program (see Table 7, Moment 4). After a mock

crime scene investigation activity facilitated by Mr. C, Benson broke the awkward silence in his

group when Mr. C asked youths to reason from evidence that was gathered from a mock crime

scene. Without asking Mr. C's permission, Benson suggested that his group move to the Chill

Zone in the corner of the room. The Chill Zone was a space open for youths to go for different

reasons, such as when they wanted free time, when they wanted to engage in making projects

without others' interruption, or when they wanted to release stress or emotions. As Benson and

his group members moved to the Chill Zone, they looked more animated and comfortable

expressing their ideas during the discussion. They spoke actively as they stood up, stretched their

bodies, and invited Mr. C as a guest to their now vigorous discussion. A shift in the space for

discussion made explicit their bid for rightful presence through an ISL community in which they

could more comfortably and actively engage in discussion.

Second type of youth-initiated moment. Creating activities that matter to youths

Seventeen of the 56 moments involved youths taking actions that created learning

activities that mattered to them by introducing new roles and associated discourses (see

Appendix E). In this type, youths sought shifts in institutional narratives about what counts as

activities for ISL and who designs and enacts them. As youths engaged in activities that their

educators designed and implemented, youths created new activities that mattered to them,

making visible their bids for rightful presence as owners and creators of their ISL experiences.

To illustrate this type, I explore in detail a moment that involves three youths (Monica, Cassie,

and Chloe), their educator (Ms. A) , and peers (see Figures 3-1 and 3-2 for the postcard of this

moment). I then describe three more moments to further illustrate this type.

Illustrative moment: "I AM HER LAWYER! Show Me the Evidence!"

To describe this type, I focus in-depth on one youth-initiated moment that emerged from one of the Mash-up Forensic program sessions. In this illustration, I attend to how the three features constituting this youth-initiated moment were presented. During a fingerprinting activity, three Black girls (Monica, Cassie, and Chloe) initiated an impromptu courtroom role play by using fingerprints as evidence in an imaginary court case (feature 1, the youths' interactions initiating the moment). In response, their educator Ms. A engaged youths in discussing the message of the impromptu role play and why it mattered with respect to racial justice in the study and use of forensic science in the real world (feature 2, educator and peer response). Following the discussion, all of the youths resumed the role play, volunteering for different roles to ensure fair judicial decisions in the imaginary court case (feature 3, bids for rightful presence made visible by three girls and their peers).

How Monica, Cassie, and Chloe initiated the moment with actions of disruption and transformation. This moment took place during a Mash-up Forensic session in the community center taught by Ms. A, who was visiting from the neighboring science center as a part of our RPP-based inter-institutional collaborative. During a fingerprinting activity, Monica and Cassie lifted each other's fingerprints onto their FBI fingerprint cards. After completing this task, Monica, who was looking at Cassie's fingerprint card, suddenly moved to the tool station at the corner of the room. She brought a mallet to her table and pounded it three times on the desk as if it were a gavel. She then stated loudly and playfully, waving Cassie's fingerprint card at her face: "I am a judge. Cassie, you are guilty! We saw your fingerprints at the crime scene." With this statement, Monica initiated an improvised courtroom role play by performing as a judge who she

thought would use the fingerprint card in making judicial decisions. Monica's role play showed one way that youths sought to relate the ISL learning activity and its product (fingerprint card) to real world practices.

Cassie joined, also playfully at first, the courtroom scene Monica had initiated. Cassie added a storyline to defend her innocence saying, "No, I am not. I have a lot of my fingerprints there because that [the imaginary crime scene] is my room, and I don't know what happened there." Monica kept calling Cassie guilty although Cassie made a reasonable defense. As Cassie was becoming increasingly upset, another youth, Chloe, walked toward Monica, and the following conversation ensued:

Chloe: You cannot say she is guilty. I am her lawyer. Show me EVIDENCE.

Monica: She had a lot of fingerprints in the crime scene.

Cassie: Hey, that was my room so I have many many fingerprints of mine!

Monica: And, and, and, you know, she has her crime history you do not know but I know. And….

Chloe: Things only you know can't be evidence. That is what you are just saying to make it. We need evidence. Before then, you can't tell she is guilty.

Chloe embodied the role of a lawyer in support of Cassie and required Monica to present evidence as grounds for judgment. When Chloe told Monica "that's just what you are saying," she asserted that a claim alone was not trustworthy but required evidence to support it. This assertion implies that without evidence, claims in court are tentative regardless of who argues the claims.

The courtroom role play, improvised by three youths' interactions, is an example of how youths could create an activity that mattered in the moment beyond participating in educator-

designed activities. In this moment, Monica initiated the role play as she was engaging in the fingerprinting activity Ms. A was facilitating. The role play became important to at first Monica, Cassie, and Chloe and then to other youths because it offered a way youths could experience real world contexts in which fingerprints would be used, which led to a discussion of what makes evidence trustworthy. As the tension escalated in the role play, Ms. A joined, as described in what follows.

Educator and peer responses. As the three youths' role play unfolded, other youths and Ms. A began to notice what was happening. Ms. A, as she later reflected, was at first hesitant about how to respond, because she was planning another activity: comparing each other's fingerprints and identifying patterns of fingerprint ridges. However, she recognized the significance of the role play. She paused the fingerprinting activity, seeking to use the moment to engage youths in critical dialogue on what it meant to make careful evidence-based decisions, how forensic investigation would support fair judicial decisions especially when the science of forensics is racialized, and why paying attention to these concerns was important in determining someone's guilt or innocence. Youths also asked about what precisely happens in the courtroom. Ms. A described multiple actors, roles, and processes around a courtroom scene, referencing the role play that Monica, Cassie, and Chloe had presented.

The conversation motivated youths to discuss different roles they could imagine, such as witnesses, jurors, and court officials, and what people in those roles might say or do. Here we observed Ms A centering the fears, and concerns of the youths of Color by recognizing the tensions present at the center of the girls' roleplay. In pausing that moment to talk in more detail about what it meant to use scientific evidence in a trial, including how the process is political, and in expanding the roleplay to include all youths as jury members and courtroom visitors, Ms.

A legitimized Cassie and Chloe's efforts to reposition the activity as an exploration of socioscientific justice and forensics.

After listening and recording students ideas, questions, concerns and opinions, Ms. A helped the youth organize around a courtroom scene, where all of the youth were involved as either witnesses or members of the jury. When the role play resumed as a whole-class activity. Other peers amplified Chloe's resistance to the alleged judicial authority performed by Monica. For example, one youth joined in support of Cassie, as "Cassie's neighbor" who could attest to her alibi. Another jumped in explaining they were a juror and wished to see the full evidence. With her allies, Cassie became more engaged (e.g., jumping up, strengthening her physical stance and immediately becoming more vocal) as she stated her alibi out loud.

Bids for rightful presence. How youths participated in the role play made explicit their bids for rightful presence as they sought shifts that would help humanize their learning community through naming and working against injustices displayed in the role play. The roles Monica and Cassie played exhibited the tension between a judge exerting power to unduly accuse someone and a defendant resisting the accusation. Recognizing and responding to the escalating tension, Chloe and other youths participated in the role play as allies of a person who seemed falsely accused. Chloe positioned herself as a lawyer who defended Cassie and required Monica to present evidence reliably supporting her claim of Cassie's guilt. Following the dialogue with Ms. A and peers, all of the youths took varying roles to keep the judge's claim in check and prevent a false accusation.

Furthermore, I conjecture the criticality of this moment is related to the racially discriminatory real world context in which the youths, all of whom are Black, live. Although Monica performed judicial injustice in a vivid and visceral matter, she did so in a playful and

low-risk way. She embodied a judge who exaggerated the authority to accuse a person without sound evidence, by repeatedly saying to Cassie and Chloe, "This is what judges do. They say and they're right." Monica embodied what she recognized as an unjust narrative of judges who may wield excessive authority in making judicial decisions biased against people of Color like themselves. Her performance reflected the vast racial disparities in incarceration for the same crimes committed by whites versus people of Color (Dumont et al., 2013). This may have prompted Chloe's and other youths' participation in the role play, in which they made explicit collective resistance against the performed injustice (not necessarily against Monica).

Additional moments of creating activities that matter to youths

Across the twenty moments of this type, including the one described above, youths sought shifts in institutional narratives about what counts as ISL activities by creating new activities that drew on and centered youths' own interests, curiosity, knowledge, and culture. To further exemplify this type, I introduce two moments: Louise and Chloe leading an investigation of images made in pinhole cameras and ReRe creating rap verses.

Louise and Chloe leading an investigation of images made in pinhole cameras. This moment is an example of how youths created new activities, often by drawing on their curiosity and interests to extend the educator-designed activities they were participating in (Table 4-1). During a STEM Summer Camp, in which I participated as an educator, Louise and Chloe spontaneously extended the activity I was facilitating for them to make their own pinhole cameras. As they excitedly looked around through their pinhole cameras, they posed questions about why images appear upside down and how the image would appear if they looked into the pinhole camera with an upside-down pose.

Without waiting for my explanation, Louise and Chloe proposed their own hypotheses and moved their bodies to test them out, which I consider their exercise of rightful presence as legitimate creators of ISL activities that center their curiosity and ideas. As the girls were good at flexibly moving their bodies, they tried doing backbends to investigate what happened to the image when viewed from this upside-down posture. Louise's and Chloe's moves prompted other youths and Ms. M, another educator, to follow suit. Louise, Chloe, and peers then expanded to experiment on what would affect the formation of different images on the wax paper inside the camera. They considered multiple variables such as how to view the image (e.g., upside down), the amount of light in the vicinity, the size of the aperture, and the distance between the camera and object.

ReRe creating rap lines. As ReRe's moment exemplifies (Table 4-1), creating new activities often took place as youths and educators engaged in dialogues about their experiences in the ISL program, their lives, and real world issues. During a STEM Club, the educator Ms. R was leading a discussion to facilitate a making project for creating a sustainable community. As youths brainstormed their ideas about which making projects would be needed for their local community, ReRe called out a few rap lines about experiences of racial injustice. ReRe read rap lines she had recorded on a piece of paper:

Stop giving people lead poisoning

Stop tryna build a wall

Before we all fall

You know folx can build a ladder

Trump you smell like bladder

You don't even matter

Other youths immediately responded to ReRe's rap by nodding and throwing some beats. After sharing the rap line, ReRe said that she had started composing it at home as she watched news about politics. ReRe was a youth who had constantly talked about music. She showed off different beats using a pen on the table and spent time across many sessions teaching these beats to her peers and to Ms. M, who enjoyed learning from her. In this moment, ReRe was showcasing one of the rap lines she created.

Ms. R recognized the importance of music and rap writing to ReRe and asked ReRe to perform the whole rap. ReRe, although she had expressed her passion and expertise in rap, seemed embarrassed to do so at first. Then, Ms. R performed the rap, and ReRe and other youths cheered Ms. R on and moved their bodies with the rap she was making. Shortly afterwards, the youths and Ms. R collaboratively authored a rap of several stanzas. As other youths further joined in continuing and exchanging rap verses, the STEM Club room floor became a stage for showcasing their expertise in rap as well as voicing critical messages about climate and environmental justice. In this moment, youths' rightful presence was made explicit with educator's and peers' amplification. They created rap verses with youths' playful and joyful vibes, yet with critical awareness of justice and community sustainability that they wanted to amplify as important aspect of their project.

Third type of youth-initiated moment. Foregrounding the sociopolitical dimension of learning

Nineteen of the 56 moments involved youths taking actions that foregrounded the sociopolitical dimension of learning (See Appendix E). By this, I refer to youths seeking to critique and question institutional narratives that have depicted STEM learning as apolitical, acultural, and neutral. While I consider that *all* of the youth-initiated moments foreground the

sociopolitical dimension with youths' actions to disrupt and transform institutional narratives, the moments falling under this type highlight further the sociopolitical dimension as youths critiqued STEM, society, and their experiences within them.

While there were moments in which community members immediately took up and amplified youth-initiated actions to foreground sociopolitical dimensions of learning, youths actions were not always taken up by educators. I first illustrate a moment that reflects the latter, involving a youth Amir and the educator Mr. E in the science center's Forensics program. I then describe two moments to exemplify how youths' actions that foregrounded sociopolitical dimensions of learning were taken up by their educators.

Illustrative moment: "Unless You're Black."

I illustrate in-depth a youth-initiated moment that took place after a DNA extraction activity in a Forensics program, by attending to how the three features constituting this moment presented. When Mr. E emphasized the importance of forensic evidence for making fair judicial decisions, Amir complicated Mr. E's point by highlighting to how racial discrimination could interfere with a fair decision (feature 1, Amir's action of disruption and transformation initiating the moment). While Mr. E was concerned about Amir's statement, viewing it as political and thus not permissible to be discussed in the science center (feature 2, educator response), he also recognized as powerful Amir's wanting to raise awareness of racial injustice in society (feature 3, Amir's bids for rightful presence) and wanted to learn how to better respond to moments like this in the future.

How Amir initiated the moment with an action of disruption and transformation. While concluding the DNA extraction activity, Mr. E was explaining the importance of gathering and analyzing evidence like DNA in order to accurately identify criminals and avoid false

convictions. Amir interrupted immediately, speaking out "Unless you're Black! If you're Black, you'll be convicted." I view this as Amir's action of disruption, with which he complicated Mr. E's statement by highlighting the sociopolitical aspect of real world instances in which racialized discrimination may operate against fair judicial decisions.

Educator response. Mr. E paused for a second after Amir's statement and then responded in a caring voice, "I like the passion in that statement, but let's make sure we talk about that somewhere else, other than this classroom, at the moment. If you want to talk about that later, we absolutely can." Amir nodded his head without verbally responding to Mr. E. For the rest of the hour, Amir completed his work as expected, with animation and rigor. However, he did not talk to Mr. E about this topic later.

At the end of the week, when I talked with Amir for a reflective conversation, he recalled this moment with a shrug and said "Ah… No, it is ok. He [Mr. A] was right. He said the right thing." This short response left me with the impression that Amir may already have internalized ("he said the right thing") or passively accepted Mr. A's view that the science learning space is apolitical. However, in the hope he would get to know there was a person who took up his statement in a different way, I thanked him for his words, told him that I kept mulling over them, and asked how we could participate in undoing the racial discrimination as individuals who experience and observe racial discrimination that may interfere with making fair judicial decisions drawn from trustworthy forensic evidence. He nodded with a smile and said, looking straight at me, "I actually want to be a forensic investigator who can be helpful when people of Color were falsely accused." He then moved on to pointing out other activities that interested him regarding his dream.

During a reflective conversation with Mr. E, he pointed to this moment as the most salient and challenging to him on that day. While Mr. E knew, at the time, that this moment was important, he elected to not engage with Amir's idea as part of the classroom activity. He reflected that this moment hit him "really quick[ly] because it's a very powerful thing to say." He also noted that talking about race was "challenging" to do "in front of a whole group of students, when all these students come from different backgrounds." He remembered that he "gave Amir a smile. I didn't want him to think what he said was wrong." Mr. A further explained that he thought Amir understood, from their exchange, that science class was "not a place to bring up politics."

As further described below, Mr. E, as he wanted to learn how to better respond in the future to moments similar to this, brought this to our RPP meeting of educators and researchers. When Mr. E and I shared this moment with other researchers and educators (including the science center director who once was an educator), they empathized with both Amir and Mr. E. They acknowledged that this moment could be challenging to any educator who may have not been encouraged to discuss, name, and center the sociopolitical dimension of learning and society. They agreed that an institution-level effort was necessary to reconsider the discourse of the science center, in particular, and ISL spaces, in general.

Bids for rightful presence. Amir's interruption of the educator's statement suggests his bid for rightful presence. He sought shifts that would provide ISL opportunities to name racial discrimination that may interfere with fair judicial decisions drawing on forensics evidence. However, this moment exposed a tension between a youth's bid for rightful presence through naming racial discrimination and an educator's beliefs about what discourse belongs in a science learning space. Mr. E, who worked hard to offer high quality disciplinary learning, welcomed

95

youths, including Amir, and provided them with access and opportunities for deep disciplinary

engagement. However, he was unwilling, in the moment, to engage with Amir's statement that

seemed to manifest the political struggle of being Black in the white-dominated spaces of the

criminal (in)justice system. As Amir's statement was sidelined, his bid for rightful presence by

naming injustices was invalidated in this moment; reflecting on this, Mr. E wanted to hear how

to better respond to such moments in the future.

Additional moments of foregrounding the sociopolitical dimension of learning

Across the seventeen moments of this type, including Amir's moment described above, youths

took actions that foregrounded the sociopolitical dimension of learning by critiquing STEM and

society and their experiences within it. To further exemplify this type, I introduce two moments:

Su'Zanne creating a new role of mentor-in-training-in-training and William's fanny pack.

     Su'Zanne creating a new role of mentors-in-training-in-training. Su'Zanne's moment

of creating a new role of mentors-in-training-in-training (see Table 4-1) is an example of youths

foregrounding the sociopolitical dimension of learning by critiquing discourse in the learning

spaces. During a circle time in the STEM Camp that I joined as an educator, youths were talking

about the system of becoming youth mentors in the STEM Club. Youths were considered

eligible to become mentors in the 9th grade by undergoing a training phase in the 8th grade, what

youths called the phase of mentors-in-training. Su'Zanne, a 7th grader, critiqued the system,

noting that she had been in the STEM Club since 5th grade and "knew a lot more than some of

the mentors" who had been in the program for fewer years. She was upset that she was

considered "too young" to be a mentor-in-training. She then created a role of a mentor-in-

training-in-training and declared that name to officialize it. Positioning herself and her peers in

this newly created role fostered new opportunities to showcase different kinds of expertise in the camp and to make present youths' bid for legitimizing their expertise.

William's fanny pack. Foregrounding the sociopolitical dimension of learning took place as youths sought to make their STEM learning activities to address the issues they experienced in daily lives, as William's moment exemplifies (see Table 4-1). During an e-textile activity in the STEM Club program, Ms. M was facilitating youths to make bookmarks with conductible threads, needles, and LEDs. William initially worked enthusiastically on creating a rocket-themed bookmark with colorful felt, LEDs and other materials. As he deftly threaded a needle with conductible threads and made a knot, he smiled and told everyone around him, "My grandma taught me." However, before finishing his bookmark, William threw down his e-textile bookmark project while yelling to everyone and no one, "This is stupid. I'm going to make a fanny pack!"

Ms. M, however, was unsure of what was troubling William in the activity. During the reflective conversation after the day, Ms. M recalled the moment:

> William seemed so upset. I could see he was so proud of his ability to sew and yet how he sewed the bookmark caused the circuit to short. I was feeling really bad like I set this moment up for his expression of pride in his sewing to cause this problem. I wasn't sure what to do, and I wanted him to have success. When he suggested a fanny pack, I was even more worried that it would just be that much more difficult a task, but I thought it might give him a fresh start on digging into e-textiles. What I didn't realize was how much the shift in design focus related to what had happened at school that day until the conversation about lunch money unfolded as the youth

began work on their fanny packs. It was about sewing, and short circuits, but it was

also about what was worth working through and why [on that particular day].

Ms. M thought he was upset that his conductive thread was crisscrossed causing a short circuit.

Not knowing immediately how to help him, Ms. M asked William why he thought the bookmark

activity stupid.

William critiqued the bookmark activity stating that "it wasn't useful." He then said a

fanny pack would be "more useful" because he could put his money and other prized items in it.

He could keep it on his body to prevent it from being stolen. He could put the light inside to help

him see what was there, and the ugly stitching wouldn't matter as much. William indicated that

he already had his idea and knew exactly what he wanted to do. He went to the bin of felt,

grabbed two yellow pieces, and started cutting half-moon shapes for the sides of his fanny pack.

Although, to Ms. M, making a fanny pack didn't seem easier than making a bookmark, William

patiently worked through the fanny pack's design challenge.

As William and a few other youths began making fanny packs, they talked about an

incident in the school lunchroom that day. One girl noted that "Jayla's purse got stolen" and

another girl replied, "You mean her money got stolen." They expressed concerns about the

difficulty of keeping belongings safely at school and in getting them back when lost. William

then added, "and that's why you gotta have a fanny pack." William devised the idea of making

fanny packs so that he and his peers keep important belongings safely at school. Listening to

what happened earlier on that day, it became clearer to Ms. M why making a fanny pack

mattered to William, which motivated William to bear the design challenge. Making a fanny

pack (shifted from the activity of making a book mark) became a personally and communally

meaningful activity such that William willingly worked through the design challenge.

How youth-initiated moments make visible bids for rightful presence

The sections above described three types of moments in which youths initiated shifts in institutional narratives. While youth-initiated moments differed from one another, they shared common features: youths' actions of disruption and transformation, educator and peer responses, and bids for rightful presence. In this section, I further examine the three features and how they collectively made visible bids for rightful presence by referring back to the moments illustrated above.

Feature 1. Actions of disruption and transformation

In youth-initiated moments, youths sought shifts in institutional narratives (discourse, practices, power relationalities, and physical presentations) by *taking actions of disruption and transformation*. These actions introduced new roles and discourses to their ISL opportunities and new norms and expectations to their learning communities. I view these actions as manifestations of youths' political struggles toward rightful presence. They exercised their power to introduce new roles, discourses, and norms and expectations in the space where inst itutional narratives were established and consequently shaped discourse, practices, power relationalities, and physical representations.

Youths' actions introduced *new roles and discourses* for disrupting and transforming ISL opportunities. Introducing new roles and discourses, youths made visible different bids for rightful presence. When Chloe and other youths collectively joined the role play, youths called themselves "lawyers," "witnesses," and "jurors" to name and resist the injustice displayed in the imaginary courtroom. Using the epistemic language of evidence, they took on these roles to help their peer, Cassie, who appeared to be unfairly accused. When Su'Zanne declared she was a mentor-in-training-in-training, it was a name of a new role she invented for youths to showcase

their expertise and legitimacy. Youths used this new role to create new ISL opportunities with their educators in empowered ways. As an example of introducing new discourse, William introduced the discourse of what makes the making project 'useful.' Throwing down the bookmark he was making by following the educator's facilitation, he said it was not useful. Instead, projects were useful to him when they would help address the issues youths experienced in their daily lives as indicated by William applying e-textile knowledge and skill to make a fanny pack that he and his peers could make to keep their belongings from being stolen.

Through their actions, youths also sought to introduce *new norms and expectations* into the learning community. As youths took up space with their bodies and movement (e.g., when Louise moved her body toward the red couch), they sought to shift norms of how youths move and act in their learning space. This was also evident when youths created activities by moving their bodies freely in the room, such as Monica initiating a role play by bringing a mallet to her table and pounding it as a gavel. Furthermore, when youths sought to foreground the sociopolitical dimension of learning in some youth-initiated moments (e.g., Amir's comment highlighting racialization in judicial decision making), they sought to introduce a new expectation about discourse and practices in the STEM learning space being political and cultural.

Feature 2. Educator and peer response

Youths' actions that sought to disrupt and transform institutional narratives caught the attention of educators and peers, prompting their responses. Educator and peer responses to the youth-initiated moments were important as they either amplified or foreclosed youths' actions of disruption. In particular, educators' responses played an important role in amplifying or foreclosing youths' actions and the shifts youths sought with these actions. In the next chapter, I

100

further examine educators' responses in terms of their pedagogical practices.

In 47 out of 56 moments, educator and peer responses *worked toward amplifying* youths' efforts to disrupt and transform with their actions. For example, Ms. M recognized and took up the love youths expressed for the red couch and supported youths in bringing an immediate shift in the room's social-physical representation by moving their circle time to the red couch. Likewise, when Bella and Jazmyn asked to leave their program room to work on their feminine hygiene project, their educator Ms. O not only supported that decision but created access to a more private space at the science center that the youths might not otherwise have known about or had access to use.

In some of these 47 moments, educators said that they did not necessarily know where the moment might lead them, but they recognized the power of youths' actions and *sought to learn in the moment with the youths*. When ReRe introduced a rap in her STEM club, Ms. R opened the floor for ReRe and youths to showcase their messages via raps. Supporting youths to exchange rap verses, Ms. R and youths engaged in a new way of creating discourse. Likewise when William rejected the bookmark making activity in his STEM Club ("this is stupid!"), Ms. M was unsure of what was troubling William in the activity, so she created the space for him to re-make the activity into a fanny pack. As she heard about what happened earlier on that day at William's school, Ms. M finally learned why the fanny pack was a useful enough activity for William to work through design challenges.

In a small number of youth-initiated moments (six moments), *youths' actions were foreclosed.* Furthermore, I acknowledge that there may be more foreclosing moments that educators and researchers may have failed to recognize and report because our experiences, including those associated with race, gender, age, and socioeconomic status, would differ from

those of the youths. These differences may have made the more foreclosing moments hard to see, making us complicit in them.

When the foreclosed moments were identified and reflected on, educators noted the conflict they felt between the shifts youths sought with their actions versus personal or institutional norms and practices the educators subscribed to or prioritized. Although they foreclosed youths' actions as they subscribed to personal or institutional norms, some educators later expressed feelings of concern and regret about their responses and wonderings about how they could have responded better. In the Amir's youth-initiated moment, for example, Mr. E recognized how important Amir's comment was, but he also felt constrained by what discourse he considered was appropriate in a STEM learning space. After the moment in which he foreclosed Amir's comment, he brought the moment onto the table of our RPP meeting and his meeting with other educators to discuss "what to do" in moments like this. I see this as another form of educator response, even though Mr. E did not immediately take up and amplify Amir's action of disruption and transformation.

Feature 3. Bids for rightful presence

As youths initiated moments with actions of disruption and transformation and their educators and peers responded to these actions, different bids for rightful presence were made visible. First, youths bid for rightful presence by seeking shifts that would legitimize *their and their peers' experiences, knowledge, and culture to make ISL opportunities matter*. For example, when ReRe shared her expertise in rap writing, her peers and Ms. R legitimized it by immediately joining the rap and using the rap as a way of brainstorming ideas about creating sustainable local communities. Second, youths bid for rightful presence by seeking shifts that would *help humanize communities they shared with their peers and educators*. The moment

102

youths sang a song of "Let It Go" is an example. By singing the song together, they expressed how they legitimately belonged in the space as they collectively released the frustration of challenging project work and encouraged one another to work through the challenges. Lastly, youths bid for rightful presence by seeking shifts that would *provide ISL opportunities to name and resist injustices they experienced and observed in their daily lives and in society*. For example, as Amir learned the importance of trustworthy forensics evidence to prevent false conviction of innocent people, he also wanted to point out how racial discrimination may interfere fair judicial decisions. In doing so, he might have sought to exercise rightful presence as a creator of a discourse highlighting injustices.

These bids were displayed simultaneously in many moments. As youths sought to legitimize their lived experiences, knowledge, and culture to make ISL matter (bid 1), they worked with peers and educators toward building humanizing communities (bid 2) and/or named and resisted injustices they experienced and observed in STEM, STEM learning, and society (bid 3). For example, in Louise's youth-initiated moment, Louise and her peers made visible two bids as they reorganized furniture in the room. By sitting on and around the red couch and sharing instances of feeling included in the room, youths expressed their bid for building a humanizing community (bid 2). In the follow-up conversation, the youths also indicated their bid for rightful presence by highlighting how educators helped legitimize youths' knowledge from home as integral for ISL (bid 1). In the STEM Club, William wanted to make fanny packs as he critiqued the bookmark activity, suggesting that the STEM learning projects should be explicitly grounded in youths' lived experiences. By using expertise learned from home (bid 1), he sought to make fanny packs for himself and his peers to keep belongings from being stolen, relating to his experience earlier in the day at school (bid 2). In one session of a Mash-up Forensics program,

Chloe and other youths joined the courtroom roleplay by positioning themselves as actors who would help ensure to make fair judicial decisions (bid 3) as they defended Cassie who seemed to be unfairly accused (bid 2).

In this chapter, I described three types of youth-initiated moments in which youths sought shifts in institutional narratives and how each moment made visible bids for rightful presence through three features constituting youth-initiated moments. In the following chapter, I attend to how educators' practices may have supported these moments to emerge and amplified the bids for rightful presence made visible in the moments.

Table 4-1 Summary of youth-initiated moments

Ways youths initiated moments	Moment example (Programs) [a]	Actions of disruption and transformation	Educator and peer responses	Bids for rightful presence
Reorganizing physical and social representations within the learning space	Louise feeling included in the red couch (STEM Club)	• Louise moving toward and laying herself down on the red couch • Louise stating how and why she felt included in the red couch and in the STEM Club	• Ms. M recognizing the importance of red couch • Ms. M asking youths if they would like to change the place for circle time to red couch Louise, peers, and Ms. M immediately rearranging their chairs around the red couch • Louise recalling a moment she felt included when she used sewing skill she learned from her auntie for her and her peers' e-textile activity	• Making ISL space to be where youths feel included • Being experts in a STEM activity by using knowledge and expertise from home
	Ivy and Rose singing together for 'let it go' (YAC)	• Ivy and Rose singing a song, 'Let It Go,' as they released the frustration coming from their challenging project • Ivy and Rose taking up space by singing and moving their bodies across the room	• Ms. A recognizing youth-expressed in-the-moment frustration, • Ms. A playing the song from her phone • Ivy's and Rose' peers immediate participation in singing the song, moving their bodies freely in the room	• Making visible and releasing emotions coming from engaging in challenging STEM projects • Humanizing community in which youths feel free to express, release, and share frustration and excitement coming with STEM projects

Table 4-1 (cont'd)

	Bella and Jazmyn moving their project work out of the room (YAC)	• Bella and Jazmyn physically moving their bodies, ideas and project materials into other – not STEM – spaces to create non-judgmental, youth-only, zones for project work	• Ms. O offering an independent and separate space for the project • Peers' joining recording testimonials Bella, Jazmyn, and peers engaging in dialogue on critically political STEM work without the worry of interference by boys	• Creating space in which girls solidify one another by sharing their own knowledge and concerns about feminine hygiene issues • Creating a non-judgmental youth-only zone for STEM project
	Benson moving his group to the Chill Zone (Forensics)	• Benson recognizing awkward silence in his group when Mr. C asked to have a group discussion about mock crime scene investigation • Benson proposing his peers to move to the Chill Zone (created inside the room to allow youth-only space)	• Peers agreeing to Benson's idea and moving to the Chill Zone without asking for Mr. C's permission • Peers circling up by themselves and engaging in an active discussion with comfortable poses • Benson and peers welcoming Mr. C sitting by their side, and joining as an active listener	• Creating a space youths are legitimate and more comfortable to discuss with one another • Seeking to disrupt the normal shaping of group formation that centers the educator and has youths sit around tables overseen by the educator
Creating activities that matters	Monica, Cassie, and Chloe improvising role play (Mash-up)	• Creating new roles (lawyers, witnesses, and jurors), and languages (evidence); • Taking up space by moving their bodies across the room for the role play;	• Ms. B supporting youths to co-facilitate the fingerprinting activity; • Verbally stating the powerful message of the role play; • Facilitating other youth's participation in the role play	• Being experts (judges, lawyers); • Humanizing communities (trying to defend their peer unduly accused); • Seeking to expose/disrupt injustice (using evidence for a just judgment)

Table 4-1 (cont'd)

Louise's and Chloe's embodied investigation of pinhole camera images (Summer Camp)	• Louise posing a question of 'what does the image on the pinhole camera look like if we stand upside down and then see through it'	• Chloe immediately moving across the room to an empty spot • Chloe taking different up-side down poses and seeing objects in and out of the room through the pinhole cameras • Me supporting youth-initiated spontaneous investigation as a co-learner	• Being legitimate members who can ask a spontaneous question that lead to create an engaging scientific investigation • Disrupting the traditional relationality that positions youths as knowledge recipients (i.e., voluntary and agentic investigation)
ReRe's creation of rap verses (STEM Club)	• ReRe spontaneously sharing one of her rap lines she had composed at home, during the discussion on which making/research projects youths would like to do with the topic of sustainable community • ReRe's rap line presenting the critique of anti-immigrant policy (that took place back then)	• Peers offering beats to ReRe's rap • Ms. R asking ReRe to continue to perform rap • Ms. R adding her own rap lines to ReRe's rap • Peers using raps to name and discuss community issues	• Legitimizing youths' expertise from their core culture • Seeking to expose injustices by using raps and taking the issues at the core of their STEM projects

Table 4-1 (cont'd)

Foregrounding the sociopolitical dimension of learning	Amir's critique gently shut down (Forensics)	• Amir seeking to shift the group discussion discourse regarding racial injustice in STEM and society	o Supporting critical dialog after disciplinary activity; Mr. E recognizing Amir's question as passionate • Mr. E gently asking Amir to discontinue his statement as it sounded political, and thus, to Mr. E's view, inappropriate to discuss in the STEM learning space • Mr. E bringing the moment to RPP meeting so that he could further discuss the moment with his colleague educators and researchers	• Seeking to expose issues of injustices and discuss them as part of ISL
	Su'Zanne naming MIT in training (Summer Camp)	• Su'Zanne introducing a new position of mentors-in-training-in-training	• Ms. M and me asking Su'Zanne why she would like to create the new position given that youths are eligible to become mentors in their 9th grade and mentors-in-training in their 8th grade • Su'Zanne, as 6th grader having multiple years of experience in STEM Club claiming that youths should be eligible to be mentors not because of their grades but because of their experiences in the STEM club • Louise reframing the camp as a program to prepare youths to be the mentors-in-training-in-training creation of new activities and expectations to be MIT in training	• Disrupting the established norm that the older youths are more eligible to become mentors for the younger youths by pointing out that one can have more or less experiences in the STEM Club regardless of the grades

Table 4-1 (cont'd)

	William's wanting to make fanny packs (STEM Club)	• William showcasing his expertise in sewing to the educator and peers • William taking up the space to move his body and exclaim out his idea • Revising the e-textile activity of making bookmarks to initiate a new project of making fanny packs	• Ms. M recognizing and legitimizing the STEM project (making fanny packs) that mattered to the youth • Peers validating the utility of fanny packs sharing with Ms. M what happened in the school earlier on that day (one friend's belongings being stolen)	• Being recognized by expertise learned from home and ideas developed from daily lives from (with their sewing skills and design ideas of why fanny packs matter than bookmarks) • Humanizing use of STEM (for keeping his peers' belongings from being stolen) • Engaging in STEM projects explicitly grounded in youth's lived lives not just in adult-suggested ones (making fanny packs instead of book marks)

Note.

a Moments are organized in the order they appeared in the manuscript.

Chapter Five. Pedagogical Practices in Support of Youth-Initiated Moments

In chapter four, I attended to how youths initiated moments and how the moments made visible their bids for rightful presence. One important part of the findings was educators' and peers' responses to youths' actions. In particular, educators' responses were important to amplify and sustain the shifts youths sought by disrupting and transforming institutional narratives. In this chapter, I further examine how educators' practices may have supported and amplified youth-initiated moments, including not only how they responded to the moments that emerged but also how they may have fostered the emergence of the moments.

In the youth-initiated moments, youths took actions that manifested their political struggles toward rightful presence by seeking to legitimize their lived experiences, knowledge, and culture; build humanizing communities; and use ISL as an opportunity to name and resist injustices they experience and observe in their daily lives and in society. These actions often became contentious, since they exposed, disrupted, and sought to transform the discourse, practices, physical and social representations, and power relationalities normalized by those who constitute ISL spaces, including educators.

My data analysis attended to describing pedagogical actions educators implemented before, during, and after the youth-initiated moments (analysis phase 1). Looking across the actions, I identified educators' pedagogical actions that may have supported emergence, amplification, and/or sustaining of youth-initiated moments (analysis phase 2). By looking into how the pedagogical actions worked together (analysis phase 3), I identified three sets of pedagogical practices for *making space*. By making space, I refer to centering and leveraging youths' agency, lived experiences, knowledge, and culture epistemologically, relationally, and politically when designing and implementing ISL opportunities. Here, space includes both

physical (e.g., location, materials, resources) and cultural (e.g., norms, daily discourse and practices, power relationalities) dimensions. I view *making space* as a justice-oriented approach because it involves educators' participation in youths' political struggle in order to legitimize youths' lived experiences, knowledge, and culture by shaping and reshaping the physical and cultural dimensions of space. Pedagogical practices for making space are justice-oriented and help youths have and expand rightful presence in not only accessing but also in disrupting dominant epistemology and culture in ISL and in creating new knowledge and culture. I identified three sets of interconnected pedagogical practices for making space:

1. Educator-designed space making: engaging youths in educator-designed ISL opportunities that center youths' agentic participation and relate to their lived experiences and knowledge

2. Taking-up youths' disruption and reorganizing ISL opportunities with youths: taking up youths' disruption of normative discourse and practices, including educator-designed ISL opportunities, and reorganizing discourse and practices with youths to center their lived experiences, knowledge, and culture

3. Co-creation of new ISL opportunities with youths: co-designing and actualizing new ISL opportunities with youths to center their lived experiences, knowledge, and culture, whether planned in advance or in response to youths' bids for co-creation.

These pedagogical practices for making space, while sometimes occurring in distinct ways, often were interconnected. For example, as I show later, the set of practices of designing for space to support youths' agentic participation, lived experiences, and knowledge often led to new moments in which youths and educators sought to expand the physical and cultural dimensions of the space through disrupting and reorganizing normative discourse and practices (set 2) or

111

through co-creating new ISL opportunities (set 3).

Pedagogical practices for making space helped both youths and educators, as learning community members, generate what I refer to as outcomes-in-practice. Drawing on social practice theory, I use the term outcomes-in-practice to describe shifts sought and/or made in the physical and cultural dimensions of space, including discourse, practices, spatial representations, and power relationalities. Outcomes-in-practice can be seen when the youths and educators immediately recognize and legitimize these shifts and subsequently sustain them in ISL spaces by creating new daily routines, programs/curricula, and spatial organization.

In what follows, I warrant claims about the three sets of pedagogical practices and how they helped generate outcomes-in-practice by describing the practices and contextualizing them in three youth-initiated moments. The moments emerged in a science center's ISL programs and involved three educators: Ms. S (Forensics), Ms. A (Forensics), and Mr. C (Robotics Camp), respectively. I chose these three moments and use them to illustrate the different sets of pedagogical practices and how these interconnected practices fostered outcomes-in-practice. Below, I present each moment and its surrounding pedagogical practices as a case. Lastly, looking across the cases, I examine the interconnectedness among the practices and politicalness of youths' presence according to the different sets of practices.

First set of pedagogical practices: educator-designed space making

Educator-designed space making practices appeared across 56 youth-initiated moments (Appendix F). These pedagogical practices include designing for and facilitating youths' agentic participation in ISL opportunities and publicizing youths' ideas, experiences, and knowledge. By agentic participation, I refer to youths exercising power in determining the forms and extent of their engagement in learning opportunities, and whether and how the opportunities matter to

112

them. Educators purposefully *designed* ISL opportunities with the hope and expectation that youths would find the opportunities important and relevant to themselves, their lived experiences, and their knowledge, and thus worth taking part in. The educators *facilitated* youths' agentic participation in such educator-designed opportunities by scaffolding disciplinary knowledge and practices and by offering multiple options for activities with abundant resources and materials. Educators also *publicized,* with revoicing and bodily expression, the ideas, experiences, and knowledge youths developed, used, and shared. These pedagogical practices helped make space where youths became agentic participants in the educator-designed ISL opportunities.

Educator-designed space making practices fostered youths' outcomes-in-practice: ideas, experiences, and knowledge elicited during the ISL; agency exercised by participating in the educator-designed ISL; and disruptive and transformative actions seeking a shift in normative discourse and practices. In particular, the disruptive and transformative actions taken by youths often extended far beyond the expectations of the educators. Although, as discussed below (sets 2 and 3), educators sometimes responded so as to center or amplify youths' actions, and co-create ISL opportunities, this did not always occur, particularly if the educators considered youths' actions little relevant to the ISL opportunities educators designed. Below, Case 1 illustrates not only practices from set 1 but also the absence of practices from sets 2 and 3, indicating that educator-designed space making is important yet insufficient to fully support youths' bids for rightful presence manifested by their disruptive and transformative actions.

Case 1. Ms. S, Forensic program (Chloe's critique of a normative activity)

To illustrate the pedagogical practices of educator-designed space making and how they helped generate outcomes-in-practice, I focus on a moment that involves a youth (Chloe) and an

educator (Ms. S) during two connected activities (DNA extraction and conclusion writing) in a science center Forensic program (November, 17, 2018; See Table 5-1). Ms. S's pedagogical practices involved designing and facilitating the disciplinary activity (DNA extraction) to support youths' agentic participation and publicizing and leveraging youths' ideas and questions to support their learning how DNA works. Ms. S's practices for making space fostered outcomes-in-practice: not only youths' agentic participation and their ideas and questions elicited during the DNA extraction activity, but also Chloe's action that sought to disrupt the normative way the conclusion writing had been done. Chloe questioned and resisted participating in the activity and suggested alternative ways to express youths' learning in addition to conclusion writing. However, Ms. S ended up not amplifying the shift towards the ways Chloe suggested; instead, Ms. S subscribed to the institutionalized discourse that legitimized the conclusion writing. This indicates that Ms. S's practices for educator-designed space making, despite being supportive of Chloe's seeking a shift, were insufficient to actualize the shift in the moment as it seemed different to or went beyond what she, as an educator, expected.

Making space by engaging youths in the DNA extraction activity (first set of pedagogical practices)

During the DNA extraction activity, Ms. S enacted two practices for educator-designed space making: (1) designing and facilitating a DNA extraction activity to support youths' agentic participation and (2) publicizing and leveraging ideas and questions youths shared along with the DNA extraction activity to support their learning about how DNA works. These practices fostered outcomes-in-practice such as youths' agency and ideas relevant to and knowledge of a disciplinary activity (DNA extraction), as well as one youth, Chloe, seeking a normative shift in a routine activity (conclusion writing).

114

Designing and facilitating a disciplinary activity to support youths' agentic participation. During our interviews before the Forensic program, Ms. S emphasized the importance of youths' having agency in learning, drawing on her previous teaching experiences:

> My experience with children is mostly very hands-on, experiential learning. Making sure
> that they have the opportunities and the agency to make their decisions... I feel like,
> they're gonna be more respectful to each other, to me, you know, to themselves. (October
> 19, 2018)

As an experienced educator who recently transitioned to the science center from another ISL institution, Ms. S had found that youths' having agency helped them to be more respectful of themselves and others in their learning community. To design and facilitate the forensic program's activities to support youths' exercise of agency and collaboration with one another, she created activity handouts containing the activity's purpose, procedure, and prompt questions to scaffold youths taking leadership in conducting the activity in small groups. For the DNA extraction activity, she reorganized the space to secure resource tables for the liquid solutions and experimental apparatuses used, as well as tables where youths could work in small groups (Figure 5-1). In the reorganized space, Ms. S facilitated youths' agentic participation in extracting their own DNA. After Ms. S used the handout to provide brief instruction on the activity, youths formed small groups. They figured out each group member's role to complete the activity, and completed each step of DNA extraction (Figure 5-2).

**Figure 5-1** Youths gathered at the resource table

Figure 5-2 Youths engaging in the activity as a small group

While engaged in the activity, youths discussed the functions of the liquid solutions and the amount and order in which they should be added to the individual cylinders. Youths continued to communicate with Ms. S in order to ask for advice on details and problems that emerged in the moment. They also suggested to one another and to Ms. S new, easier ways they found to conduct the activity. Ms. S paid consistent attention to what was happening in each group and to individual youths.

Publicizing and leveraging ideas and questions youths shared along with the DNA extraction activity to support youths' learning about how DNA works. Ms. S also publicized the ideas and questions youths shared during the DNA extraction activity. She legitimized these ideas and questions by leveraging them to support youths' learning of disciplinary knowledge about DNA's structure and function.

Figure 5-3 DNA strands extracted in test tubes
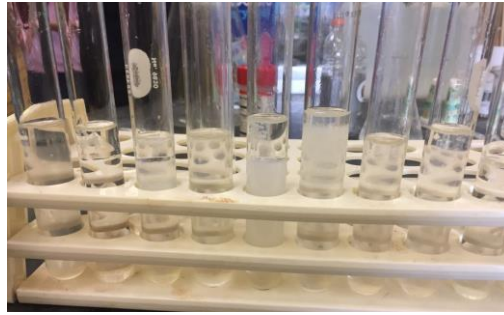
As the DNA extraction activity came to an end, youths shared with Ms. S their excitement about watching white threads of DNA strands appear in the middle of the test tubes they were holding (Figure 5-3).

Daisy: Look at this, [Ms. S]!! This is me, this is what makes me up.

Chloe: Can I do this again at home? I wanna do this for my mom.

Ms. S: Yay! Daisy, that is true. You look very clear in it!!!! I love that, Chloe! You can definitely do that with your mom. Keep the handout with you. What you need to do this are probably at your home already.

Ariel: [Ms. S]! Can I make clones out of this? I will make a big army of myself. They will do everything I do at the same time. This is so cool.

Ms. S: [with a smile and open arms, exclaimed] That is an amazing idea. Basically, DNA helps make ourselves. I think this is a perfect timing for us to learn more about what DNA does and what it really looks like on a microscopic level. As Daisy said, DNA makes us up. Then, how? And, why is this important in forensics?

Ms. S emphasized youths' excitement with her bodily expression. She listened to and affirmed the ideas and questions posed by Daisy, Chloe, Ariel, and other youths as youths were able to see 'themselves'—the DNA strands seen in their test tubes. She leveraged the youths' ideas and questions about how DNA makes up their bodies to support their disciplinary learning about

117

DNA's function by using video-clips visualizing the process of DNA replication. Her

pedagogical practice of publicizing and leveraging their ideas further animated youths as they

continued to discuss how DNA would become forensic evidence.

From making space to outcomes-in-practice: The youth-initiated moment of Chloe's questioning and resisting conclusion writing. In the space Ms. S purposefully designed, youths

exhibited agentic participation and ideas relevant to and knowledge of a disciplinary activity

(DNA extraction) as outcomes-in-practice. In addition, one youth, Chloe, initiated a moment

seeking a normative shift in a routine activity (conclusion writing), which I view as an important

outcome-in-practice.

Chloe initiated this moment as Ms. S transitioned from the DNA extraction activity to

conclusion writing, which was one of the daily activities in the science center Forensic program.

During this activity, youths individually wrote answers to questions related to each of the three

sessions of the day. For example, the three sessions that day were examining blood types (with

Ms. A), different kinds of hair lets (with Mr. C), and DNA (with Ms. S). The corresponding

conclusion writing questions were, respectively:

- What was the hardest part of the blood typing procedure?

- What are 3 types you can distinguish from hair collected as evidence? What

  characteristics of hair help you make that decision?

- How does your body know how to make proteins from your DNA?

These prompts show that the conclusion writing activity mostly attended to confirming the

content and procedure youths might have learned during the day. Presenting the questions

written on the whiteboard, Ms. S said, "Let's write down your own answers, not talking. You

know that, once you finish writing and turning in your note to me, you can go outside and have

free time." This statement, in addition to the question prompts above, indicates the individualized and assessment-like manner of the conclusion writing activity. It also highlighted that the quicker the youths completed the conclusion writing activity, the more free-time they had.

While other youths opened their notebooks silently to write down their answers, Chloe, who had been so engaged with the DNA extraction activity that allowed active and agentic group work and discussion, and saw herself in the DNA, took a disruptive action, signaling this as a youth-initiated moment. She asked "Why should we write all this? Why can't we talk?" and resisting writing down her answers. With these actions, Chloe exercised her power as a legitimate member of the ISL space by seeking a normative shift in the way conclusion writing was done. Chloe told us about the moment later in our reflective interview:

> I did not mean that writing is a bad thing. But, to somebody, writing is not always easy. Why should we only write? If you want to see whether we really learned or not you can let us talk and record our conversation. Just like we did before the writing thing [conclusion writing], why not talking and helping others learn more? It will be much fun and helpful to learn.

Chloe, with this statement, suggested how to make the activity more meaningful and accessible. She considered that the modes of articulating their thoughts would differ for each youth and that allowing the multiple modes may help learning and make it more engaging.

I infer the shift Chloe sought in the moment as an outcome-in-practice that was fostered in the space where Ms. S's pedagogical practices supported youths, including Chloe, to exercise their power as they actively participated in the DNA extraction activity. Chloe raised the question shortly after Ms. S quickly transitioned to the conclusion writing from a rich discussion about DNA and DNA extraction activity in which Ms. S supported youths' free speech,

questioning, and exchange of ideas. Chloe might have noticed the contrast between how Ms. S supported youths during the DNA extraction activity and in the conclusion writing; this might have prompted Chloe to seek the shift in how conclusion writing was done.

The shift was particularly significant in the context of my three-year long observation of this program. This was the first instance in which a youth directly raised a critical question and suggestion about the conclusion writing activity, although youths had offered similar feedback in their written surveys after the program ended. The shift that Chloe sought immediately and explicitly emerged as an outcome-in-practice in the encounter between Chloe's presence and the program space Ms. S and youths were making.

A missed outcome-in-practice: Ms. S's response to Chloe's seeking disruption of a normative activity. Ms. S ended up not amplifying the disruption that Chloe sought. Although Ms. S acknowledged Chloe's question saying, "You are right," she benignly foreclosed it in the moment by adding "but I heard you should write that." One youth, Jose, added that "Mrs. D [a teacher from the school district who brings youths to the science center and supervises them] checks our note every day." While Chloe refused to write down her answers in her notebook, other youths finished up theirs and went out of the room to have free time. Finally, left alone in the room where Ms. S was cleaning, Chloe started to write her own answer. Her answers were thorough and detailed, indicating that her resistance was not due to her not knowing the answers. Rather, as indicated in our reflective interview (see above), she seemed to seek a rethinking of the way the youths reflect on and express their learning.

That the shift Chloe sought was benignly foreclosed can be explained by how the conclusion writing had become a normative activity to which educators readily subscribed. As the Forensic program was district-partnered, there were activities required for educators to

implement; one of these was the conclusion writing. Mrs. D asked educators to collect youths'

notebooks so that she could evaluate youths' performance and learning attainment. In this

institutional context, most educators shared a positive view of the conclusion writing. During our

informal conversation after Chloe left the room, Ms. S said that "kids may not like it [conclusion

writing], but conclusion writing is good for training how to explain their thoughts." Similarly,

when I asked their thoughts about conclusion writing on the same day, Mr. C and Ms. A, who

also taught in the Forensic program, reported that they viewed the conclusion writing as helpful

to organize youths' thoughts in logical ways (Mr. C) and as a proud feature of their program

(Ms. A).

This case shows that the pedagogical practices of educator-designed space making can

support youths' exercising power through agentic participation in disciplinary activities and help

generate outcomes-in-practice such as youths seeking shifts in routine activities. However, this

case also shows that educator-designed space making may be insufficient when educators

foreclose the shifts that youths seek.

Second set of pedagogical practices: Taking-up youths' disruption and reorganizing ISL opportunities with youths

Educators often built on their pedagogical practices for educator-designed space making

(set 1) to disrupt and reorganize normative discourse and practices with youths (set 2). The latter

set of pedagogical practices appeared in 26 out of a total 56 youth-initiated moments (Appendix

F). With these practices, educators sought to leverage and center youths' lived experiences,

knowledge, and culture to challenge and transform discourse and practices that shape ISL

opportunities. Making space by disruption and reorganization helps youths empower themselves

as legitimate critics and re-organizers of the normative discourse and practices underlying ISL

121

opportunities, including educator-designed and institutionalized ISL opportunities.

Pedagogical practices for disruption and reorganization include recognizing and affirming youths' bids for disruption and transformation of discourse and practices and participating in the disruption by soliciting youths' leadership in reorganizing discourse and practices. Educators *recognized and affirmed* not only youths' bids for disruption and transformation (e.g., how youths sought to disrupt discourse and practices) but also what underlies those bids (e.g., youths' experience and culture) and tensions made visible by the bids (e.g., power relationalities in the space). As part of recognizing and affirming, educators reflected on how they may have partaken in discourse, practices and power relationalities youths were seeking to disrupt. Such reflections prompted educators' participation in youths' disruption by *candidly and respectfully soliciting youths' insights and imaginations to reorganize* normative discourse and practices legitimized in educator-designed ISL opportunities and spaces. These pedagogical practices for disruption and reorganization helped generate outcomes such as exposing, reexamining, and revising ISL opportunities that include normalized assumptions underlying classroom discussion, daily institutional routines, and educator-designed activities and programs.

Case 2. Ms. A, Forensic program (Amir's critique of interrogating questions)

To illustrate how educators may build on the first set of pedagogical practices to enact the second set of pedagogical practices, and how these practices helped generate outcomes-in-practice, I focus on one youth-initiated moment involving Amir, his peers, and their educator, Ms. A, during the first day of the Forensics program (October, 26, 2018; See Table 8). I contextualize Ms. A's practices in a moment when Amir exposed and critiqued the normalized assumption underlying the interrogative questions that Ms. A and his peers were brainstorming.

While the case of Ms. S (above) shows an educator's practices can foster a youth's seeking to disrupt a normative activity without amplifying the disruption, this case shows how an educator fostered and amplified a youth's disruption of the classroom discussion by revising with youths.

Pedagogical practices from two sets unfolded in this case:

- Engaging youths in a scenario-based interrogation activity in which youths could immerse themselves (set 1, educator-designed space making);

- Taking up Amir's critique to revise the classroom discussion and underlying assumptions with youths (set 2, disruption and reorganization).

Ms. A's practices for making space fostered outcomes-in-practice: the shift Amir sought in the classroom discussion (following the set 1 practices) and revisions to interrogative questions, youths' approach to interrogation, and Ms. A's instructional prompts (following the set 2 practices).

Engaging youths in a scenario-based interrogation activity in which youths could immerse themselves (first set of pedagogical practices)

In this case, I identified two practices for educator-designed space making: (1) designing and facilitating a scenario-based interrogation activity and (2) publicizing interrogative questions youths generated. These practices fostered outcomes-in-practice such as youths' interrogative questions and Amir's critique of the interrogative questions .

Designing and facilitating a scenario-based interrogation activity. Ms. A had been instructing in the Forensic program for multiple years. As a way to engage youths with the knowledge and practices she hoped they would learn, Ms. A developed and used imaginary scenarios to situate activities of the day. She used the scenario-based approach to give youths' learning an "element of surprise that helps youths want to pay attention" (Reflective interview,

October 26, 2018). She designed the scenarios to be forensic cases; solving the cases required youths to learn and draw on lesson content and activities.

The day I focus on here was the first day of the five-week Forensics program. Ms. A engaged youths in the concepts of evidence such as class evidence and individual evidence, and different ways to collect and examine evidence. As the first activity of the day, she designed a scenario-based interrogation. She developed a scenario in which LEGO blocks secured for the science center's big exhibit were stolen and an educator, Kevin, was suspected as the thief. Ms. A asked one of the science center educators to perform as 'Kevin' to be interrogated by the youths. She then introduced youths to the scenario to facilitate them to create interrogative questions:

> Ms. A: We here at [the science center] just found that some boxes of LEGO blocks were gone. We are a bit suspicious of Kevin who had said that he really likes LEGO ... because he disappeared for a while and it seemed like the blocks were gone during his absence. Even though we are suspicious, it feels difficult for us colleagues to ask him some sensitive questions regarding the theft. Would you help us interrogate him?

> Youth: Was it real?

> Ms. A: We should see. Which questions should we ask? In fact, we will visit Kevin in person to ask the questions you suggested.

She asked which interrogative questions they would like to use when they later interrogated the educator in the main hall of the science center. By using a scenario in which youths could situate themselves, Ms. A facilitated youths' participation in the target activity of interrogation.
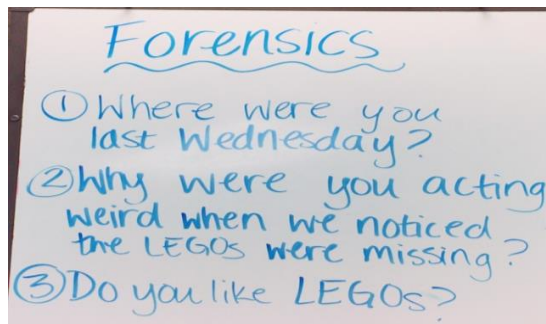
Publicizing interrogative questions youths generated. As youths brainstormed their

interrogative questions, Ms. A publicly recorded the questions on a whiteboard, and some youths wrote those questions in their notebooks for use during the later interrogation (Figure 5-4).

Figure 5-4 Youths and Ms. A brainstorming interrogative questions

Figure 5-5 The questions Amir critiqued

Based on Ms. A's facilitation, youths actively engaged in developing interrogative questions. Questions youths proposed include (Figure 5-5): "1) Where were you last Wednesday? 2) Why were you acting weird when we noticed the LEGOs were missing? 3) Do you like LEGO?" Youths proposed questions that may help confirm Kevin's suspiciousness. Youths were animated when proposing these questions with loud and accusatory voices, suggesting they were viewing Kevin as a strong suspect.

From making space to outcomes-in-practice: Amir's critique of the normalized assumption underlying classroom discussion. Ms. A's practices for educator-designed space making fostered outcomes-in-practice such as youths' interrogative questions. Furthermore,

Amir's critique of the interrogative questions emerged in the space Ms. A created; I also view his critique as an important outcome-in-practice.

While Ms. A and the youths were creating interrogative questions and presenting them on whiteboards and in notebooks, Amir asked, "But what if he didn't do it? Those questions are like we already think he was the thief, but what if he was not?" Amir's question came up abruptly as other youths were excited to leave the room to meet Kevin. The second Amir posed this critical statement about the questions his peers were generating, all attention was directed to Amir and Ms. A, and the brainstorming paused. Amir, by asking 'what if he didn't do it?,' exposed the assumption underneath the interrogative questions his peers had generated and Ms. A had affirmed by writing them on the whiteboard. I infer this question to be Amir's bid for rightful presence, exercised as a legitimate critic of the classroom discourse and its underlying assumption. In what follows, I describe how Ms. A responded to Amir's bid. As demonstrated below, Ms. A's responses allowed Amir to explain further why he was concerned about the interrogative questions and how he suggested to revise them.

Taking up Amir's critique to revise classroom discussion and the underlying assumption with youths (second set of pedagogical practices)

In response to Amir's critique, Ms. A enacted practices for making space to take up Amir's disruption and reorganize the interrogative questions. Such practices involved: (1) recognizing and affirming Amir's seeking to shift the biased assumption underlying interrogative questions other youths and Ms. A were generating and (2) participating in Amir's disruption by soliciting youths' critique and revision of the interrogative questions. These practices fostered outcomes-in-practice such as revisions to the interrogative questions and youths' approaches to the interrogation, as well as to the instructional prompts that Ms. A used for future sessions.

Recognizing and affirming Amir's seeking to shift the biased assumption underlying interrogative questions. Amir's critical statement was immediately honored by Ms. A's asking for Amir's insight into how they could generate more respectful interrogative questions. First, Ms. A affirmed Amir's critique, saying "Oh! I didn't think like that but that totally makes sense! Thanks, Amir. (Nodding) that's right. I think I had to ask differently." Ms. A immediately recognized and publicly affirmed Amir's question while reflectively acknowledging a point she had not considered. Instead of treating Amir's statement, 'what if he didn't do it?,' as something that interrupted or derailed the classroom discussion, Ms. A legitimized Amir's concern with her bodily (i.e., nodding) and verbal (i.e., saying "that's right, I had to ask differently") expressions. This publicized acknowledgement of Amir's critical statement may have helped Amir's peers readily rethink the questions they generated.

Participating in Amir's disruption by soliciting youths' critique and revision of the interrogative questions. Based on the concern Amir expressed, Ms. A asked Amir and the other youths whether and how they would like to revise the interrogative questions they had originally suggested.

> Ms. A: How can we make our questions better? How can we be more respectful to Kevin?
>
> Amir: Well, we should start from that he was one of the staff instead of a real thief. -he may or may not. Cause we do not know for sure. I saw many CSI things on TV and many people are suspected cause they're poor, no they look poor or they are Black, or they look weird, or something like that. But, they were not actually. That's, you know, unfair.

Youth 1: You are right. I think we should change our questions. They may sound unfair. And, if we ask questions with suspicions, he might get upset.

Youth 2: And, maybe not giving honest answers… That question, why acting weird, that is not good.

Youth 3: What about asking him who he thinks took the LEGOs? Hm… We also should change the order of questions…

Ms. A asked Amir and the other youths how they could make the questions "more respectful to Kevin," legitimizing and amplifying Amir's critical question ("what if he didn't do it"). I also view this solicitation of youths' advice as an active effort to share authority with youths as legitimate critics whose voices matter in reorganizing and transforming the discourse and practices in the learning space. In response to Ms. A's efforts, Amir stated that his critique was based on what he observed as unfair cases from his experience watching *CSI* on TV. He was aware of cases in which innocent people were unfairly suspected due to bias associated with their appearances. Ms. A prompted Amir to further state his concern about criminal injustices that may be done to particular groups of people. Amir then suggested taking an unbiased approach in crafting the interrogative questions ("start from" seeing that Kevin "may or may not" be the thief). Amir's peers amplified his disruption by critically reviewing and revising the interrogative questions they had generated. This dialogue exhibits how youths, initiated by Amir, named both the sociopolitical (assumption seemingly biased due to people's race and appearance) and epistemic (whether the biased questions can generate trustworthy statement from the interrogatee) concerns about the interrogative questions and how they tried to address the concerns by revising the questions.

From making space to outcomes-in-practice: Shifts in interrogative questions, youths' approach to interrogation, and Ms. A's revision of instructional prompts. Ms. A's practices for making space helped shift the discourse and approach of the interrogation activity. First, the shift appeared in youths' discourse and approach during their interrogation of Kevin. When approaching Kevin, who was working in the crowded main hall, to interrogate him, the youths tried to sustain a respectful manner toward him. For example, one youth started the interrogation by introducing why they were visiting and asking if Kevin would have time to sit and talk. Conversation moves like this were rare based on my observations of previous groups engaged in the same interrogation activity. Specifically, when previous groups of youths spotted Kevin in the main hall, they pointed their fingers at him and shouted out questions in playfully accusing tones, exuding their excitement at interrogating an adult. One way to explain the difference might be the shift in approach to interrogation prompted by Amir, Ms. A, and the youths' revision of their interrogative questions and reconsideration of their underlying assumption.

As outcomes-in-practice for the educator, Ms. A revised her prompts for the scenario-based interrogation activity. She reflected on and changed how she had instructed this activity. In Forensic sessions in the following year, Ms. A's prompts in the interrogation activity were noticeably different. After narrating an imaginary scenario in which an educator Kevin again appeared as a suspect, Ms. A first engaged youths in a discussion of the difference between interviews and interrogations, and between accusatory and non-accusatory tones, instead of immediately asking youths to create interrogative questions. She also asked if and why the youths may want to use either accusatory or non-accusatory questions. Ms. A's revision of

prompts in subsequent Forensics program sessions indicates that her instructional discourse and practice was constructed in response to the disruptive and transformative action Amir initiated.

Third set of pedagogical practices: Co-creating new ISL opportunities with youths

Some pedagogical practices for making space showed how educators sought to create new possibilities of ISL with youths (set 3) beyond educator-designed space making (set 1) and disruption and reorganization with youths (set 2). This last set of practices appeared in 21 out of a total 56 youth-initiated moments (Appendix F). Through these practices, educators sought to leverage and center youths' lived experiences, knowledge, and culture to co-create ISL opportunities such as new routines, physical spaces, activities, programs, and curricula. These practices help make space where youths empower themselves as legitimate constructors of ISL opportunities that matter to them.

Pedagogical practices for co-creation include recognizing and affirming youths' bids for new ISL opportunities (whether planned in advance or in response to youths' bids for co-creation) and soliciting youths' leadership to co-create these new opportunities. Educators *recognized and affirmed* youths' *in-the-moment* bids for new possibilities in ISL spaces (e.g., Mr. C's case below) as well as tensions between the opportunities youths sought and the normalized ones in ISL spaces. Some educators proactively co-created new activities and programs by *purposefully planning for youth-participatory design work* (e.g., Calabrese Barton et al., 2020). Furthermore, educators *solicited youths' leading the co-creation* of, for example, new STEM activities, events, and opportunities to investigate science-related social issues that mattered to them. In some cases, educators and youths exposed and examined tensions between the new and normalized opportunities, and sought to transform the normalized ones. Some educators sought to make knowledge, practice, and imaginations from youths' home and

130

communities have a permanent and material presence in the ISL space. The pedagogical practices for co-creation helped to actualize and sustain outcomes-in-practice such as new opportunities to learn and co-created artifacts, some of which were made present and materialized in the physical and cultural dimensions of the ISL space.

Case 3. Mr. C, Robotics Camp (youths co-creating Sphero soccer game)

While the previous case shows how Ms. A built on educator-designed space making practices toward disrupting and reorganizing ISL with youths (set 2), this case will illustrate how Mr. C's pedagogical practices co-created new ISL opportunities with youths (set 3). I contextualize Mr. C's practices in two interconnected youth-initiated moments that took place in the morning and the afternoon, respectively, of the second day of a five-day summer camp at a science center (June, 25, 2019, See Table 8). In the morning, youths coded microchips and Sphero robots. In the afternoon, they created a game using Sphero robots, which they called Sphero soccer.

I identified two sets of pedagogical practices for making space in this case:

- Engaging youths in a coding activity Mr. C designed to help youths exercise agency (set 1. educator-designed space making);

- Supporting youths in taking ownership of the creation of the Sphero soccer game as a new ISL activity foregrounding youths' passion, expertise, and culture (set 3. co-creating new ISL opportunities).

Mr. C's pedagogical practices fostered outcomes-in-practice: youths' seeking to negotiate the institutional routines of the camp to continue coding and operating the Sphero robots (following the set 1 practices); youths' creating the new activity of a Sphero soccer game drawing on their passion, expertise, and cultural knowledge about soccer (following the set 3 practices); and

131

subsequently, the shift in power relationality for educators and youths alike to be legitimate co-constructors of the activity.

Engaging youths in an activity designed to help relate to and exercise agency through coding (first set of pedagogical practices)

Mr. C made space by engaging youths in coding activities through enactment of two pedagogical practices: (1) designing and facilitating multiple options for activities and (2) publicizing knowledge and expertise youths developed and used during the activities. These practices fostered outcomes-in-practice such as youths' taking resistant actions that sought to negotiate the institutionalized routine of lunch time to continue the activity they had immersed themselves in.

Designing and facilitating multiple options for activities. During our pre-camp interview, Mr. C shared his plan to make space that would allow for youths' agentic participation by "showcasing skills that people had coming in" and "promoting sort of expertise or interest in whatever activities" (June, 24, 2019). As a way to help youths showcase and promote their interests in and experiences relevant to the program, he offered two or three activities for each of the morning and afternoon sessions so that youths could exercise agency in choosing an activity they would prefer to start with and then move on to the other one(s) to expand their experiences. For this day's morning session, Mr. C facilitated youths' agentic participation by offering two activity options: coding microchips (having light, sound, or vibration modes) or Sphero robots (having lighting or movement modes). He offered abundant resources and materials (i.e., microchips, robots, batteries, laptops, and tablets) so that each student could have access to them when needed. To help youths familiarize themselves with and excel at the activities, he first provided instruction on the basics of developing codes, which would be used for both microchips

and Sphero robots. He encouraged youths to choose activities between microchips or Sphero robots so that they would practice coding, then further modify and create code sequences on their own, and finally test out the codes they modified and created.

Publicizing knowledge and expertise youths developed and used during the activities. Mr. C was attentive to ongoing learning and knowledge youths established as they tried out different ways of coding. When youths came to him with ideas about tips and sequence of coding that they wanted to share with their peers, Mr. C encouraged them to share their ideas verbally or by writing them on the whiteboard. Doing so helped youths establish and share expertise and authority in coding. Youths gradually formed groups according to their chosen activities so that they could learn with and from one another. Many youths accomplished multiple coding tasks as a result. Toward the end of the morning session, many youths were working on programming Sphero robots as the youths who finished other coding activities joined in coding and running the Sphero robots on the makerspace floor.

From making space to outcomes-in-practice: Youths seeking to negotiate the camp routine to continue operating the Sphero robots. Mr. C's practices for educator-designed space making helped generate outcomes-in-practice manifested in a youth-initiated moment such as youths actively seeking to negotiate the institutional routine of lunch time that urged them to discontinue the activity they were deeply immersed in.

As the space was filled with the sounds of youths' excitement at operating Sphero robots, lunch time approached. Mr. C announced that youths should pause, grab their packed lunches, and head towards the lunch area. Instead of wrapping up the morning session, however, youths kept working on their Sphero robots, even making obstacle structures their robots should navigate. Some youths excitedly asked, "Mr. C, can I have my lunch here?" and "Can I do this a

bit more?" At that moment, Ms. S, the camp coordinator, entered and said, "We are waiting for your group. Let's first have lunch so that you can have free time for exploration." Exploration meant youths' playing in the second floor exhibition halls, which was the favored post-lunch free time activity. However, it still took several more minutes for youths to move to the lunch area. I view this immersion in and resistance to discontinue the activity as actions with which youths sought to make visible their rightful presence. Youths suggested they wanted to stay in the room so that they could keep doing projects they loved (coding and operating Sphero robots). They added creative components to the projects (building obstacle structures for their robots to navigate) and tried negotiating with educators (asking if they could stay in the makerspace instead of moving to the lunch area and having free exploration). The passion youths exhibited in this moment continued in the next youth-initiated moment.

Supporting youths to take ownership of creating the Sphero soccer game as a new ISL activity that foregrounds youths' passion, expertise, and culture (third set of pedagogical practices)

Mr. C paid attention to the youth-initiated moment described above, not sidelining or trivializing it. He further sought to make space by supporting youths to take ownership of creating a culturally meaningful ISL activity, the Sphero soccer game, by enacting two sets of practices: (1) recognizing and affirming youths' wanting to continue operating Sphero robots as agentic and legitimate action and (2) soliciting youths' co-creation of the Sphero soccer game and its playing field.

Recognizing and affirming youths' wanting to continue operating Sphero robots. First, Mr. C recognized and affirmed youths' wanting to stay in the room as an agentic and legitimate action that revealed their passion for and expertise about Sphero robot operation. This involved his recognition of the tension between youths' actions and institutional routines.

Mr. C's recognition and affirmation was captured from his informal conversation with me during the lunch break after the morning session:

Won: They really like to play with Sphero balls they coded for!

Mr. C: They just latched on immediately and just ran with it. For me, it was exciting to see they got excited.

Won: Yes, they even didn't wanna go out to lunch and free exploration time - the best part of a day I think.

Mr. C: But as Ms. S said, there were other groups who were waiting for us in the lunch place and it was how the camp works, so I had to pause my kids.

Won: Hm… then, are you thinking of giving them some free time to play with it?

Mr. C: Yep, something like a game. I think I can push the afternoon activity tomorrow and then keep doing something fun with the Sphero in a way that I can help them more productively. At least, I wanna ask them if it seems cool and what they would prefer to do.

Mr. C recognized youths' agentic actions displayed as they "latched on and ran with" operating the Sphero robots. By describing youths' actions, he acknowledged the fun, passion, and immersion youths exuded during this activity. He also acknowledged tension between youths (wanting to continue working on the Sphero robots) and the institutional routine (having lunch time out of the makerspace).

Mr. C affirmed youths' wanting to operate Sphero robots as legitimate actions. Seeking to create meaningful opportunities to learn and engage with STEM, he was willing to push the activity he originally planned for the afternoon (i.e., designing and making wooden toys with customized microchips) into the next morning. He sought to affirm youths' passion for and

135

expertise about Sphero robot operation. As youths would "keep doing something fun with the Sphero" robots, he wanted to "help them more productively," being open to the uncertainty of not knowing yet the youths' responses when "ask[ing] what they would prefer to do."

Soliciting and supporting youths' co-creation of the Sphero soccer game and its playing field. As Mr. C pushed back the activity he had planned, he asked for and centered youths' insights, knowledge, and imagination to create new ISL opportunities that would matter to youths. When they resumed the afternoon session, he said, "I found you really liked Spheros. So, what if we continue playing with them, something like a game? In a way we can add some design work onto it?" First, Mr. C publicly honored youths' passion for and expertise in operating the Sphero robots. He reminded youths of what he noticed from the morning session ("I found you really liked Spheros"). Second, he solicited youths' taking the lead in creating a new activity that would help them continue the activity paused in the morning session ("What if we continue playing with them, something like a game?"). In addition, he collegially, not authoritatively, presented his hope about what could be integrated into the youth-created activity ("in a way we can add some design work onto it"). These conversation moves made space for the second youth-initiated moment to emerge, in which youths created a Sphero soccer game and its playing field. I describe below how this moment illustrates outcomes-in-practice.

Mr. C's practices were crucial for youths to lead the process of creating rules and space for the Sphero soccer game, using materials and resources available in the room. He assisted youths in realizing their ideas, trying not to direct youths' decisions and moves. He listened to and affirmed youths' ideas and asked questions to clarify what youths meant when describing the game. He observed what was happening at multiple sites, for example, those building a soccer field and those finding proper materials to be used as walls, and checked to see if Sphero robots

136

were sufficiently charged. He provided needed support —ideas and materials— to each of the sites, which required keen attention and capacity to handle multiple tasks at a coordinated pace.

From making space to outcomes-in-practice for youths and Mr. C, on the day and afterward. The Mr. C's pedagogical practices for co-creation helped generate outcomes-in-practice for youths and the educator Mr. C himself, such as the actual design and implementation of the Sphero soccer game with the agency and authority youths exercised, as well as a shift in power relationality.

First, outcomes-in-practice generated on that day included the design ideas for the Sphero soccer game, which reflected youths' exercise of agency and authority. In particular, the agency and authority that girl campers exercised was noticeably increased. In the Robotics camp, boys greatly outnumbered girls; among eleven campers, only two youths were girls, Brittany and Anne (Black and White, respectively). In the male-dominant space, the two girls closely interacted as they supported each another to accomplish coding tasks during the day prior to and in the morning of the day this moment took place. They seldom express in public their ideas, experiences, or products of coding, as other nine boy campers did without hesitance. As I illustrate below, however, when Mr. C asked for youths to lead a creation of an activity that would use the Sphero robots, the girls stood out as they suggested ideas that were important to realize the Sphero soccer game. They led the work of designing and making the soccer field by collaborating with their boy peers.

When Mr. C resumed the afternoon session and asked for youths to co-create a new activity, the youths generated many ideas and quickly turned the idea of a game into a Sphero soccer:

Jake: Let's do soccer! Spheros hit a real soccer ball to goal in!

137

Many youths at Once: Yes, yes, yes!

Anne: Soccer! The Spheros are us. They will kick the soccer ball!

Mr. C: Cool! I think we have a ball somewhere. I will bring it.

Anne: We need to make teams.

Ben: Who wanna join?

As Mr. C solicited youths' co-creation of a new activity, youths immediately brought up their experience, knowledge, and skills about soccer developed from their home and school lives. Jake's suggestion of soccer further elicited youths' knowledge about the rules of soccer and their design of 'Sphero soccer.' Two youths, Anne and Jake, came to the whiteboard while Mr. C stepped back with a smile. The youths took turns suggesting ideas for game rules, and Anne wrote them on the whiteboard. It became a game in which three players on each of two teams would drive a rubber ball with Sphero robots operated remotely with tablet PCs (Figure 5-6). The team that moves the rubber ball to the other team's goal first would win. The youths divided into three teams and looked excited to further develop details of the game rules.

Figure 5-6 Sphero soccer game youths co-created
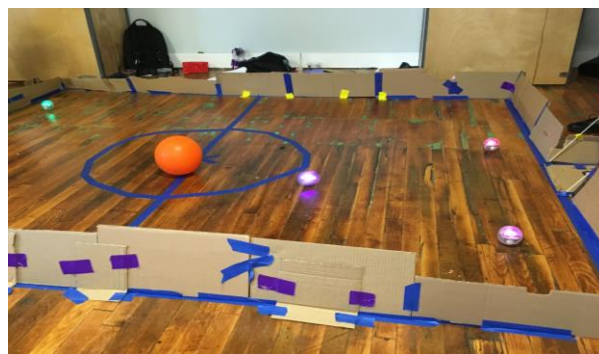
Then, Brittany asked a crucial question that caused everyone to pause for a second: "Hey, but what about playground?" Youths looked around the room, and multiple youths volunteered ideas at once.

138

Eiden: Let's play over there! [pointing to the area covered by carpet]

Brittany: But, the Sphero does not roll well enough on the carpet!

Ben: Just remove the carpet and make the walls to play.

Anne: Yes, with cardboards and duct tape.

Brittany started to draw on the whiteboard what her peers said about how to make the Sphero soccer field and goals, estimating their overall sizes. The youths quickly identified roles needed to make the Sphero soccer run. Building the field involved STEM practices such as measuring the length of four sides of the walls and constructing the walls and goal frames using cardboard and wood sticks (Figure 5-7). They tested different methods for constructing the field and shared their discoveries and successes with one another and with Mr. C.

Figure 5-7 Youth co-designing the Sphero soccer field using materials and resources available in the makerspace


Second, as the youths exercised agency and authority in designing and actualizing the Sphero soccer game, power relationality institutionally assumed between youths and Mr. C was shifted. With the Sphero soccer game, the power relationality shifted so that youths and Mr. C were co-constructors of STEM activity that mattered to youths. This was made explicit when the youths finally completed construction and gathered to start the Sphero-soccer game. Mr. C paused to publicly recognize and honor youths' agentic and collaborative participation. He said:

Ok, So! Now, we are ready to go and play. Before we start, look around and see what you

did together. We were a big team of everyone working together on that. Not everyone

was involved in everything, but everyone was either making something or experimenting

with the Spheros, which is a massive success!

He then opened the floor for youths to lead their Sphero soccer tournament (Figure 5-8). As the

game started, youths exuded excitement and pride. Later on, when other educators or youths'

parents entered the camp room, the youths greeted them with the new soccer field. As the

legitimate constructors of the artifact, the youths introduced how they invented the game, its

rules for participation, and the constructed field. Ms. S dropped by the makerspace again and

exclaimed with joy listening to youths enthusiastically explaining what they did in the afternoon

session.

Figure 5-8 Youth-led implementation of the Sphero soccer tournament
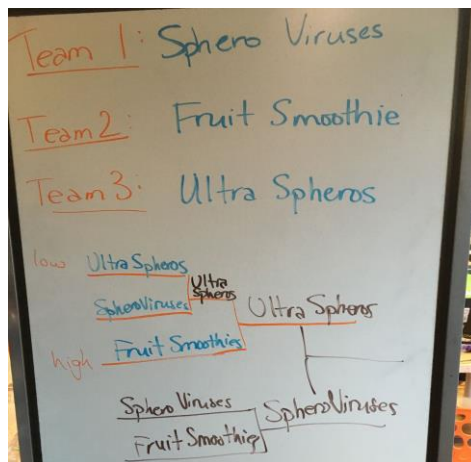
During the end-of-day interview, Mr. C pointed out what unfolded in the afternoon as his

highlight of the day:

That was my big highlight of today, where the kids got to run the show more or less. I

kept trying to—I kept getting so amped up that I wanted to get in and be like, but Anne's

like, "Mr. C, you keep interrupting me." I'm like, "You know what? You're right. I'm

sorry." [Chuckles] I got told to step back, I think, which was fantastic. I got to just be on

the perimeter trying to make sure Spheros were charging so that when one died, I had one

to replace it. Then eventually too many ran out of batteries, but we had a nice break for

snack.

Mr. C proudly recalled how youths took ownership of the activity and space. As indicated by

Anne's remark, youths challenged their educator trying to provide directional support and

claimed that the Sphero soccer was their game and their space so that Mr. C willingly did "step

back."

It is worth noting that Anne's tone was festive and animated when she said "You keep

interrupting me." It was an expression of joy and excitement in taking up power based on Mr.

C's ready assistance, rather than of annoyance. When Mr. C said, "You know what? You are

right." Anne, Mr. C, and other youths giggled together, which I view as youths and the educator

alike willingly disrupting the normalized and institutionalized power relationality. Importantly,

youths were aware that the Sphero soccer was possible based on their educator's support. During

our interviews, many youths identified the Sphero-soccer as their favorite memory of the camp.

They said, "When Mr. C said 'let's do something like a game,' we got crazy, 'what?' 'OK!'

(giggle). We knew what we wanted to do" (Eiden), and "I wanna say thank you, Mr. C. It was

the best day I've ever had in [the science center]" (Anne).

Looking across the cases: Pedagogical practices for making space in support of youths'

having and expanding rightful presence in ISL

Drawing on three educators' cases in the context of youth-initiated moments identified

from the science center ISL programs, I found three sets of pedagogical practices for making

space and how they fostered outcomes-in-practice. Table 1 summarizes findings about the

pedagogical practices and outcomes-in-practice, with examples from the illustrative cases

141

described above. Here, I further report findings gained by looking across the cases: the interconnected pedagogical practices for making space and the politicalness of youths' presence according to the different sets of pedagogical practices. Interconnections among pedagogical practices for making space

The pedagogical practices for making space were interconnected, not individual or one-off as they fostered outcomes-in-practices. For educator-designed space making (first set of pedagogical practices), educators enacted the practices of designing and facilitating ISL opportunities that fostered outcomes-in-practice such as agency, ideas, and knowledge youths used and developed during their participation in the activities. In turn, educators enacted the practice of publicizing by acknowledging and highlighting these outcomes-in-practice (i.e., agency, ideas, and knowledge youths exhibited). For example, Ms. A designed and facilitated youths' agentic participation in DNA extraction activities, during which youths expressed their ideas about DNA (viewing DNA as themselves) and curiosity about DNA cloning. Ms. A publicized the ideas and curiosity by revoicing them and leveraging them to help youths learn about DNA's function.

Table 5-1 Pedagogical practices for making space

Sets of pedagogical practices		Pedagogical practices		Outcomes-in-practice	
Each set	**Description**	**Respective practices within the set**	**Example**	**Respective outcomes-in-practice**	**Example**
Educator-designed space making	Engaging youths in ISL opportunities educators purposefully designed to center youths' agency, ideas, experiences, and knowledge to make space where youths became agentic participants in these ISL opportunities	• Designing ISL opportunities to help youths exercise agency and find relevance to their lived experiences and knowledge. • Facilitating youths' engagement in such educator-designed opportunities by scaffolding disciplinary knowledge and practices and offering multiple options for activities with abundant resources and materials • Publicizing the ideas, experiences, and knowledge youths developed, used, and shared with revoicing and bodily expressions	• Ms. S's practices for educator-designed space making: • Designing and facilitating a DNA extraction activity to support youths' agentic participation • Publicizing the ideas and questions youths shared along with the DNA extraction activity and leveraging them for youths to learn how DNA works	• Ideas, experiences, and knowledge youths developed, used, and shared • Agency exercised in participating in the educator-designed ISL opportunities • Disruptive and transformative actions seeking a shift in normative discourse and practices	• Outcomes-in-practice fostered by Ms. S's pedagogical practices: • Youths' agentic participation and their ideas and questions elicited during the DNA extraction activity • Chloe's action that sought to disrupt the normative way the conclusion writing had been done

Table 5-1 (cont'd)

Disruption and reorganization of normative discourse and practices	Taking up youths' disruption of normative discourse and practices and reorganizing them with youths to center youths' lived experiences, knowledge, and culture to make space where youths empower themselves as legitimate critics and re-organizers of ISL opportunities	• Recognizing and affirming youths' bids for disruption and transformation of discourse and practices, (including educator-designed and institutionalized ISL opportunities), what underlies the bids, and which tensions were made visible by the bids • Participating in youths' disruption by candidly and respectfully soliciting youths' insights and imaginations to reorganize educator-designed ISL spaces	• Ms. A's practices for disruption and reorganization: • Recognizing and affirming Amir's seeking to shift the biased assumption underlying the interrogative questions • Participating in Amir's disruption by soliciting youths' critiques and revisions of interrogative questions	• Exposed, reexamined, and revised ISL opportunities, discourse and practices (e.g., normalized assumptions underlying classroom discussion, daily institutional routines, and educator-designed activities and programs)	• Outcomes-in-practice fostered by Ms. A's pedagogical practices: • Revised interrogative questions and youths' approach to interrogation • Instructional prompts Ms. A revised for the interrogative activity in future sessions
Co-creation of new ISL opportunities	Co-designing and actualizing new ISL opportunities with youths to center youths' lived experiences, knowledge, and culture, whether planned in	• Recognizing and affirming youths' in-the-moment bids for new opportunities in ISL spaces and tensions between new opportunities sought by the youths and the normalized	• Mr. C's practices for co-creation: • Recognizing and affirming youths' wanting to continue operating Sphero robots as agentic and	• New opportunities to learn and co-created artifacts (e.g., new routines, physical spaces, activities,	• Outcomes-in-practice fostered by Mr. C's pedagogical practices: • Youth-created new activity of a Sphero soccer game drawing on

Table 5-1 (cont'd)

advance or in response to youths' bids for co-creation, to make space where youths empower themselves as legitimate constructors of ISL opportunities that matter to them	opportunities • Purposefully planning for youth-participatory design work to create new space, activities, and programs • Soliciting youths' leading the co-creation of, for example, new STEM activities, events, and opportunities to investigate science-related social issues that mattered to them	legitimate • Soliciting youths' co-creation of the Sphero soccer game and its playing field	programs, and curricula) • Opportunities and artifacts made present and materialized in the physical and cultural dimensions of the ISL space	their passion, expertise, and cultural knowledge about soccer • Shift in normalized educator-youth power relationality from host-to-guest to co-constructors of ISL • A new daily wrap-up discussion activity added after the creation of the Sphero soccer game

For making space by disruption and reorganization (second set of practices), or by co-creation (third set of practices), educators recognized and affirmed youth-sought disruption or co-creation, and then solicited youths' leadership to actualize what they sought to disrupt or co-create. I viewed youths seeking to shift discourse, practice, and power relationalities, which can shape their ISL opportunities, as important outcomes-in-practice. The cases of Ms. A and Mr. C indicate how the shifts youths sought were supported by the practices of recognizing, affirming, and soliciting. Recognizing and affirming helped educators to avoid unconsciously subscribing to the discourse and practices that had been normalized and dominant in the moment (the biased assumption about Kevin revealed as Amir's peers and Ms. A were creating interrogative questions) and at the institutional level (the summer camp routine the youths in Mr. C's camp sought to negotiate). The educators solicited youths' lead in disruption, reorganization, and co-creation of ISL opportunities, by leveraging youths' knowledge and culture (the wrongness of biased assumptions Amir observed from some CSI shows on TV, and the youths' knowledge and experiences about soccer) toward realizing ISL that youths suggested and claimed as important to them. These practices helped educators readily embrace the uncertainty of which ISL opportunities youths may suggest and claim and complicate the normalized and dominant discourse and practices with youths.

Recognizing, affirming, and soliciting youth-led disruption, reorganization, and co-creation of ISL opportunities were important in going beyond educator-designed space making. Without recognizing and affirming the shifts youths sought in discourse, practices, or power relationalities, educators may end up highlighting and reinforcing outcomes-in-practice conforming to the STEM knowledge and ways of learning that have historically been normalized in the ISL institution. This selective reinforcement was seen in Ms. S's different responses to

Chloe: welcoming response to her wanting to do the DNA extraction activity at home and benign foreclosure of her critique of conclusion writing. Similarly, without soliciting youth-led reorganization and co-creation, ISL opportunities may remain within the realm of experiences, knowledge, and culture educators assumed to be important to youths.

Politicalness of youths' presence according to the different sets of pedagogical practices

In this chapter, I have identified educators' pedagogical practices for making space and outcomes-in-practice in the contexts of youth-initiated moments. The outcomes-in-practice included not only youths' ideas and knowledge developed and used during the educator-designed/facilitated disciplinary activities but also shifts in ISL opportunities and power relationality sought and/or made through youths' disruptive and transformative actions. Youths took action by questioning and resisting normative activities, routines, and discourse and by suggesting revised and new ones. These actions are manifestations of youths' political struggle, bidding for rightful presence by seeking to legitimize their lived experiences, knowledge, and culture in the ISL spaces and opportunities. By enacting the pedagogical practices for making space, educators can participate in youths' political struggle to become legitimate and rightfully present members.

Although the three sets of pedagogical practices for making space can be collectively considered a justice-oriented approach to support youths' having and expanding rightful presence, the politicalness of youth's presence supported by each set differed. By political, I refer to how the practices legitimize power youths exercise with their rightful presence in terms of learning opportunities, including disciplinary and cultural activities, resources/materials, discourse and practices, spatial representations, and power relationalities. As educators build on the first set of pedagogical practices to enact the second or third sets of pedagogical practices,

147

youths' presence becomes more apparently political, as their roles change from agentic

participants to critics, reorganizers, and co-constructors of ISL. Although youths exercised power

as agentic participants in educator-designed ISL (set 1), youths exercised their power more

explicitly in the spaces where they were deemed legitimate critics and reorganizers (set 2), and

co-constructors of the opportunities (set 3).

Chapter Six. Discussions and Implications

In earlier chapters, I explored how youth-initiated moments made visible bids for rightful presence and how educators' pedagogical practices supported the moments to emerge and to be amplified and sustained. First, in youth-initiated moments, youths sought shifts in institutional narratives that shape ISL opportunities, by taking actions to disrupt and transform the dominance of the white, heteropatriarchal underpinnings of ISL. These actions called for educators and peers to work together toward:

- reorganizing physical and social representations within learning spaces,

- creating activities that mattered to youths, and

- foregrounding the sociopolitical dimension of learning.

The youth-initiated moments made visible bids for rightful presence such as legitimizing youths' lived experiences, knowledge, and culture in ISL, building humanizing ISL communities, and using ISL as an opportunity to name and resist injustices.

Second, I identified three sets of educators' pedagogical practices for making space, which supported youth-initiated moments to emerge and to be amplified and sustained. The three sets of practices were identified according to how the space for supporting and amplifying rightful presence was made. They are:

- educator-designed space making,

- taking-up youths' disruption and reorganizing ISL opportunities with youths , and

- co-creating new ISL opportunities with youths.

The pedagogical practices for making space fostered outcomes-in-practice such as youths' questions, critiques, shared experiences, and knowledge, and reorganized or newly created routines, activities, or spatial representations.

In this chapter, I discuss how the findings and the process of conducting this study advances the field of STEM education research, particularly work attending to rightful presence, justice-oriented pedagogies, and RPP-based ethnography. I then highlight the implications of this study for STEM educational research and practice, noting limitations of this study.

Advancing the field of informal STEM education research

This dissertation study helps advance three areas of research: rightful presence, justice-oriented pedagogies, and RPP-based ethnographic study in ISL settings. Below, I discuss the findings of this study in relation to each of the areas.

Youth-initiated moments making visible bids for rightful presence in ISL spaces

Identifying and examining youth-initiated moments helped articulate ways youths wanted to exercise rightful presence. I discuss first how this study advances research on rightful presence by attending to youth-initiated moments. I then discuss how this study adds empirical evidence to the literature framing learning as sociopolitical by articulating actions of disruption and transformation youths took in the moments.

Identifying youth-initiated moments helped articulate ways youths wanted to have and exercised rightful presence in ISL spaces.

This dissertation study started by foregrounding a critical justice stance to understand and address inequities and injustices underlying historicized narratives of ISL spaces that position youths, intentionally or not, as minoritized, temporary, and invisible, particularly based on their presentation of social markers such as race, gender, socioeconomic status, language, and culture. In particular, I attended to the critical justice framework of rightful presence (Calabrese Barton & Tan, 2020) because it proposes a deliberate vision of who youths are in their learning communities: they are already legitimate and valuable just because of who they are, not because

of who they are expected to be by the historicized and normalized narratives about learning, STEM, and society.

The findings of this study add to the literature on rightful presence as it, through identification and analysis of youth-initiated moments, articulates further how youths may want to exercise rightful presence. As further discussed in what follows, the findings, facilitated by conceptually framing rightful presence using local contentious practice, provides insights into the way youths—particularly Black youths and girls—imagine ISL space.

Framing rightful presence using local contentious practice helped identify youths' actions seeking to shift institutional narratives. I established the conceptual framework of this study by incorporating the critical justice framework of rightful presence (Calabrese Barton & Tan, 2020) with the construct of local contentious practice drawn from social practice theory (Holland & Lave, 2009). I view this incorporation as adding to the understanding of rightful presence.

The construct of local contentious practice helped articulate how youths' bids for rightful presence were manifested by youths' actions and interactions with educators and peers. Local contentious practice takes shape in the encounter between history-in-person and sociocultural and historicized institutional narratives. As a personal narrative of self-making, history-in-person takes shape via interactional practices with others in local spaces (Holland & Lave, 2001). As youths engage in ISL, they bring their history-in-person that involves their lived ideas, experiences, knowledge, expertise, culture, and values. They take actions and interact with peers and educators; these actions and interactions manifest youths' political struggle toward rightful presence, informed by their history-in-person and their encounter with institutional narratives.

Findings from this study provide empirical evidence of contentious encounters between

the two histories by examining actions and interactions among youths, educators, and peers. Youths took actions of disruption and transformation—e.g., Louise freely moving her body in the learning space, ReRe's rap performance, Brittany and Anne leading the co-creation of a new activity. These actions drew on their histories-in-person—e.g., knowledge of sewing Louise learned from her auntie, the anti-immigrant narrative ReRe observed from the news media, the gender disparity Brittany and Anne experienced in their STEM camp. By youths taking actions, they sought to shift historicized institutional narratives about, for example, what the physical and social representation within the ISL space looks like, which discourse is allowable in the ISL space, and who has legitimacy in creating the discourse in the ISL space.

Youths' actions of disruption and transformation often entailed tensions between youths and educators as the actions exposed and sought to disrupt and transform the institutional narratives utilized by educators through the statements they made, activities they facilitated, or institutional routines they asked youths to follow. For example, when Chloe questioned 'why should we only write?', tensions arose between Ms. S and Chloe since Ms. S was facilitating the conclusion writing activity and Chloe bid for expanding ways youths could express their learning beyond conclusion writing. In other moments, tensions were manifested between youths and narratives of the larger society as illustrated by Amir and Ms. A during the interrogation activity. Tension emerged momentarily when Amir asked a question of 'what if he didn't do it?' as his peers and Ms. A were generating interrogative questions. To Amir, the interrogative questions seemed to assume Kevin's (the interrogatee's) guilt, which mirrored the narratives on criminality bias based on race and economic status. When the tensions were attended to and addressed by educator and peer responses, shifts that youths sought were actualized (e.g., Amir, his peers, and Ms. A revising interrogative questions), although some tensions were left unresolved (e.g., Ms.

S's not responding to Chloe's question). These findings indicate that tensions can be what Calabrese Barton et al. (2020) noted as a means of transformation according to how educators and peers recognize and respond to them.

Furthermore, the conceptual framework helped name the shifts that youths sought and made through their ISL as 'outcomes-in-practice' and to analyze them in relation to educators' pedagogical practices for making space centering youths' rightful presence. By using the conceptual framework grounded in rightful presence and local contentious practice, my study considered outcomes as not only disciplinary knowledge and skills but also sociopolitical actions. Outcomes-in-practice came about in the encounter between youths' history-in-person and the institutional narratives of ISL spaces (involving educator practices, activities, and routines). Outcomes-in-practice ranged from ideas, knowledge, and agency youths used and developed during their participation in ISL activities to the actions youths took for exercising rightful presence. For example, Mr. C's summer Robotics Camp fostered multiple outcomes-in-practice: youths' agency exercised in and knowledge developed during coding activities, youths' resistance to discontinuing the operation of Sphero robots, and the Sphero soccer game youths designed and the authority they exercised in designing it.

Youth-initiated moments for rightful presence provide insights into how youths imagined ISL spaces differently. I identified three types of youth-initiated moments in which youths worked with peers and educators toward reorganizing social and physical representations, creating activities that matter, and foregrounding the sociopolitical dimensions of learning. In those moments where youths took actions of disruption and transformation, and educators and peers responded to these actions, different bids for youths' having and expanding rightful presence manifested. Although I acknowledge that other bids can manifest in different contexts

153

of ISL, this study identified three bids often simultaneously exhibited in youth-initiated moments: 1) legitimizing youths' and their peers' lived experience, knowledge, and culture in ISL; 2) building humanizing ISL communities, and 3) using ISL to name and resist injustices they experienced and observed in their daily lives and society more generally.

The different bids for rightful presence I identified in this study align with the literature describing how youths seek to make their learning matter by integrating values and epistemologies that dominant discriminatory narratives delimit and sideline (e.g., Bang & Marin, 2015). Exposing and disrupting dominant narratives of ISL that center on adults' political, commercial, and military needs for STEM learning, youths' bids for rightful presence may answer questions such as "STEM learning toward what end?" (Vossoughi & Vakil, 2018, p. 137). In particular, investigating youth-initiated moments to make youths' bids explicit and visible is important given the concern about how youths' lived lives and presence easily remain overlooked and invisible (Booker & Goldman, 2016). Visibility constitutes a "site of power and contestation that can lead to […] the reification of dominant discourse" (Bang & Vossoughi, 2016, p. 182). Given literature emphasizing the importance of visibility, this study's findings are important because they report different bids for rightful presence made visible through youth-initiated moments.

In particular, the findings of this study add empirical evidence of youths' bids for rightful presence that draw on their racialized and gendered experiences in learning spaces and in society. In many of the analyzed moments, Black youths and girls bid for rightful presence as they sought to diverge White and masculine ways of knowing and doing normalized in their ISL spaces (Vossoughi et al., 2016). The moments initiated by Black youths (including the moments with Louise, Monica, Cassie, Chloe, ReRe, Amir, Su'Zanne, and William) reflected their lived

experiences, knowledge, and culture. For example, Amir's moments with Mr. E and Ms. A showed how he sought to exercise rightful presence through naming injustices in false convictions and assumptions due to people's race and economic status, drawing on his observations of unjust and discriminatory narratives in the real world (e.g., through media like the *CSI television* series).

Black youths' bids for rightful presence drawing on their lived lives can be connected to what Bates et al. (2018) described as Black imaginary--i.e., new narratives and visions of the "Black presence" that expose, resist, and transcend "the white gaze on Black bodies, communities, and geographies" (p. 254). The imaginary presents as "not merely anti-colonialist or anti-racist" but also as "otherwise" (p. 255). *Otherwise* calls attention to not only the oppressive past but also the forward-looking wisdom to disrupt dominant narratives. Black youths' bids for rightful presence can be considered their imaginary of the otherwise that differs from and disrupts dominant narratives of STEM learning spaces that have centered the white, male, and affluent. The otherwise imaginary presented by Black youths' bids for rightful presence can be the depiction of what youths curated as "Black education space … to facilitate black peoples' well-being in an education institutional context" (Warren & Coles, 2020, p. 383).

Some moments initiated by girls also suggested the *otherwise imaginary* of ISL spaces grounded in their gendered experiences. In the moment involving Bella's and Jazmyn's feminine hygiene project, their bid for rightful presence was explicit as they sought to legitimize their experiences as girls in creating a STEM project that mattered directly to their lives. They moved out of their program room in order to actualize their bid without being concerned about the gendered narrative that made their feminine hygiene concerns an embarrassing topic to talk about. Without understanding what made the girls take the action of moving to a different space,

155

the action could have been viewed as their lack of engagement with the program. The different bids for rightful presence this study offers, therefore, is useful as it can help educators better understand actions youths enact in disruptive and often unexpected ways.

Actions of disruption and transformation offer empirical evidence of learning as sociopolitical.

I have discussed how youths' actions of disruption and transformation help make visible youths' bids for rightful presence in the here and now. The actions youths took in youth-initiated moments introduced new roles, discourses, norms, and expectations that called for educator and peer participation in shifting institutional narratives. Given that youths' actions of disruption and transformation sought to shift institutional narratives that inform and shape youths' ISL experiences, I view the actions as political struggle through which "oppressive modes of power, are challenged, disrupted, and potentially restructured" (Calabrese Barton & Tan, 2020, p. 433). I acknowledge youths in different settings may seek different kinds of shifts through actions of disruption and transformation. Youths sought to bring immediate shift in the physical, social, and discursive space with their actions introducing new roles, discourse, norms, and expectations. The actions prompted educators and peers to participate in the youth's political struggles toward rightful presence.

The actions of disruption and transformation articulated by this study offer empirical evidence in support of the literature emphasizing learning as sociopolitical (Tolbert & Bazzul, 2016). Youths' actions were sociopolitical as they empowered themselves as legitimate critics, re-organizers, and constructors of ISL by seeking to address personal experiences and communal concerns through their ISL. Youths exercised their power in seeking shifts in institutional narratives to create ISL opportunities that matter to them and their communities. The youth-

initiated moment of William's fanny pack making offers a good example. William actively proposed his ideas of making fanny packs, as he threw the bookmark away. Although his remark, 'this [bookmark] is stupid' surprised Ms. M momentarily, she sought to learn with William in the moment by recognizing and affirming William's actions as important and rightful. William brought a shift in the activity from an educator-designed project of making bookmarks to a making project that would help him to address a safety issue he and his peers experienced in school. This moment illustrates how youths' actions of disruption and transformation were sociopolitical, as youths utilized their critical understanding of spaces, including ISL spaces, classrooms, community, and society, where they were insiders and knowers (Birmingham & Calabrese Barton, 2014).

These findings align with literature attending to how learning as sociopolitical is presented through youths' actions. Davis, Vossoughi, and Smith (2020) attend to how learning as sociopolitical was practiced through youths' microacts of self-determination, which they define as "contestations and moves to elsewhere that shift activity and dictate future status" (p. 1). Their description of microacts of self-determination resonates with actions of disruption and transformation I report in this study. While I focused on identifying youths' bids for rightful presence by looking at youths' discursive and embodied actions shaped, recognized, and affirmed via social practice, Davis et al. (2020) identified youths' actions by paying close attention to the discursive moves youths utilized during their engagement in ISL programs. Incorporating the findings of this study with others in the literature, like Davis et al. (2020), will further advance understanding of youths' actions as evidence of learning as sociopolitical. Particularly, this study provides insights to the research of youths' actions and sociopolitical

learning as it utilizes the lens of rightful presence to understand why actions would be enacted and how youths would seek to be present in learning spaces.

Pedagogical practices for making space

The first set of findings of this dissertation study attended to how youths initiated moments and how the moments made visible rightful presence. An important part of the first set of findings were the responses by educators and youths to youths' actions. In particular, educators' responses were crucial to amplifying and sustaining the shifts youths sought by disrupting and transforming institutional narratives. The second set of findings further examined educators' support for youth-initiated moments and identified pedagogical practices for making space, which included not only how educators responded to the moments that emerged but also how they fostered the emergence of those moments. In what follows, I discuss how this study advances research on justice-oriented pedagogies by identifying sets of pedagogical practices for making space.

Educators' pedagogical practices for making space are ways to participate in youths' political struggles toward rightful presence.

To call for educators' participation in youths' political struggles toward rightful presence, Calabrese Barton and Tan (2020) articulate three tenets of rightful presence (allied political struggle, rightfulness through presence, making justice/injustice visible) that inform pedagogical practices oriented toward justice. Building on their work, this study adds understanding of how these tenets are enacted through educators' daily engagement with youths, by analyzing cases that each involve a youth-initiated moment and the surrounding practices educators enacted.

While I recognize that there may be other pedagogical practices that make space and support and amplify youths' rightful presence, I highlight pedagogical practices for making space

158

that this study identified as important evidence of educators' efforts in support of youths' having and exercising rightful presence. Educators enacted practices such as designing and facilitating activities that center youths' agentic participation; publicizing ideas and knowledge youths developed and used as they engaged in the activities; recognizing and affirming youths' critique, suggestions, and insights about ISL; and soliciting youths' leading the reorganization and co-creation of ISL opportunities. These practices were grouped into three sets according to how they worked in an interconnected way to make space for youths' having and exercising rightful presence:

1. Educator-designed space making: engaging youths in educator-designed ISL opportunities that center youths' agentic participation and relate to their lived experiences and knowledge;

2. Disruption and reorganization: taking up youths' disruption of normative discourse and practices, including educator-designed ISL opportunities, and reorganizing discourse and practices with youths to center their lived experiences, knowledge, and culture; and

3. Co-creation of new ISL opportunities: co-designing and actualizing new ISL opportunities with youths to center their lived experiences, knowledge, and culture, whether planned in advance or in response to youths' bids for co-creation.

I view that justice-oriented pedagogies can be enacted through these practices for making space as they help youths have and expand rightful presence through not only accessing but also disrupting dominant epistemology and culture in ISL and creating new knowledge and culture. In what follows, I discuss further the three sets of practices. The first set of practices fostered outcomes-in-practice involving the shifts youths sought with their actions of disruption and

transformation, yet often ended up foreclosing the shifts that were sought. The second and third sets of practices helped actualize and sustain the shifts youths sought.

Educator-designed space making practices suggest how educators can work toward justice-oriented ISL with their routine planning and implementation of ISL programs, but these practices often were insufficient to amplify youths' bids for rightful presence.

The first set of practices for making space (educator-designed space making) includes: designing ISL opportunities that youths find relevant to their lived experiences, knowledge, and expertise; facilitating youths' agentic participation; and publicizing youths' ideas and expertise exhibited through ISL. These practices fostered different outcomes-in-practice: agency exercised and knowledge developed during ISL activities, actions of disruption and transformation, and shifts in institutional narratives.

Educator-designed space making practices were the most commonly observed across cases, indicating how educators make efforts to honor youths' presence through daily implementation of ISL programs such as designing and facilitating ISL and publicizing youths' ideas, expertise, and knowledge. Educator-designed space making suggests that educators can work toward justice-oriented ISL through their routine practice of planning and implementing ISL programs by seeking to foreground youths' agentic participation and ideas and expertise from their homes and community.

However, educator-designed space making practices often were not sufficient to amplify youth-initiated disruption and transformation of institutional narratives. In 6 out of 56 moments, although the practices fostered some important outcomes-in-practice such as youths' actions of disruption and transformation, the practices ended up not amplifying but foreclosing the actions. For example, Mr. E worked hard to design and facilitate disciplinary learning in which he hoped

youths could engage deeply by relating their learning to their lived experiences and knowledge. These practices of designing and facilitating fostered youths' agentic participation in the Forensics program, such as Amir's contribution to the discussion about the utility of Forensics investigation. However, Mr. E ended up benignly foreclosing Amir's statement because it sounded political and thus, from his perspective, inappropriate to be discussed in ISL spaces. As another example, Ms. S tried to facilitate youths' agentic participation in disciplinary activities as she revised educator-centered lesson plans used by previous educators in the Forensics program and actively reorganized the chairs and tables to ensure youths' agency in the activities. However, Ms. S ended up benignly foreclosing Chloe's suggestion that youths be allowed to express and share their knowledge, takeaways, and expertise in ways other than conclusion writing. Although Chloe's resistance to conclusion writing was apparent, Ms. S avoided affirming Chloe's suggestion and resistance because Ms. S subscribed to the norm that individualized written assessment like conclusion writing is a proper way for youths to prove learning attainment.

Cases like these suggest that youths' actions seeking to shift institutional narratives can be foreclosed when educators (feel obliged to) prioritize narratives functioning as borders that control allowable discourse and practices (Bang et al., 2012). In Mr. E's case, the norm that science learning space is apolitical and neutral functioned as a border that foreclosed Amir's attempt to shift the norm. Ms. S's view on conclusion writing as an important routine in the Forensics program functioned as a border that foreclosed Chloe's attempt to shift the routine.

I reflect on the cases of foreclosing from a critical justice stance seeking to disrupt and go beyond approaches that frame equity as access or as inclusion by calling attention to the culture of power and the sociopolitical dimension of learning (Calabrese Barton & Tan., 2020; Calabrese

161

Barton & Yang, 2000; Tolbert & Bazzul, 2016; Vossoughi et al., 2016). The cases of foreclosing may illustrate educators' efforts to ensure access and inclusion to ISL opportunities and spaces, which were crucial to help youths present agency, ideas, and knowledge. However, such efforts, without seeking to disrupt dominant narratives that shape ISL opportunities, end up sidelining or only partially acknowledging youths' lived lives, experiences, knowledge, culture, and values (Dawson, 2017; Philips & Azevedo, 2017).

Educators worked toward justice-oriented ISL by building on educator-designed space making practices to reorganize and co-create ISL opportunities with youths.

In 47 out of 56 moments, educators amplified youths' call for shifts in institutional narratives by building on the practices of educator-designed space making to enact the second or the third set of practices, which involved recognizing, affirming, and soliciting reorganization and co-creation of new ISL possibilities. The second set of practices for making space (disruption and reorganization) includes: recognizing youths' disruption of institutional narratives, including educator-designed activities; affirming youths' disruption; and soliciting youth-led reorganization of ISL opportunities. For example, as Ms. A recognized and affirmed that Amir's disruption of interrogative questions mattered, she further asked for Amir and other youths to take the lead in reorganizing the interrogative questions. Ms. A's pedagogical practices like this fostered youths to revise the questions so that the questions would express respect for the interrogated person (i.e., Kevin in the interrogation scenario) while more effectively eliciting truthful answers from the person. The third set of practices for making space (co-creation) includes: recognizing and affirming youths' critique, suggestions, and imagination of new ISL and soliciting for youth-led design and actualization of ISL that matters to them. For example, as Mr. C recognized and affirmed youths' wanting to keep engaging in Sphero robot operation, he

further asked for youths to take the lead in co-creating a new ISL activity that resulted in youths' designing the Sphero soccer game and its playing field. In both the second and third sets, recognizing, affirming, and soliciting youths taking leadership and authority were important practices, which I view as educators' efforts to collectively disrupt and transform the culture of power and dominant narratives (Philip & Azevedo, 2017).

These findings about the practices of recognizing, affirming, and soliciting align with the literature attending to justice-oriented pedagogies. Calabrese Barton et al. (2020) found recognition, refraction, and social transformation to be important in orienting high-leverage practices toward actualizing justice in and through learning. Recognition prompted educators' reflection and refraction on the institutional narratives of who counts in ISL spaces, whose knowledge and ideas matters, and which learning counts for whom (Tan et al., 2019). Affirmation, as Shea and Sandoval (2020) found, was crucial in creating space in which youths were asked to act as owners and constructors of ISL that mattered and of discourse about what is scientific, political, or cultural.

RPP-based critical ethnography in ISL settings

The research-practice partnership helped me to work toward ensuring trustworthiness of the findings by generating and analyzing data with youth, educator, and researcher partners. Their contributions were critical in identifying and articulating moments and enriching and complicating the data analysis. We engaged in frequent and sustained discussion through individual and group reflective conversations and RPP meetings and thus worked to flatten power and epistemic authority between the researcher and the researched. During data generation and the analysis phase of open coding, moments that mattered to any of the youth and educator partners were counted. In particular, asking for and listening to youths' ideas about which

163

moments stood out regarding their ISL experiences were critical in this study. In doing so, we

sought to find clues about justice-oriented pedagogies from youths' discursive and embodied

actions initiating bids for rightful presence. Centering youths' voices was one way to support

youths' having and exercising rightful presence in our partnership work. During the iterative

analysis of youth-initiated moments and pedagogical practices, educators' perspectives were

centered in critiquing, enriching, and complicating researchers' understanding.

This study offers insights as to productive tools for future RPP-based critical

ethnographies to refer to and build on: an analytic heuristic, protocols for data co-

generation/analysis, and postcards for data co-analysis. From the early phase of our RPP, we,

researchers and educators, developed an analytic heuristic that informed what we should attend

to the most as we sought to collectively work toward creating equitable ISL opportunities and

just ISL spaces (see Table 3-1 as the most recent version of our analytic heuristic). The heuristic

informed protocols of data generation and analysis, such as prompts that we used for different

kinds of reflective conversations (see Appendices A and B) and protocols for educators' self-

reflective portfolios (see Appendix C). The analytic heuristic would be useful in studies aimed at

examining and actualizing justice-oriented ISL education through partnership among youths and

their communities, educators, and researchers.

I developed 'postcards' to clearly communicate with educator and researcher partners the

story, context, resources, and highlighted practices for each moment (see Figures 3-1 and 3-2 for

an example postcard). Using postcards helped educators and researchers access the moments.

Engaging with the moments by using the postcards, RPP educators and researchers questioned,

enriched, validated, and complicated my initial data analysis of the moments and associated

practices, which helped this study ensure transparency of data analysis and trustworthiness of

findings. Other researchers could use postcards to document the instances identified as important by their RPP partners and facilitate further co-analysis of the instances.

Sharing the goal of justice-oriented informal STEM education, and generating/analyzing data together with partners required politicized trust. While Vakil et al. (2016) describe politicized trust by attending to racialized power dynamics, our partnership involved multiple sources of power dynamics such as race, gender, nationality, language, and duration of professional experiences. Sustaining awareness that the social markers could shape our relationalities, and our approach to generate and analyze data to arrive at the findings, was important. I tried to make sure to listen to and incorporate perspectives of multiple participants involved in the moments identified and analyzed. Perspectives and interpretations drawn from their experiences, often associated with social markers, were honored. Because participants' perspectives and interpretations enriched and complicated one another, I believe I was able to work toward ensuring trustworthiness in data analysis.

In particular, the process of identifying and analyzing pedagogical practices for making space required politicized trust between educator and research partners, which helped us be vulnerable and humane in sharing regret, frustration, wondering, joy, pride, and hope during reflective conversations and regular RPP meetings. Undertaking RPP-based critical ethnography was how I believe we, researchers and educators, strove to become allies who share the burden of youths' political struggles toward rightful presence (Calabrese Barton & Tan, 2020). Our RPP suggests how community efforts involving researchers, educators, and youths can enact participatory research and practice, amplify youth-initiated bids for rightful presence, and work toward creating and enacting justice-oriented pedagogies.

Implications for STEM education research and practice

In order to foreground youths' presence in STEM learning spaces, it is critical to support youths in exercising their rightful presence as legitimate constructors and organizers of learning opportunities that matter to them. This dissertation attended to youth-initiated moments in ISL spaces and educators' pedagogical practices in support of the moments as an effort to address inequities that make youths' presence minoritized in the spaces and work toward realizing a socially just present and future for the youths.

This study, grounded in ISL programs, offers implications basically for ISL educators and institutions that utilize flexible curricula, offer programs with varying durations, and serve a wide range of audience. Still, it is worth noting this study's potential implications for STEM education in formal settings like school science classrooms. Both informal and formal settings have been operated by the host-guest framework –i.e., youths (students) being positioned as knowledge recipients and educators (teachers) as knowledge transmitters. Efforts to work against the normalized relationalities that limit youths' presence in learning spaces toward them having rightful presence, are needed not only in informal but also in formal learning spaces.

A number of studies are concerned about dominant narratives in formal learning spaces, like school classrooms, that sideline youths' community wisdom and lived experiences, including racialized and gendered experiences (e.g., Calabrese Barton et al., 2020). When they encountered such dominant narratives in classrooms, some youths may seek to shift the narratives by taking actions of disruption and transformation. Teachers, who directly interact with youths in classrooms (as educators do so in informal spaces), are important actors who can/should help youths make visible bids for rightful presence. In this study, some crucial finding were gained from the programs and activities reflecting narratives of schooling (e.g., the

Chloe and Ms. S's moment and Amir and Mr. E's moment). As such, I discuss implications this study brings for future STEM education research and practice working toward rightful presence both in the informal and formal settings.

Implications for future STEM education research

The process of undertaking this study and the resulting findings provide implications for RPP-based *participatory design research* in STEM education contexts. Participatory design research refers to the methodological approach aimed at generating knowledge by "developing effective interventions that cultivate transformative agency among historically marginalized individuals and communities toward specific and consequential ends" (Bang & Vossoughi, 2016, p. 173). Some RPP partners who started from enacting participatory critical ethnography may seek to apply and expand their findings by enacting participatory design research. It would allow RPP partners to proactively and purposefully design and implement justice-oriented STEM learning opportunities and spaces. This study's methods and findings can be important references for researchers and practice partners seeking to take the proactive approach of participatory design research in informal and/or formal settings.

First, the analytic heuristic and prompts for reflective conversations developed and used in this study offers a set of tools those engaged in participatory design research may need to consider when creating transformative and justice-oriented STEM learning opportunities and spaces. In this study, the analytic heuristic and reflective prompts were used as tools for 'reflections'; however ,they have utility also for guiding planning/design. For example, the question 'How may the educator practices have helped the moments to emerge?' in the analytic heuristic (Table 3-1) can be tweaked to ask 'What sequence of practices will teachers or educators enact to foster and sustain youth-initiated moments?'

In addition, this study's findings offer empirical evidence of youth-initiated moments making visible bids for rightful presence and pedagogical practices for making space. These findings can be utilized as a framework for designing learning opportunities or instructional approaches. Referring to the three types of youth-initiated moments, researchers and their partner educators/teachers can design ISL opportunities for youths to reorganize physical and social representations within the learning space, create activities that matter, and foreground the sociopolitical aspect of learning. Furthermore, pedagogical practice will help organize instructional plans. For example, researchers and teachers seeking to co-create with youths a new physical and social representation within the classroom may start with the practices of recognizing and affirming youths' critique of the classroom. They then may solicit youths' creation of new learning opportunities by facilitating youths' rearrangement of their classroom and design of new learning activities that they want to engage in.

Implications for future STEM education practice

The findings of this study also suggests what educators and teachers need to learn so that they work toward justice-oriented STEM education and how their institutions and research partners should support the learning of educators and teachers. Educators and teachers are important actors who can work toward supporting and amplifying youths' rightful presence by enacting justice-oriented pedagogies in informal and formal STEM learning spaces. In order to do this work, it is crucial for educators and teachers to make continuous efforts to enact and reflect on their practices in support of youths' rightful presence. In this study, I highlighted educators' efforts toward making space in support of youths having rightful presence while also critically recognizing educators' difficulties in amplifying youths' actions and bids for rightful presence when those conflicted with the institutional narratives educators prioritized. These

findings about educators' efforts and difficulties suggest a need for learning opportunities for educators and teachers who seek to enact justice-oriented pedagogies.

Consider Mr. A's not knowing in the moment how to respond to Amir's comment that highlighted unjust law enforcement against Black people in the US. Although Mr. A was committed to educator-designed space making, in the moment, he, as a white male educator, viewed Amir's remark as too political to be discussed in a science classroom. Given the historicized whiteness in STEM learning environments, educators and teachers in such white-centered contexts may not have had the professional learning opportunities to critically reflect on injustices that underlie dominant institutional narratives about ISL. If that is the case for experienced educators like Mr. A, it is possible to further conjecture that newer educators and teachers may need even more support to amplify youth's actions and bids for rightful presence.

This study's findings offer three implications about what educators and teachers need to learn to enact justice-oriented pedagogical practices: 1) pedagogical practices for making space, 2) the concepts and examples of outcomes-in-practice and bids for rightful presence, and 3) tensions as entry points to transformation. First, the pedagogical practices for making space identified in this study provide educators and teachers with specific ways to participate in youths' political struggles toward rightful presence, and examples of other educators supporting youths in these ways. By learning the specific ways and examples, educators and teachers may readily recognize and affirm youths' questioning and transforming of whose voices, knowledge, and experiences matter, and solicit youths' lead in challenging and expanding STEM learning.

Second, the concept of outcomes-in-practice introduced by this study suggest that educators and teachers need to expand their conception of outcomes in order to recognize and affirm not only disciplinary knowledge and skills but also actions of disruption and

transformation as important learning outcomes. The specific bids for rightful presence described in this study can help educators and teachers understand youths' actions of disruption and transformation in terms of their bids for rightful presence. For example, when an educator encounter a moment in which her youth throws away his making project (as Ms. M did in the moment with William), she can try to understand the apparently disruptive action by examining which bids the action may draws on.

Lastly, this study suggests that educators and teachers should be encouraged to reframe the tensions they may encounter between youths' actions and bids for rightful presence and the institutional narratives educators and teachers have subscribed to. As discussed earlier, such tensions are entry points to reconsider, disrupt, and transform the narratives and create new narratives centering youths' rightful presence. For example, Mr. E took up the tension he encountered in the moment with Amir by bringing the moment to an RPP meeting and sharing his regret and wondering. He asked insights from his RPP educator and researcher partners, which opened up discourse that helped other RPP partners reconsider their own narratives about which discourse is allowable in their institutions; these discussions were followed by regular critical conversations among staff afterward.

Concluding this study with the implications for STEM education research and practices, I argue that educators and teachers need to be supported by their institutions, administrators, and partnering researchers. It is insufficient to emphasize only the responsibilities of educators and teachers. Commitment to be allies of youths' political struggles and to actively incorporate youth's insights into daily practices *should not be solely on the shoulders of educators and teachers*. STEM learning institutions and schools, administrators, and partnering researchers have a duty to support such efforts by participating actively in educators' efforts to enact justice-

oriented pedagogical practices and to address the tensions they encounter.

The RPP project in which this study is grounded offers two examples of such supports for educators and teachers. First, the postcards from this study were used as tools and resources in professional development sessions held by championing the partner educators as leaders of justice-oriented ISL in their respective institutions (supported but not dominated by research partners). Second, to support the dialogue between educators in different institution, the directors of the science and community centers directly partnered with one another and encouraged educators to exchange programs, resources, and practices (e.g., Mash-up Forensics). Educators who participated in the professional development sessions and/or the inter-institution dialogue told us that they felt not alone both in their efforts to enact justice-oriented pedagogical practices and in the difficulties they encountered as they made such efforts. I believe the feeling of not being alone is crucial in making collective efforts toward justice oriented STEM education.

Youth-initiated moments tell us—educators and teachers, administrators, community members, and researchers engaging in STEM education—what and how we can/should support youths' rightful presence. I articulated actions youths took to seek shifts in dominant institutional narratives and how the community members, particularly educators, participated in youths' political struggle by enacting pedagogical practices for space making. Drawing on these findings, I suggest that researchers should support educators and teachers (and their institutions/ administrators) to vigilantly recognize and amplify the learning possibilities youths seek to reorganize and co-create. I hope that this study helps researchers, educators, and teachers in multiple STEM learning contexts to participate in the moments youths initiate as ways of sustaining their rightful presence as legitimate constructors of just and equitable narratives in learning, STEM, and society.

APPENDICES

A-1. Crosscutting questions (for both of youths' individual interviews and group conversations)

- Would you tell me about your day?
- Are there any "moments" in particular that you want to highlight?
  [ask which ones the educator wants to talk about. Continue to ask questions about those moments and then others, by referring to the following question prompts Activity overview].
    - What went well?
    - What did you enjoy? Why did you enjoy?
    - What was challenging?
- Why did you choose to participate in the program?
- Would (Do) you talk to anybody about today's activity (or this program)?
    - What would (do) you tell them?
- If you were to participate again, what would you like to do or see?
- If you could make today's activity (or this program) different, what would you change?
- What are some things we do here that help you feel like you belong?
    - What are some things you wish we would do?
- What are some things we do that make you feel excluded?
    - What are some things you wish we would do?

A-2. Program-specific questions

Table 7-1 Program specific questions for youth conversation

Programs	Questions
STEM Club, STEM Summer Camp, YAC	Youth group conversation • Which artifacts do you want to introduce? • What was your biggest challenge in design/making projects? Why? • How do your projects connect to your life or someone else?
Robotics Camp, Forensics; Mash-up Forensics	Youth individual interview • What was your biggest challenge in Forensics? Why? • What felt different about Forensics program than being in school? • What connections did you make with Forensics and your life?

Appendix B. Educator Interview Protocol

Table 7-2 Year 1 protocol (2017) for educator interview

Aspects of reflection	Questions
General overview	• Emotions, (moments of joy and frustration in teaching) • What did you do today? How? • Are there any "moments" in particular that you want to highlight? Why? (ask which ones the educator wants to talk about. Continue to ask questions about those moments and then others, by referring to the following question prompts)
Strong points of the day	• What went well today? • What changes did you (try to) make within/across sessions? • What did you think went particularly well in terms of helping youths connect with each other?
Challenging points of the day	• What challenges, if any, did you have with youth, or teaching contents and activities? • How did you respond to those challenges? • Any lingering questions or concerns?
Connection to youths' future ISL opportunities	• How did you make sure to help youths envision their STEM pathways through today's learning? • Relationships (with youth, with parents) • Connections to outside the space
Institutional/ research support	• What do you expect to be supported by the institutions? • What do you want to meet with other researchers about this week?

Table 7-3 Year 2-3 Protocol (2018-2019) for educator interview

Aspects of reflection	Questions

Choice of focal practices (The first day/hour)	• Which practices did you choose to focus on for (today, this week, this program)?
	   o How did you plan these into the (today, this week, this program)?
	   o Are there any tools you created to do this?
	• What are the planning and instruction roles? How are they distinguished? How do they play out in the classroom?

Daily reflective conversation prompts	• Are there any "moments" in particular that you want to highlight?
	[ask which ones the educator wants to talk about. Continue to ask questions about those moments and then others, by referring to the following question prompts].
	   o What went well?
	   o What were challenges, regrets, wonderings?
	• Refer back to the practices you chose,
	   o What were you planning to do to support this practice? How did that go?
	     ▪ What would you do again? Why?
	     ▪ What would you change and how?
	   o How do you think the kids responded to this practice?
	     ▪ Positively? Challenged the practice?
	   o Can you think of any times when youths initiated your focal practices?
	     ▪ What do you think prompted this youth action?
	     ▪ How did you respond?
	     ▪ What might you do to support more youth actions in the future?
	• How have your views of your choice practices evolved through this session (**at the end of each cycle**)?

Appendix C. Educator Portfolio Generation Protocol

Welcome to Science Learning + Partnership!
Thank you for sharing your experiences, wisdom, and reflections with us. Here, we'd like to discuss the goals and processes for co-generating portfolios.

Goals
- To co-generate new understandings of equitable teaching practices for STEM pathways of minoritized youth
- To co-generate outcomes of equitable teaching practices that support meaningful participation and engagement in STEM learning

Co-generated Portfolios
- You will develop portfolios reflecting on your own teaching practices in Google Drive and we, researcher partners will assist you to develop portfolios.
- Everybody will add ***Reflections*** to your own portfolio
  - Quick audio reflections (Researcher will add to your folder the audio files and transcripts -later).
  - Creative reflections, if any (poetry, prose, story, music)
- ***Artifacts of Practice*** will be added weekly to portfolios
  - Lesson plans
  - Student work (written, images of artifacts produced)
- ***Images*** will be added weekly to portfolios
  - Short Videos that capture multiple artifacts
  - Photos of youths engaging with each other, with captions

Follow-up Conversations
- Both one-on-one and in groups, researchers and educators will collectively reflect on their portfolios and on efforts to implement teaching practices.

Appendix D. Field Note Protocol

Table 7-4 Field note protocol

Program Name:
Location:
Target Audience:
Instructors:

Program characteristics	Questions to consider
Purposes	• How was the Program described to the participants? • How did the educators describe the program (to researcher)?
Resources & tools	• Used or available materials & resources? • What tools/resources kids from in from outside? • Resources required in order to participate?
People	• Recruitment & Demographics Approaches • What is the relationship of people in setting with each other? Are they purposefully connected already (e.g. school, family)?
Community setting	• Who makes up the community of people participating? • What organizations & people are involved? • Who delivers content? • Who can youths potentially interact with during the activity? • What does the physical setting look like? • How do participants describe how the setting feels?
Roles	• What roles do people play? • How are those roles assigned? • When/how do they shift if at all? • How do these roles fit/challenge the norm? • Who is a "member" and in what way?
Norms	• What are the expectations for participation in this setting? • How are these expectations set and maintained? • How are they disrupted and by whom? • Who is invited to do things/ what are they invited to do?
Activities	• List the different activities which take place in this program
Power	• Who owns the space? How is ownership described by different actors/parties? • Who has power? To do what?

Table 7-5 First type of youth-initiated moments: Reorganizing social-spatial representations within learning spaces

Program[5]	Youth and educator	Brief description of the moment	Actions of disruption and transformation	Educators' and peers' responses	Bids for rightful presence
A-1	Kay, Ms. M	Taking space and time to express one's being and feeling	• Kay's playing with wrap bubble as a way of releasing frustration she felt from a maker project	• Ms. M's and peers' embracing Kay's wrap bubble play as a way of expressing and transforming the frustration Other youths joining in the wrap bubble play with joy • Kay acknowledging that wrap bubble helped her satisfied • Youths coming back and reengaging with their projects	• Embracing one another just as how they feel and what they want to be/do when they were engaging in challenging STEM making projects
A-1	Louise, Ms. M	Red couch becoming a place of the circle time activity in the STEM Club	• Louise moving toward and laying herself down on the red couch • Louise stating how and why she felt included in the red couch and in the STEM Club	• Ms. M recognizing the importance of red couch • Ms. M asking youths if they would like to change the place for circle time to red couch • Louise, peers, and Ms. M immediately rearranging their chairs around the red couch • Louise recalling a moment she felt included	• Making ISL space to be where youths feel included • Being experts in a STEM activity by using knowledge and expertise from home

---

[5] For the tables in Appendices E and F, I coded each of six programs as follows:
A-1. STEM Club (community center), A-2.STEM Summer Camp (community center)
B-1. YAC (science center), B-2. Forensics (science center), B-3. (science center)
C. Mash-up Forensics (science center + community center) Collaboration

Table 7-5 (cont'd)

A-2	Su'Zanne, Ms. M	Going out to try the STEM artifacts	• Su'Zanne holding the artifacts and urging to go out	• Ms. M following Su'Zanne's call and leading the group out of the building	• Disrupting the normative narrative of where learning happens
B-1	Ivy, Rose, Ms. A	Singing a song together	• Ivy and Rose singing a song, 'Let It Go,' as they released the frustration coming from their challenging project • Ivy and Rose taking up space by singing and moving their bodies across the room	• Ms. A recognizing youth-expressed in-the-moment frustration, • Ms. A playing the song from her phone • Ivy's and Rose' peers immediate participation in singing the song, moving their bodies freely in the room	• Making visible and releasing emotions coming from engaging in challenging STEM projects • Humanizing community in which youths feel free to express, release, and share frustration and excitement coming with STEM projects
B-1	Ivy, YAC youth, Ms. O	Designing shelves as furniture to exhibit youths' in-the-making artifacts	• Ivy's questioning why not displaying youth's in-the-making artifacts (not only the artifacts completed by adults educators and professionals)	• Other YAC youth's agreeing with Ivy's idea and suggesting to secure new furniture like shelves on which youths' in-the-making projects would be put and displayed Ms. O reaching out to the science center administrators to create the space and furniture for exhibiting youths' in-the-making artifacts	• Legitimizing youths' ideas of making and process of realizing the ideas while disrupting the narrative that the adults-made complete artifacts are worth being displayed in the makerspace

Table 7-5 (cont'd)

B-1	Bella, Jazmyn, Ms. O	Moving youths' project out of the YAC room	• Bella and Jazmyn physically moving their bodies, ideas and project materials into other – not STEM – spaces to create non-judgmental, youth-only, zones for project work	• Ms. O offering an independent and separate space for the project • Peers' joining recording testimonials Bella, Jazmyn, and peers engaging in dialogue on critically political STEM work without the worry of interference by boys	• Creating space in which girls solidify one another by sharing their own knowledge and concerns about feminine hygiene issues • Creating a non-judgmental youth-only zone for STEM project
B-1	JJ, Mr. C	Dancing out of joy	• JJ's expressing Joy and excitement by dancing while putting on his backpack he made possible to light up the electric circuit on it	• Ms. C clapping hands and dancing together as he knew how challenging and frustrating JJ felt when he was stuck with the circuit work • Peers exclaiming with JJ • Peers' asking for JJ's help to troubleshoot their electric circuit problem • JJ encouraging his peers by sharing his troubleshooting experience	• Being experts who learn by troubleshooting and working through challenges • Humanizing community in which youths feel free to express frustration and excitement coming with STEM projects
B-1	Trey, his family	Walking family members through the science center youths renamed/recl aimed	• Trey's letting his mother and younger brother into the science center (instead of just picking him up to go back home) and walking them to the	• Trey's mother and younger brother engaging in the science center tour toward Katherine Johnson room and listening to Trey's explanation of the project through which youths were renaming and redesigning the room	• Being experts who examine and redesign social-spatial representations of the science center • Being legitimate who can walk his

Table 7-5 (cont'd)

			'Katherine Johnson' room the YAC peers and he consensually named • Trey as a Black youth sharing his pride of renaming the room with a Black female engineer		family members into the science center space • Disrupting the white/male-centered representation of the science center by giving a room a name of a woman/Black engineer
B-2	Benson, Ms. A	Youth's correcting the educator	• Benson gently pointing out where Ms. A should rewrite the information about chromatography on the whiteboard	• Ms. A explicitly appreciating Benson • Ms. A asking Benson for how to revise her writing	• Being experts who can revise educator's statement and annotation
B-2	Ella, Ms. A	Being helped by a youth who volunteered co-teaching	• Ella noticing Ms. A being busy in responding to multiple questions from multiple tables during a foot-printing activity • Ella taking a new role as a co-educator by circulating several tables	• Peers viewing Ella as a co-teacher and asking for her help • Peers taking different roles to further help Ms. A • Ms. A verbally appreciating Ella and other youth	• Seeing their educator as a human being who may need youths' help • Being legitimate members who can proactively engage in activities not waiting for an educator's direction

Table 7-5 (cont'd)

B-2	Benson, Mr. C	Moving to the Chill Zone to discuss	• Benson recognizing awkward silence in his group when Mr. C asked to have a group discussion about mock crime scene investigation • Benson proposing his peers to move to the Chill Zone (created inside the room to allow youth-only space)	• Peers agreeing to Benson idea and moving to the Chill Zone without asking for Mr. C's permission • Peers circling up by themselves and engaging in an active discussion with comfortable poses • Benson and peers welcoming Mr. C sitting by their side, and joining as an active listener	• Creating a space youths are legitimate and more comfortable to discuss with one another • Seeking to disrupt the normal shaping of group formation that centers the educator and has youths sit around tables overseen by the educator
B-2	Dori, Mr. C	Youth's expressing excitement of investigation and reasoning.	• Dori standing straight up and stating her reasoning from evidence she gathered through the activity • Dori stating how she feels about herself ('I am so smart!')	• Mr. C noticing Dori's shift in participation from being less engaged to actively leading • Revoicing Dori's thoughts and asking Dori to articulate her thoughts further in front of her peers	• Being recognized as an expert who reasons with evidence
B-2	Dori, Mr. C	Standing up and leading the group discussion	• Dori standing up with the iPad with which she took photos of the mock crime scene • Dori moving to the front to lead the group discussion-not being led by Mr. C	• Mr. C readily stepping aside while attentively listening to youth • Peers participating in the discussion • One of them coming out to the front of the whiteboard to display his calculation	• Being an expert who critically reason with evidence • Transforming the discussion to be youth-led

Table 7-5 (cont'd)

B-2	Jerome, Mr. C	Being helped by a youth who volunteered co-teaching	• Jerome noticing Mr. C being busy in responding to multiple questions from multiple tables during a foot-printing activity • Jerome approaching to Mr. C and saying he can help Mr. C	• Mr. C, verbally appreciating Jerome being willing to help him and asking Jerome for some specific supports • Jerome moving around tables and helping his peers saying 'we' (not by Mr. C's hands) can do this ourselves • Peers shifting from waiting for Mr. C to discussing with one another	• Seeing their educator as a human being who may need youths' help • Being legitimate members who can proactively engage in activities not waiting for an educator's direction
B-2	Reshma, Mr. C	Putting on gloves and goggles	• Reshma's asking Mr. C to provide with gloves and goggles before conducting a powder testing activity • Reshma claiming that wearing gloves and goggles is important for her to do real science	• Mr. C, who thought the gloves and goggles would be unnecessary or cause distraction, recognizing youths' seeking to legitimize their activities as science • Mr. C providing youths with gloves and goggles so that youths could choose to wear • Youths, wearing gloves (to them, as a symbol of their engagement in a scientific work), becoming careful in their use and measuring of powder	• Being experts who engage in authentic investigation (not the copy or simplified version of it) • Disrupting the norm that investigation in classrooms is fine to be simplified
B-2	Carla, Ms. S	Youth's expressing excitement of feeling herself connected to science	• Carla's naming the activity result as 'another me'; Moving around to recognize others' results and sharing joy	• Ms. S echoing youth's excitement stretching her arms with a big smile • Ms. S looking into other youths' results and expressing the same excitement for them	• Finding youths themselves through ISL activities • Creating a space in which they can move around and interact with others

Table 7-5 (cont'd)

B-2	Joe, Ms. S	Youth's expressing excitement of trouble-shooting and feeling accomplished	• Joe's exclaiming with joy of troubleshooting • Moving around to recognize and praise others' artifacts	• Ms. S's echoing Joe's excitement Encouraging youths bring her artifact to home	• Being recognized as experts who can solve problems and help others
B-3	Brittany, Anne, Mr. C	Leading the co-creation of Sphero soccer game and its playing field	• Brittany and Anne proposing the ideas of creating a new activity, Sphero soccer game. • Brittany and Anne actively discussing details of the game they created and pointing out the need to make a playing field to do the game.	• Mr. C noticing the shift in the girls' engagement in the Leading the co-creation of Sphero soccer game and its playing field camp with other nine boys	• Disrupting a white-male dominant space in which girls have voices and lead boys to co-create new activities
B-3	Brittany, Anne, me	Shifting from a researcher interviewing youths to youths interviewing one another	• When I asked if the two girls are interested in having an interview • Brittany and Anne asking if they can have the interview together	• Me welcoming the idea of Brittany and Anne having an interview together • Brittany asking me which questions I would ask to them • Brittany and Anne proposing that they reorganize the questions add some more and that they interview their peers • Me supporting youths to develop question prompts and peer-interview	• Shifting the binary between the adult researcher and the youths researched by legitimizing their suggestions (to edit the question prompts and the format of interview)

Table 7-5 (cont'd)

C	K, Ms. A	Laying on the red couch and still actively participating in activity	• K's laying on the red couch as a way to feel safe and rightful as she was	• Ms. A heading her body to youths not only in the activity tables but to K on the red couch so that K would feel that she was still involved in the session • K coming back to the activity table when she felt she had sufficient time to take rest in the red couch • Ms. A welcoming K when she re-joined	• Seeking different ways of youths wanting to feel and do and legitimizing the different ways

Table 7-6 Second type of youth-initiated moments for creating activities that matter to youths

Program	Youth and educator	Brief description of the moment	Actions of disruption and transformation	Educators' and peers' responses	Bids for rightful presence
A-1	ReRe, Ms. R	Rap as a brainstorming activity for designing STEM projects	• ReRe spontaneously sharing one of her rap lines she had composed at home, during the discussion on which making/research projects youths would like to do with the topic of sustainable community • ReRe's rap line presenting the critique of anti-immigrant policy (that took place back then)	• Peers offering beats to ReRe's rap • Ms. R asking ReRe to continue to perform rap • Ms. R adding her own rap lines to ReRe's rap • Peers using raps to name and discuss community issues	• Legitimizing youths' expertise from their core culture • Seeking to expose injustices by using raps and taking the issues at the core of their STEM projects
A-1	STEM Club youth, Ms. M	Youth Talent Show	• Youths suggesting the idea of talent show • Youths using the whiteboard, and moving their body across the Maker Club room	• Ms. M immediately incorporating the youths' ideas • Ms. M soliciting youths' input to concretize the plan.	• Being legitimate members who create new activities • Creating an ISL space in which youths' expertise and its diversity are recognized and publicized

Table 7-6 (cont'd)

A-1	Su'Zanne, Ms. M	Youth's wanting to make an artifact for her educator	• Su'Zanne personalizing the maker tools and materials to make artifacts that matters	• Ms. M explicitly appreciating Su'Zanne's thinking of her • Peers' recognizing the quality of Su'Zanne's artifacts	• Making artifacts that matter • Humanizing community as expressing gratitude to the educator using artifacts youths produced
A-2	Louise, Chloe, me	Embodied investigation of pinhole camera images	• Louise posing a question of 'what does the image on the pinhole camera look like if we stand upside down and then see through it'	• Chloe immediately moving across the room to an empty spot • Chloe taking different up-side down poses and seeing objects in and out of the room through the pinhole cameras • Me supporting youth-initiated spontaneous investigation as a co-learner	• Being legitimate members who can ask a spontaneous question that lead to create an engaging scientific investigation • Disrupting the traditional relationality that positions youths as knowledge recipients (i.e., voluntary and agentic investigation)
A-2	Louise, Chloe, Lele, Su'Zanne, Ms. M	Identifying problems to solve and troubleshooting immediately	• Louise' calling out peers for a spontaneous discussion among youths to figure out ways to voice control devices	• Peers' gathering and brainstorming to solve problems; • Expressing joy of troubleshooting by exclamation	• Being experts who identify and troubleshoot problems in making artifacts

Table 7-6 (cont'd)

A-2	Su'Zanne, Lele, me	Youth's proposal of revising the educator-planned activity	• Su'Zanne proposing to revise an activity I planned for them • Su'Zanne announcing in public her wants to add a showcase time to invite her friends and educators	• My revising the daily goal and activity • Lele teaming up with Su'Zanne to make their artifact be showcased to adults and friends who were important for them in the community center	• Being recognized as experts by those who matter to youth • Being legitimate members who can revise the educator-planned activities
B-1	Lele, Mr. C	Wanting to make a difference	• Lele adding one more hand than what Mr. C instructed youths to do, during a YAC session	• Mr. C verbally acknowledging Lele's version working well and introducing other youths about the way Lele attempted and succeeded • Peers visiting Lele's table and asking how she added it and trying their own versions of additions	• Being legitimate members who can revise educator-planned activities • Realizing ideas youths imagined into the STEM project
B-1	Samuel, Ms. O	Wanting to make what matters	• Samuel's initiating a new individual project of making a nameplate; different from what Ms. O asked for youths to do	• Ms. O appreciating Samuel's initiative • Ms. O adding the nameplate making activity for other youths to create nameplates (in the following YAC session)	• Identifying and creating artifacts that matter • Realizing ideas youths imagined into the STEM project
B-2	Amir, Ms. A	Youth wanting to continue an activity he immersed himself in (foreclosed)	• Amir stating out loud that he wanted to discuss the interrogative interview	• Ms. A, however, due to the planned schedule of the program, having to discourage Amir and letting youths prepare for moving to the next session	• Being legitimate members who can choose to continue the activity that mattered

Table 7-6 (cont'd)

B-2	Zion, Ms. A	Youth-suggested game as a legitimate science learning activity	• Zion standing up and shouting out 'let's play a game' (when there was a time remained until the break time)	• Peers' immediate echoing Zion with excitement • Ms. A leveraging youths' ideas to create and enact a game that can incorporate the daily learning • Youths and Ms. A enjoying the game taking a turn of the facilitator role	• Creating a space that shares joy and excitement as they engage in the game
B-2	Neeala, Mr. C	When youths are curious about something different from what the educator wants them to be (1)	• Neeala's asking Mr. C a question about the bottom layer of DNA extraction solution	• Mr. C at first feeling a dilemma because Neeala's question was what he hoped to avoid as the question requires a length of time to answer and he was concerned about time, however • Mr. C appreciating Neeala's question and modifying his plan to take time having youths share their thoughts • Mr. C finding youths' thoughts were importantly connected to the main concept of the day he sought to introduce	• Being legitimate members who can raise questions about what one wonders about
B-2	Neeala, Mr. C	When youth are curious about something different from what the educator wants them to be (2)	• Neeala's asking Mr. C a question if the class evidence can be an individual evidence and vice versa	• Mr. C, instead of giving direct answers, improvising an activity in the moment by offering the materials (e.g., fingerprint sample, footprints) youths can investigate • Peers creating stories by distinguishing class/individual evidence from offered materials	• Being legitimate members who can raise questions about what one wonders about

Table 7-6 (cont'd)

B-2	Amy, Ms. S	From a youth's imagination elicited by an educator-facilitated activity to peers' creating an imaginary story	• Amy asking a question to Ms. S if she can make clones out of the DNA strands extracted from spit	• Peers' participating in the storyline to make clones of themselves • Ms. S's centering youth's stories, instead of taking them as off-task	• Being legitimate creators of imaginary stories that are relevant to the activity educators facilitated youths to engage themselves in
B-2	Sarah, Ms. S	Shift in engagement	• Sarah shifting her mode of interaction with her educator Ms. S from being quiet and listening toward being actively asking and wanting to discuss forensics-related professions	• Ms. S recognizing Sarah's evident shift in interaction • Ms. S changing the plan of the day in response to Sarah's curiosity and improvising a discussion activity of exploring forensics-related professions	• Expressing one's curiosity and interest without hesitation • Being legitimate members who can change the educator's instructional plan to respond to what matters youths in the moment
B-3	Brent, Mr. C	Initiating and leading a daily discussion	• Brent approaching Mr. C during lunch time and suggesting that the campers need a discussion activity at the end of every day, instead of writing a journal	• Mr. C agreeing to Brent's idea and verbally thanking to Brent • Asking other youths about the idea of end-of-day discussion in which youths would share their project progress and wonderings • Brent further suggesting youths to take a turn of the facilitator role • Mr. C having youths facilitate the activity	• Being legitimate members who can suggest and make a decision of adding a new activity that would matter more than what educators intended to offer • Building a community where youths respect and encourage one another and their projects

Table 7-6 (cont'd)

B-3	Jake, Anne, Mr. C	Co-creating a new ISL activity of Sphero Soccer	• Jake and Anne proposing a Sphero Soccer game • Jake and Anne coming out to the front where the whiteboard was placed	• Mr. C stepping himself back to have youths discuss with one another • Brittany proposing an idea that they should make a playing field if they really would like to play the game • Peers joining in the creation of the game rules and the playing field	• Legitimizing their passion and knowledge (about soccer, in this case) to create a new activity • Building a community where youths take both leadership and respect one another's ideas
C	Monica, Cassie, Chloe, Ms. A	Youth-improvised role play as an activity that matters in the Forensic science learning	• Monica, Cassie, and Chloe improvising the role play developed from fingerprinting activity • Monica, Cassie, and Chloe taking up space by moving their bodies across the room for the role play	• Ms. A noticing and verbally stating the powerful message of the role play • Ms. A facilitating other youth's participation in the role play • Monica, Cassie, Chole, and peers joining the role play, positioning themselves with new roles (lawyers, witnesses, and jurors)	• Humanizing communities (trying to defend their peer unduly accused in the role play storyline) • Seeking to expose/disrupt unjust narratives of unfair judicial decision making • Being experts (judges, lawyers)

Table 7-7 Third type of youth-initiated moments for foregrounding the sociopolitical dimension of learning

Program	Youth and educator	Brief description of the moment	Actions of disruption and transformation	Educators' and peers' responses	Bids for rightful presence
A-1	William, Ms. M	Wanting to make what matters	• William showcasing his expertise in sewing to the educator and peers • William taking up the space to move his body and exclaim out his idea • Revising the e-textile activity of making bookmarks to initiate a new project of making fanny packs	• Ms. M recognizing and legitimizing the STEM project (making fanny packs) that mattered to the youth • Peers validating the utility of fanny packs sharing with Ms. M what happened in the school earlier on that day (one friend's belongings being stolen)	• Being recognized by expertise learned from home and ideas developed from daily lives from (with their sewing skills and design ideas of why fanny packs matter than bookmarks) • Humanizing use of STEM (for keeping his peers' belongings from being stolen) • Engaging in STEM projects explicitly grounded in youth's lived lives not just in adult-suggested ones (making fanny packs instead of bookmark)
A-2	Louise, Chloe, me	Co-designing and revising program plan with educators	• Louise and Chloe, who were looking into the handout I generated, critiquing some languages in the handout they were unfamiliar	• Me asking youths to help change the handout • Louise and Chloe bringing a big whiteboard to visualize how they want to change it • As a follow up, me bringing the revised handout next day to be confirmed by the youths	• Being legitimate members who critique and revise educator-designed activities/programs

Table 7-7 (cont'd)

A-2	Su'Zanne, Ms. M	Naming out MIT in training	• Su'Zanne introducing a new position of mentors-in-training-in-training	• Ms. M and me asking Su'Zanne why she would like to create the new position given that youths are eligible to become mentors in their 9th grade and mentors-in-training in their 8th grade • Su'Zanne, as 6th grader having multiple years of experience in STEM Club claiming that youths should be eligible to be mentors not because of their grades but because of their experiences in the STEM club • Louise reframing the camp as a program to prepare youths to be the mentors-in-training-in-training creation of new activities and expectations to be MIT in training	• Disrupting the established norm that the older youths are more eligible to become mentors for the younger youths by pointing out that one can have more or less experiences in the STEM Club regardless of the grades
B-1	Ivy, Mr. C	Refusing to schoolwork-type project	• Ivy verbally expressing refusal and reason why she refuses	• Mr. C recognizing and affirming the refusal as reasonable • Mr. C asking youths to help him figure out alternative activities youths can participate in • Ivy and peers brainstorming which alternative projects they would like to do in addition to (or instead of) the project Mr. C planned	• Seeking to disrupt the school-type STEM activity • Being legitimate members who critique and revise educator-designed activities/programs

Table 7-7 (cont'd)

B-1	RQ, Ms. A	Valuing the work using research to expose and disrupt injustice	• RQ, who was mostly quiet in the YAC, voicing out her thoughts about how the names of science center rooms should be changed • As a new name of the room in the science center, RQ suggesting 'Mamie Clark'	• Ms. A recognizing the explicit passion exuded by RQ who had remained usually quiet • Ms. A and Peers attentively listening to RQ and asking for RQ's further explanation about Mammie's life • Peers' resonating with RQ and adding Black female scientists and engineers who were historically hidden	• Seeking to make visible the efforts to disrupt injustices in their very own learning spaces • Seeking to make visible women and people of Color who had been invisible in the major narrative of STEM fields
B-1	YAC youths, Ms. O	Envisioning a place to dream big	• YAC youths freely discussing how they would like to redesign their makerspace	• Ms. O asking youths to further develop their ideas about how such a space would look • YAC youths concretizing their ideas by sketching them on the paper and the whiteboard • Ms. O continuing to design the makerspace with youths, undergoing administrative negotiation	• Being legitimate members who can create the science center space that matters • Critiquing the white-male-centered imaginary representing science and science centers
B-2	Amir, Ms. A	Critiquing and revising interrogative questions	• Amir critiquing the biased assumption revealed from interrogative questions his peers and Ms. A were brainstorming	• Ms. A affirming Amir's critique and acknowledging the assumption • Ms. A asking Amir and other youths how to improve the interrogative questions they made • Amir and peers revising interrogative questions carefully	• Seeking to expose and critique presumption that underlie the discourse • Being legitimate members who critique and revise ideas and discourse presented in the learning community

Table 7-7 (cont'd)

B-2	Laila, Mr. C	Spelling out a scientific term that sounds difficult to pronounce	• Laila's pausing Mr. C to practice pronunciation of the word, when Mr. C wrote the term deoxyribonucleic acid and spelled it out and one youth claimed that Mr. C was smart • Laila practicing herself the term several times and successfully spelling it out publicizing that young people can do it	• Peers also spelling the term out being able to pronounce the word • Laila pointing out that being able to spell out scientific terms are more about practice less about smartness	• Exposing and disrupting the normative narrative that people are considered smart when they can pronounce scientific jargons well enough
B-2	Markeila, Mr. C	Navigating tension between scientific and religious ways of explaining human origin	• Markeila interrupting Mr. C who was explaining evolution • • Markeila asking Mr. C about the gap between two different explanations about the beginning of life in Earth	• Mr. C, while acknowledging multiple ways to explain the origin of life in earth, stating how scientific explanation works • Markeila acknowledging Mr. C's explanation making sense and speaking out what she further wanted to learn to understand both ways of explaining the origin of life and earth	• Seeking to legitimize one's identity (Markeila's faith) in the learning space • Legitimizing their willingness to opening up the conversation to some controversial topics
B-2	Amir, Mr. E	Youth critical question (foreclosed)	• Amir seeking to shift the group discussion discourse regarding racial injustice in STEM and society	o Supporting critical dialog after disciplinary activity; Mr. E recognizing Amir's question as passionate •	• Seeking to expose issues of injustices and discuss them as part of ISL

Table 7-7 (cont'd)

				• Mr. E gently asking Amir to discontinue his statement as it sounded political, and thus, to Mr. E's view, inappropriate to discuss in the STEM learning space o Mr. E bringing the moment to RPP meeting so that he could further discuss the moment with his colleague educators and research partners	
B-2	Jose, Mr. E	Youth's wanting to bring what they learned in the science center to home	• Jose's asking questions to Mr. E so that he could continue doing Forensic activity at home with his brother and his friends	• Mr. E suggesting several pathways to continue the similar investigation both at home and in their school • Mr. E encouraging other youths also to try out	• Seeking to disrupt and expand the space of doing STEM from the science center to the community youths cared
B-2	Chloe, Ms. S	Youth's wanting to bring what they learned in the science center to home	• Chloe's asking Ms. S to let her know the detailed process of experiments again so that she could do it for her mother at home.	• Ms. S writing down the procedure on the whiteboard so that other youths also can try it at home • Youths asking more questions about why each step is necessary so that they could explain when they use particular materials at particular steps	• Seeking to disrupt and expand the space of doing STEM from the science center to the community youths cared

Table 7-7 (cont'd)

B-2	Chloe, Ms. S	Youth resisting competitive and individualized conclusion writing (foreclosed moment)	• Chloe suggesting Ms. S to diversify ways of youths expressing daily learning attainment	• Ms. S noting that the youths' supervisor teacher requested educators to have youths complete the conclusion writing • Jose validating Ms. S's point as he wrote his answer on his note • Chloe still refusing to write it down while her peers were leaving the room after completing the conclusion writing (however, she ended up completing her conclusion writing with well-versed answers)	• Being legitimate members who critique and revised adult-designed activities • Humanizing community in which youths share what each other learned and develop learning as community • Seeking to disrupt and transform a normalized activity
B-2	Jose, Ms. S	Youth's challenging question about the value of learning forensic program (foreclosed)	• Jose asking Ms. S why one should learn forensics, pointing out the possible misuse of forensics knowledge ('what if bad people use the knowledge of fingerprints and manipulate them')	• Ms. S being embarrassed and not knowing to how to respond at the moment	• Seeking to examine the value of learning forensics knowledge
B-2	Sam, Ms. S	Youth's challenging question about the scientific ground of judicial norms (foreclosed)	• Sam pausing Ms. S and peers from moving onto the next activity and wanting to make sense of the information Ms. S shared	• Ms. S, as she felt obliged to transition to the next activity (conclusion writing), gently asking Sam to move on, not discussing her questions	• Seeking to examine fairness and scientific basis of social norms

Table 7-7 (cont'd)

B-3	Brent, Mr. C	Resisting against writing daily journals	•	Brent shouting out, "I don't want to write it [journal]. I should do this [making a robot] instead of writing it"	•	Mr. C recognizing why Brent shouted out and letting Brent and other youths continue working on their individual projects o making robots	•	Resisting to engage in a normative daily activity
B-3	Youth campers, Mr. C	Resisting to discontinue an activity youths immersed themselves in (foreclosed)	•	Youths approaching to Mr. C to ask if they could continue working on their coding projects	•	Mr. C recognizing youths' wanting to engage in an activity they had immersed themselves in • Mr. C, however, having youths pause and follow the camp routine	•	Resisting a routine practice (lunch time) to take time for an activity that matter
C	W, Ms. A	Resisting traditional lecture-type session	•	W's naming how the program feels to him; W while coming to every program session, but leaving	•	Ms. A's engaging with critical reflection of the moment and seeking to change her pedagogical approaches to be explicitly youth-participatory	•	Critiquing the traditional imaginary of lecture-centered learning

Appendix F. Educators' Pedagogical Practices: Summary of Analysis Results

Table 7-8 Cases presenting the first set of pedagogical practices (Educator-designed space making)

Program	Youth and educator	Brief description of the moment	Practices for educator-designed space making
B-1	JJ, Mr. C	Dancing out of joy	• Designing and facilitating makers' projects that youths design, prototype, and propose as activities potentially usable in the science center STEM programs • Publicizing youths' success in a challenging task by clapping hands and dancing together (as Mr. C knew how challenging and frustrating JJ felt when he was stuck with the circuit work)
B-2	Dori, Mr. C	Youth's expressing excitement of investigation and reasoning.	• Designing an activity in which youths can exercise agency (Mock CSI) • Facilitating youths to work as groups to gathering and reasoning from evidence • Publicizing Dori's thoughts and asking Dori to articulate her thoughts further in front of peers
B-2	Joe, Ms. S	Youth's expressing excitement of trouble-shooting and feeling accomplished	• Designing an activity in which youths can exercise agency (DNA extraction) • Facilitating youths to work as groups to figure out their experiment processes through discussing with one another and referring to handouts or instruction on the whiteboard • Publicizing the ideas and questions youths presented along with the DNA extraction activity and leveraging them for youths to learn how DNA works
B-2	Carla, Ms. S	Youth's expressing excitement of feeling herself connected to science	• Designing an activity in which youths can exercise agency (DNA extraction) • Facilitating youths to work as groups to figure out their experiment processes through discussing with one another and referring to handouts or instruction on the whiteboard • Publicizing the ideas and questions youths presented along with the DNA extraction activity and leveraging them for youths to learn how DNA works

Table 7-8 (cont'd)

B-2	Amir, Ms. A	Youth wanting to continue an activity he immersed himself in (foreclosed)	• Designing a scenario-based activity of creating interrogative questions • Facilitating the activity by casting an Adult educator member who will play the role as an imaginary person who would be interrogated by youths (giving the sense of real interrogation) • Publicizing youths ideas of interrogative questions on the whiteboard • *However,* due to the planned schedule of the program, having to discourage Amir and letting youths prepare for moving to the next session
B-2	Amir, Mr. E	Youth critical question (foreclosed)	• Designing an activity in which youths can exercise agency (mock CSI) • Facilitating: Engaging youths in discussion of who they are suspicious among five suspects (imaginary) introduced by the handout • Recognizing Amir's question as passionate • *However*, not affirming Amir's statement • Bringing the moment to RPP meeting so that he could further discuss the moment with his colleague educators and research partners
B-2	Chloe, Ms. S	Youth resisting competitive and individualized forms of assessment (foreclosed)	• Designing an activity in which youths can exercise agency (DNA extraction) • Facilitating youths to work as groups to figure out their experiment processes through discussing with one another and referring to handouts or instruction on the whiteboard • Publicizing the ideas and questions youths presented along with the DNA extraction activity and leveraging them for youths to learn how DNA works • *However,* Ms. S not affirming: that the youths' supervisor teacher requested educators to have youths complete the conclusion writing
B-2	Jose, Ms. S	Youth's challenging question about the value of learning forensic program (foreclosed)	• Designing an activity in which youths can exercise agency (Mock CSI) • Facilitating youths to work as groups to gathering and reasoning from evidence • *However,* Ms. S being embarrassed and not knowing to how to respond at the moment

Table 7-8 (cont'd)

B-2	Sam, Ms. S	Youth's challenging question about the scientific ground of judicial norms (foreclosed)	- Designing an activity through which youths can exercise agency (Mock CSI) - Facilitating youths to work as groups to figure out their experiment processes through discussing with one another and referring to handouts or instruction on the whiteboard *However,* Ms. S, (in a hurry) to transition to the next activity (conclusion writing), gently asking Sam to move on, not discussing her questions
B-3	Youth campers, Mr. C	Resisting to discontinue an activity youths immersed themselves in (foreclosed)	- Designing coding activities youths can choose from and exercise agency - Facilitating youths' choice activities with abundant materials and resources; as youths engage in their activity, Mr. C circulating across tables as youths work as groups and continuing to communicate with youths - Publicizing the ideas, knowledge, and skills that youths shared with him individually or as groups and that allowed Mr. C to share with other youths - Recognizing what youths wanted, *However,* not affirming in the moment as youths were asked to follow the routine [later this foreclosed moment led to another moment of youths co-creating new ISL opportunities]

Table 7-9 Cases presenting the second set of pedagogical practices (Taking-up youths' disruption and reorganizing ISL opportunities with youths), in addition to the first set

Program	Youth and educator	Brief description of the moment	Practices for educator-designed space making	Practices for taking up youths' disruption and reorganizing ISL opportunities with youths
A-1	Kay, Ms. M	Taking space and time to express one's being and feeling	• Planning and facilitating a making project that youths use STEM to address issues of their local community • Offering the circle time for youths to share their design ideas and comments, emotions and daily experiences	• Recognizing and affirming Kay's wrap bubble play as a way of expressing and transforming the frustration
A-1	Louise, Ms. M	Red couch becoming a place of the circle time activity in the STEM Club	• Planning and facilitating a making project that youths use STEM to address issues of their local community • Offering the circle time for youths to share their design ideas and comments, emotions and daily experiences	• Recognizing the importance of red couch • Soliciting youths' thoughts about if they would like to change the place for circle time to red couch
A-1	William, Ms. M	Wanting to make what matters	• Planning and facilitating a making project that youths use STEM (bookmark) • Offering the circle time for youths to share their design ideas and comments, emotions and daily experiences	• Recognizing and legitimizing the STEM project (making fanny packs) that mattered to the youth • Soliciting William's design ideas and prototyping for his peers who might be interested in making theirs
A-2	Louise, Chloe, me	Co-designing and revising program plan with educators	• Being willing to co-design and revise the summer camp activities with youths while rigorously preparing for the activities based on what the educators observed as youths' interested areas (visual devices)	• Recognizing and affirming youths' critique on the educator-designed handout as important • Asking youths to help change the handout As a follow up, bringing the revised handout next day to be confirmed by the youths

Table 7-9 (cont'd)

A-2	Su'Zanne, Lele, me	Youth's proposal of revising the educator-planned activity	• Being willing to co-design and revise the summer camp activities with youths while rigorously preparing for the activities based on what the educators observed as youths' interested areas (visual devices)	• Recognizing and affirming youths' want to revise the daily plan • Immediately revising the daily goal and activity asking youths' suggestions
A-2	Su'Zanne, Ms. M	Going out to try the STEM artifacts	• Being willing to co-design and revise the summer camp activities with youths while rigorously preparing for the activities based on what the educators observed as youths' interested areas (visual devices)	• Recognizing and affirming the benefit of going out for the pinhole camera activity Asking Su'Zanne's to take lead on the observation activity
A-2	Su'Zanne, Ms. M	Naming out MIT in training	• Being willing to co-design and revise the summer camp activities with youths while rigorously preparing for the activities based on what the educators observed as youths' interested areas (visual devices)	• Recognizing and affirming Su'Zanne's wanting to name a new position • Asking Su'Zanne to further unpack her thoughts and how to revise the camp plan
B-1	Ivy, Mr. C	Refusing to schoolwork-type project	• Planning and facilitating a making project that youths express themselves (Identity poster) • Offering times for youths to share their design ideas and comments	• Recognizing and affirming the refusal as reasonable • Asking youths to help him figure out alternative activities youths can do
B-1	Ivy, Rose, Ms. A	Singing a song together	• Planning makers' projects that youths outline, prototype, and propose as activities potentially usable in the science center STEM programs • Facilitating youths' maker projects with abundant materials and resources • Offering times for youths to share their design ideas and comments	• Recognizing youths' frustration in the middle of engaging in the projects that became to be challenging as youths tried to realize their design ideas • Immediately responding to Ivy and Rose singing a song by playing the song from her phone; Singing together with Ivy, Rose, and other youths and helping youths take time to release their frustration and refresh the atmosphere with laughter and free movement

Table 7-9 (cont'd)

B-1	Lele, Mr. C	Wanting to make a difference	• Designing and facilitating youth-authored makers' projects that youths outline, prototype, and propose as activities potentially usable in the science center STEM programs • Offering times for youths to share their design ideas and comments	• Verbally acknowledging Lele's version working well and introducing other youths about the way Lele attempted and succeeded
B-1	Samuel, Ms. O	Wanting to make what matters	• Designing and facilitating youth-authored makers' wood making projects that may be used for the science center programs • Offering times for youths to share their design ideas and comments	• Validating Samuel's initiative Adding the nameplate making activity for other youths to create nameplates (in the following YAC session)
B-2	Amir, Ms. A	Critiquing and revising interrogative questions	• Designing a scenario-based activity of creating interrogative questions • Facilitating the activity by casting an Adult educator member who will play the role as an imaginary person who would be interrogated by youths (giving the sense of real interrogation) • Showcasing youths ideas of interrogative questions on the whiteboard	• Acknowledging that she was not aware of how the interrogative questions sound biased • Immediately validating Amir's critique and acknowledging the assumption • Over time, revising educator prompts facilitating the interrogation activity for the following sessions • Asking Amir and other youths for how to improve the interrogative questions
B-2	Amy, Ms. S	From a youth's imagination to peers' creating an imaginary story	• Planning and facilitating an activity that youths can exercise agency (as small groups, DNA extraction, developing handouts) • Sharing the ideas and questions youths presented along with the DNA extraction activity and leveraging them for youths to learn how DNA works	• Affirming youths' imaginary stories of making clones by centering youth's stories, instead of taking them as off-task

Table 7-9 (cont'd)

B-2	Benson, Mr. C	Moving to the Chill Zone to discuss	• Planning and facilitating an activity that youths can exercise agency (as small groups, Mock CSI) • Having youths share their reasoning of who seem suspicious by analyzing evidence they gathered	• Recognizing and affirming youths wanting to have a separate space for discussion • Sitting by their side, and joining as an active listener
B-2	Benson, Ms. A	Youth's correcting the educator	• Planning and facilitating an activity that youths can exercise agency (blood typing) • Allowing youths chime in during her explanation	• Explicitly appreciating Benson • Asking Benson for how to revise the note she put on the whiteboard
B-2	Laila, Mr. C	Spelling out a scientific term	• Planning and facilitating an activity that youths can exercise agency (DNA extraction) • Allowing youths chime in during her explanation of content and activity	• Recognizing and affirming Laila's point by revoicing what she said (being able to spell out scientific terms are more about practice less about smartness)
B-2	Markeila, Mr. C	Navigating tension between scientific and religious ways of explaining human origin	• Planning and facilitating an activity that youths can exercise agency (DNA extraction) • Allowing youths chime in during her explanation of content and activity	• Recognizing and affirming Markeila's wanting to be welcome with questions from her faith • Acknowledging multiple ways to explain the origin of life in earth, stating scientific explanation • Asking for Markeila's explanation and wonderings
B-2	Neeala, Mr. C	When youths are curious about something different from what the educator wants them to be (1)	• Planning and facilitating an activity that youths can exercise agency (DNA extraction) • Allowing youths chime in during her explanation of content and activity	• Recognizing tension Mr. C felt at first because Neeala's question was what he hoped to avoid for the sake of time; However, • Appreciating Neeala's question and modifying the instructional plan to take time to listen to youths thoughts

Table 7-9 (cont'd)

				• Soliciting youths to share their observations and wonderings from the experiment • Recognizing youths' thoughts were importantly connected to the main concept of the day Mr. C planned to introduce
B-2	Neeala, Mr. C	When youths are curious about something different from what the educator wants them to be (2)	• Planning and facilitating an activity that youths can exercise agency (Types of evidence in Forensics) • Allowing youths chime in during her explanation of content and activity	• Recognizing Neeala's question worth investigating; • Instead of giving direct answers, improvising an activity in the moment by offering the materials (e.g., fingerprint sample, footprints) from which youths can distinguish class and individual evidence
B-2	Reshma, Mr. C	Putting on gloves and goggles	• Planning and facilitating an activity that youths can exercise agency (powder testing, small groups) • Offering time to explain the process and results of powder testing activity	• Acknowledging tension Mr. C felt at first because he thought the gloves and goggles would be unnecessary or cause distraction; however • Recognizing youths' seeking to legitimize their activities as science • Providing youths with gloves and goggles so that youths could choose to wear them
B-3	Brent, Mr. C	Initiating and leading a daily discussion	• Designing coding activities youths can choose from and exercise agency • Facilitating youths' choice activities with abundant materials and resources • Publicizing the ideas, knowledge, and skills that youths shared with him	• Affirming Brent's idea by verbally thanking him • Asking other youths about the idea of end-of-day discussion in which youths would share their project progress and wonderings Having youths facilitate the activity

Table 7-9 (cont'd)

B-3	Brent, Mr. C	Resisting against writing daily journals	• Designing coding activities youths can choose from and exercise agency • Facilitating youths' choice activities with abundant materials and resources • Publicizing the ideas, knowledge, and skills that youths shared with him	• Recognizing why Brent shouted out and letting Brent and other youths continue working on their individual projects o making robots
B-3	Brittany, Anne, me	Shifting from a researcher interviewing youths to youths interviewing one another	• Designing coding activities youths can choose from and exercise agency • Facilitating youths' choice activities with abundant materials and resources • Publicizing the ideas, knowledge, and skills that youths shared with him	• Affirming the idea of Brittany and Anne having an interview together • Supporting youths to develop question prompts and peer-interview
B-3	Brittany, Anne, Mr. C	Leading the co-creation of Sphero soccer game and its playing field	• Designing coding activities youths can choose from and exercise agency • Facilitating youths' choice activities with abundant materials and resources • Publicizing the ideas, knowledge, and skills that youths shared with him	• Recognizing and affirming youths' wanting to continue operating Sphero robots as agentic and legitimate • Soliciting youths' co-creation of the Sphero soccer game and its playing field; and offering continued support for youths to take leadership
C	W, Ms. A	Resisting traditional lecture-type session	• Planning and facilitating an activity that youths can exercise agency (blood typing) • Allowing youths chime in during her explanation of content	• Engaging with critical reflection of the moment • Seeking to change her pedagogical approaches to be explicitly youth-participatory

Table 7-10 Third set of pedagogical practices (Co-creating new ISL opportunities with youths), in addition to the first set

Program	Youth and educator	Brief description of the moment	Practices for educator-designed space making	Practices for Co-creating new ISL opportunities with youths
A-1	Jeff, Ms. R	Youth's story of home	• Planning and facilitating a making project that youths use STEM to address issues of their local community • Offering the circle time for youths to share their design ideas and comments, emotions and daily experiences	• Resonating with Jeff's willingness to incorporate his home story and supporting him to do his individual project
A-1	ReRe, Ms. R	Rap as a brainstorming activity for designing STEM projects	• Planning and facilitating a making project that youths use STEM to address issues of their local community • Offering the circle time for youths to share their design ideas and comments, emotions and daily experiences	• Asking ReRe's Rap performance • Ms. R validating rap by adding her own rap lines to ReRe's rap Soliciting youths for using raps to name and discuss community issues
A-1	STEM Club youth, Ms. M	Youth Talent Show	• Planning and facilitating a making project that youths use STEM to address issues of their local community • Offering the circle time for youths to share their design ideas and comments, emotions and daily experiences	• Recognizing and affirming youths wanting to be recognized by people important to them • Immediately incorporating the youths' ideas as soliciting youths' input to concretize the plan.
A-1	Su'Zanne, Ms. M	Youth's wanting to make an artifact for her educator	• Planning and facilitating a making project that youths use STEM to address issues of their local community • Offering the circle time for youths to share their design ideas and comments, emotions and daily experiences	• Explicitly appreciating Su'Zanne's thinking of her • Asking further the process of making the artifact

Table 7-10 (cont'd)

A-2	Louise, Chloe, me	Embodied investigation of pinhole camera images	• Being willing to co-design and revise the summer camp activities with youths while rigorously preparing for the activities based on what the educators observed as youths' interested areas (visual devices)	• Recognizing youths movement in the room as their spatial ownership • Supporting youths to engage in the instantiated investigation by having youths use whiteboards, markers, and other tools for them to record the result of investigation
A-2	Louise, Chloe, Lele, Su'Zanne, Ms. M	Identifying problems to solve and troubleshooting immediately	• Being willing to co-design and revise the summer camp activities with youths while rigorously preparing for the activities based on what the educators observed as youths' interested areas (visual devices)	• Affirming youths as authors of in-the-moment activities that matter • Being a learner with youths gathering and brainstorming to solve problems • Expressing joy of troubleshooting by exclamation
B-1	Bella, Jazmyn, Ms. O	Moving youths' project out of the YAC room	• Planning and facilitating a making project that youths use STEM to address issues youths care • Offering youths time to work as groups • Supporting youths take up of space and free use of materials	• Recognizing and affirming youths' wanting to disrupt the limit of space in which youths can work on • Offering an independent and separate space for the project
B-1	Ivy, YAC youth, Ms. O	Designing shelves as furniture to exhibit youths' in-the-making artifacts	• Planning and facilitating for youths to engage in a project of reclaiming the science center's physical and social representations • Offering youths time to examine the science center space as groups, and brainstorm how to transform the space	• Other YAC youth's agreeing with Ivy's idea and suggesting to secure new furniture like shelves on which youths' in-the-making projects would be put and displayed • Ms. O reaching out to the science center administrators to create the space and furniture for exhibiting youths' in-the-making artifacts

Table 7-10 (cont'd)

B-1	RQ, Ms. A	Valuing the work using research to expose and disrupt injustice	• Planning and facilitating for youths to engage in a project of reclaiming the science center's physical and social representations • Offering youths time to examine the science center space as groups, and brainstorm how to transform the space	• Recognizing the explicit passion exuded by RQ who had remained usually quiet • Ms. A and Peers attentively listening to RQ and asking for RQ's further explanation about Mammie's life
B-1	Trey, his family	Walking family members through the science center to the room youths renamed/reclaimed	• Planning and facilitating for youths to engage in a project of reclaiming the science center's physical and social representations • Offering youths time to examine the science center space as groups, brainstorm how to transform the space, and making a decision of naming the space	• Trey recognizing himself as a legitimate member of the center • Ms. A, who saw Trey's family come in, noting to the staff on the front desk that he and his family can enter toward the Katherine Johnson room
B-1	YAC youths, Ms. O	Envisioning a place to dream big	• Planning and facilitating for youths to engage in a project of reclaiming the science center's physical and social representations • Offering youths time to examine the science center space as groups, brainstorm how to transform the space, and making a decision of naming the space	• Recognizing and affirming youths' ideas as legitimate critique and crucial imagination to reclaim the science center space • Asking youths to further develop their ideas about how such a space would look • Ms. O continuing to design the makerspace with youths, undergoing administrative negotiation
B-2	Chloe, Ms. S	Youth's wanting to bring what they learned in the science center to home	• Planning and facilitating an activity that youths can exercise agency (as small groups, DNA extraction, developing handouts) • Sharing the ideas and questions youths presented along with the DNA extraction activity and leveraging them for youths to learn how DNA works	• Recognizing Chloe's wanting to do the activity for her mom Affirming Chloe's idea as Ms. S wrote down the procedure on the whiteboard so that other youths also can try it at home and Engaging in a spontaneous in-depth discussion about why each step is necessary

Table 7-10 (cont'd)

B-2	Dori, Mr. C	Standing up and leading the group discussion	• Planning and facilitating an activity that youths can exercise agency (as small groups, Mock CSI) • Having youths share their reasoning of who seem suspicious by analyzing evidence they gathered	• Recognizing Dori's shift in participation (from being quite to being active and leading discussion) • Affirming Dori's shift by readily stepping aside while attentively listening to youth • Soliciting also other youths to come out to the front of the whiteboard to display his calculation
B-2	Ella, Ms. A	Being helped by a youth who volunteered co-teaching	• Planning and facilitating an activity that youths can exercise agency (group activity of blood typing) • Allowing youths chime in during her explanation	• Recognizing and affirming Ella's volunteering to co-teach, by verbally thanking her • Soliciting other youths to exercise agency in making decisions and trying out different combination of tester serums
B-2	Jerome, Mr. C	Being helped by a youth who volunteered co-teaching	• Planning and facilitating an activity that youths can exercise agency (group activity of making and examining footprints) • Publicizing when youths share their own strategies of making footprints and identifying footprint match	• Recognizing and affirming Jerome's volunteering to co-teach, by verbally thanking him • Asking Jerome for some specific support
B-2	Jose, Mr. E	Youth's wanting to bring what they learned in the science center to home	• Planning and facilitating an activity that youths can exercise agency (DNA extraction) • Sharing the ideas and questions youths presented along with the DNA extraction activity and leveraging them for youths to learn how DNA works	• Validating and thanking Jose's question • Suggesting several ways to continue the similar investigation both at home and in their school • Encouraging other youths also to try out

Table 7-10 (cont'd)

B-2	Sarah, Ms. S	Shift in engagement	• Planning and facilitating an activity that youths can exercise agency (as small groups, DNA extraction, developing handouts) • Sharing the ideas and questions youths presented along with the DNA extraction activity and leveraging them for youths to learn how DNA works	• Recognizing Sarah's evident shift in interaction • Changing the plan of the day in response to Sarah's curiosity and improvising a discussion activity of exploring forensics-related professions
B-2	Zion, Ms. A	Youth-suggested game as a legitimate science learning activity	• Planning and facilitating an activity that youths can exercise agency (group activity of blood typing) • Allowing youths chime in during her explanation	• Recognizing and affirming Zion's proposal as a sign of active engagement and relationship developed between youths and Ms. A herself • Leveraging youths' ideas to create and enact a game that can incorporate the daily learning
B-3	Jake, Anne, Mr. C	Co-creating a new ISL activity of Sphero Soccer	• Designing coding activities youths can choose from and exercise agency in participation • Facilitating youths' choice activities with abundant materials and resources; as youths engage in their activity • Publicizing the ideas, knowledge, and skills that youths shared with him individually or as groups and that allowed Mr. C to share with other youths	• Recognizing and affirming youths' wanting to continue operating Sphero robots as agentic and legitimate • Soliciting youths' co-creation of the Sphero soccer game and its playing field; and offering continued support for youths to take leadership
C	Monica, Cassie, Chloe, Ms. A	Youth-improvised role play as an activity that matters in the Forensic science learning	• Planning the pair activity of lifting up fingerprints on to the fingerprint cards • Facilitating youths' lead by asking for youths to be co-teacher of the activity	• Recognizing and verbally stating the powerful message of the role play • Opening up discussion about fair judicial decision making and the use of forensic evidence

Table 7-10 (cont'd)

			• Sharing the fingerprint cards when youths approached her and showcased their accomplishment of lifting up fingerprints	• Facilitating other youth's participation in the role play • Incorporating the scenario-based activity for the following Forensic sessions
C	K, Ms. A	Laying on the red couch and still actively participating in activity	• While rigorously planning to engage youths in experimental activities (Blood typing and powder testing), leaving room for instantiated changes in her instructional plans • Having the circle time to listen to youths' experiences of the day, emotions of the moment, and ideas about the activities she prepared	• Ms. A heading her body to youths not only in the activity tables but to K on the red couch so that K would feel that she was still involved in the session • Welcoming K when she re-joined

REFERENCES

REFERENCES

Bang, M., & Marin, A. (2015). Nature–culture constructs in science learning: Human/non-human agency and intentionality. *Journal of Research in Science Teaching, 52*(4), 530-544. https://doi.org/10.1002/tea.21204

Bang, M., & Vossoughi, S. (2016). Participatory design research and educational justice: Studying learning and relations within social change making. *Cognition and Instruction, 34*(3), 173-193. http://dx.doi.org/10.1080/07370008.2016.1181879

Bang, M., Warren, B., Rosebery, A. S., & Medin, D. (2012). Desettling expectations in science education. *Human Development, 55*(5–6), 302–318. https://doi.org/10.1159/000345322

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

Basu, S. J., & Calabrese Barton, A. (2010). A researcher-student-teacher model for democratic science pedagogy: Connections to community, shared authority, and critical science agency. *Equity & Excellence in Education, 43*(1), 72-87.

https://doi.org/10.1080/10665680903489379

Bates, L. K., Towne, S. A., Jordan, C. P., & Lelliott, K. L. (2018). Introduction: What shakes loose when we imaging otherwise. Planning Theory & Practice, 19(2), 254-256. https://doi.org/10.1080/14649357.2018.1456816

Bevan, B., Bell, P., Stevens, R., & Razfar, A. (Eds.). (2012). *LOST opportunities: Learning in out-of-school time* (Vol. 23). Springer Science & Business Media.

Birmingham, D., & Calabrese Barton, A. (2014). Putting on a green carnival: Youth taking educated action on socioscientific issues. *Journal of Research in Science Teaching, 51*(3), 286-314. https://doi.org/10.1002/tea.21127

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. https://doi.org/10.1002/sce.21293

Brossard, D., Lewenstein, B., & Bonney, R. (2005). Scientific knowledge and attitude change: The impact of a citizen science project. *International Journal of Science Education, 27*(9), 1099-1121. https://doi.org/10.1080/09500690500069483

Bryant, A., & Charmaz, K. (2007). *The SAGE Handbook of Grounded Theory*. United Kingdom: SAGE Publications.

Business Roundtable. (2005). *Tapping America's potential: The education for innovation initiative*. Washington, DC: Business Roundtable

CAISE Broadening Participation Taskforce (2019). *Critical Perspectives on Broadening Participation in ISL*. https://www.informalscience.org/broadening-perspectives

Calabrese Barton, A. & Tan, E. (2010). We be burnin'! Agency, identity, and science learning. *Journal of the Learning Sciences, 19*(2), 187-229.

   https://doi.org/10.1080/10508400903530044

Calabrese Barton, A., & Tan, E. (2019). Designing for Rightful Presence in STEM: The Role of Making Present Practices. *Journal of the Learning Sciences, 28*(4-5), 616-658. https://doi.org/10.1080/10508406.2019.1591411

Calabrese Barton, A., & Tan, E. (2020). Beyond Equity as Inclusion: A Framework of "Rightful Presence" for Guiding Justice-Oriented Studies in Teaching and Learning. *Educational Researcher, 49*(6), 433–440. https://doi.org/10.3102/0013189X20927363

Calabrese Barton, A., Tan, E., & McDaniel, A. (2020). Becoming in STEM: Developing a Culture of Criticality in the Space Between Person and Institution. *Frontiers in Education, 5*(37), 1-14. https://doi.org/10.3389/feduc.2020.00037

Calabrese Barton, A., & Yang, K. (2000). The culture of power and science education: Learning from Miguel. *Journal of Res"earch in Science Teaching, 37*(8), 871-889. https://doi.org/10.1002/1098-2736(200010)37:8<871::AID-TEA7>3.0.CO;2-9

Cammarota, J., & Fine, M. (2010). *Revolutionizing Education: Youth Participatory Action Research in Motion*. Routledge.

Chazan, D., & Ball, D. (1999). Beyond being told not to tell. *For the Learning of Mathematics, 19*(2), 2–10. https://www.jstor.org/stable/40248293

Davis, N. R., Vossoughi, S., & Smith, J. F. (2020). Learning from below: A micro-ethnographic account of children's self-determination as sociopolitical and intellectual action. Learning, Culture and Social Interaction, 24. https://doi.org/10.1016/j.lcsi.2019.100373

Dawson, E. (2014). Equity in informal science education: developing an access and equity framework for science museums and science centres. *Studies in Science Education, 50*(2), 209-247. https://doi.org/10.1080/03057267.2014.957558

Dawson, E. (2017). Social justice and out-of-school science learning: Examining equity in science television and science clubs. *Science Education, 101*(4), 539–547. https://doi.org/10.1002/sce.21288

Dawson, E., Archer, L., Seakins, A., Godec, S., DeWitt, J., King, H., Mau, A., & Nomikou, E. (2019). Selfies at the science museum. *Gender and Education, 32*(5), 664-682. https://doi.org/10.1080/09540253.2018.1557322

de Royston, M., Vakil, S., Nasir, N., Ross, K., Givens, J., & Holman, A. (2017). "He's more like a brother than a teacher": Politicized caring in a program for African American males. *Teachers College Record, 119*(4), 1–40. https://www.researchgate.net/publication/316255279_He%27s_more_like_a_%27brother%27_than_a_teacher_Politicized_caring_in_a_program_for_African_American_Males

Delpit, L. (1988). The silenced dialogue: Power and pedagogy in educating other people's children. *Harvard Educational Review, 58*(3), 280-299. https://doi.org/10.17763/haer.58.3.c43481778r528qw4

DeWitt, J., & Archer, L. (2017). Participation in informal science learning experiences: the rich get richer?. *International Journal of Science Education, 7*(4), 356-373. https://doi.org/10.1080/21548455.2017.1360531

Dumont, D. M., Allen, S. A., Brockmann, B. W., Alexander, N. E., & Rich, J. D. (2013). Incarceration, community health, and racial disparities. *Journal of Health Care for the Poor and Underserved, 24*(1), 78-88.

Eisenhart, M. (2001). Educational ethnography past, present, and future: Ideas to think with. *Educational Researcher, 30*(8), 16-27. https://doi.org/10.3102/0013189X030008016

Feinstein, N. W. (2017). Equity and the meaning of science learning: A defining challenge for science museums. *Science Education, 101*(4), 533-538. https://doi.org/10.1002/sce.21287

Feinstein, N. W., & Meshoulam, D. (2014). Science for what public? Addressing equity in American science museums and science centers. *Journal of Research in Science Teaching*, *51*(3), 368-394. https://doi.org/10.1002/tea.21130

Fendler, L. (2012). Edwin & Phyllis. In Making Sense of Education (pp. 35-41). Springer, Dordrecht. https://doi.org/10.1007/978-94-007-4017-4_6

Fraser, N. (2009). Social justice in the age of Identity politics. *Geographic thought: A praxis perspective*, 72-91. Routledge.

Furtak, E. M. (2006). The problem with answers: An exploration of guided scientific inquiry teaching. *Science Education, 90*(3), 453–467. https://doi.org/10.1002/sce.20130

General Services Administration (n.d.). citizenscience.gov. https://www.citizenscience.gov/#

Gillborn, D. (2005). Education policy as an act of white supremacy: Whiteness, critical race theory and education reform. *Journal of Education Policy, 20*(4), 485-505. https://doi.org/10.1080/02680930500132346

Gutiérrez, R. (2013). The sociopolitical turn in mathematics education. *Journal for Research in Mathematics Education*, *44*(1), 37-68.

Gutiérrez, K., Higgs, J., Lizárraga, J., & Rivero, E. (2019). Learning as Movement in Social Design-Based Experiments. *Human Development, 62*(1-2), 66-82. https://doi.org/10.1159/000496239

Harding, S. (2008). *Sciences from below: Feminisms, postcolonialisms, and modernities*. Durham, NC: Duke University Press.

Henrick, E.C., Cobb, P., Penuel, W.R., Jackson, K., & Clark, T. (2017). *Assessing Research-Practice Partnerships: Five Dimensions of Effectiveness*. New York, NY: William T. Grant Foundation. https://wtgrantfoundation.org/library/uploads/2017/10/Assessing-Research-Practice-Partnerships.pdf

Hill, P. W., McQuillan, J., Hebets, E. A., Spiegel, A. N., & Diamond, J. (2018). Informal Science Experiences among Urban and Rural Youth: Exploring Differences at the Intersections of Socioeconomic Status, Gender and Ethnicity. *Journal of STEM outreach*, *1*(1), 1-19. https://doi.org/10.15695/jstem/v1i1.28

Holdren, J. P., Marrett, C., & Suresh, S. (2013). *Federal Science, Technology, Engineering, and Mathematics (STEM) Education 5-Year Strategic Plan*. National Science and Technology Council: Committee on STEM Education.

Holland, D., & Lave, J. (2001). *History in person: Enduring struggles, contentious practice, intimate identities*. SAR Press.

Holland, D., & Lave, J. (2009). Social practice theory and historical productions of persons. *Action: An International Journal of Human Activity Theory*, *2*, 1–15. https://doi.org/10.1007/978-981-13-6826-4_15

Holland, D., Lachicotte, W., Skinner, D., & Cain, C. (1998). *Identity and agency in cultural worlds*. Cambridge, MA: Harvard University Press.

Howard, T. C. (2010). *Why race and culture matter in schools: Closing the achievement gap in America's classrooms*. Teachers College Press.

Kaijser, A., & Kronsell, A. (2014). Climate change through the lens of intersectionality, *Environmental Politics, 23*(3), 417-433. https://doi.org/10.1080/09644016.2013.835203

Ladson-Billings, G. (2006). From the achievement gap to the education debt: Understanding achievement in US schools. *Educational researcher*, *35*(7), 3-12. https://www.jstor.org/stable/3876731

Luna, M. J. (2018). What does it mean to notice my students' ideas in science today?: An investigation of elementary teachers' practice of noticing their students' thinking in science. *Cognition and Instruction*, *36*(4), 297-329. https://doi.org/10.1080/07370008.2018.1496919

Massey, D. (2013). Space, place and gender. John Wiley & Sons.

Medin, D. L., & Bang, M. (2014). Who's asking? Native science, western science, and science education. Cambridge, MA: Massachusetts Institute of Technology Press.

Moje, E.B., Ciechanowski, K.M., Kramer, K., Ellis, L., Carrillo, R., & Collazo, T. (2004). Working toward third space in content area literacy: An examination of everyday funds of knowledge and Discourse. *Reading Research Quarterly, 39*(1), 38–70. https://doi.org/10.1598/RRQ.39.1.4

Morales-Doyle, D. (2017). Justice-centered science pedagogy: A catalyst for academic achievement and social transformation. *Science Education, 101*(6), 1034-1060. https://doi.org/10.1002/sce.21305

Mutegi, J. W. (2011). The inadequacies of "Science for All" and the necessity and nature of a socially transformative curriculum approach for African American science education. *Journal of Research in Science Teaching, 48*(3), 301-316. https://doi.org/10.1002/tea.20410

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. https://doi.org/10.1080/10508406.2017.1314215

National Research Council. (2000). *Inquiry and the national science education standards: A guide for teaching and learning*. National Academies Press.

National Research Council (2012). A framework for K-12 science education: practices, crosscutting concepts, and core ideas. Washington, D.C: The National Academies Press.

National Research Council. (2015). *Identifying and supporting productive STEM programs in out-of-school settings.* National Academies Press.

National Science Foundation, National Center for Science and Engineering Statistics. (2015). *Women, minorities, and persons with disabilities in science and engineering: 2015* (No. Special Report NSF 15-311). Arlington, VA: National Science Foundation, National Center for Science and Engineering Statistics. Retrieved from http://www.nsf.gov/statistics/wmpd/

Organisation for Economic Co-operation and Development. (2016). PISA 2015 Assessment and Analytical Framework: Science, Reading, Mathematic and Financial Literacy. OECD publishing.

Philip, T. M., & Azevedo, F. S. (2017). Everyday science learning and equity: Mapping the contested terrain. *Science Education, 101*(4), 526-532. https://doi.org/10.1002/sce.21286

Rawls, J. (1971). *A theory of justice*. Cambridge, MA: Belknap Press of Harvard University Press.

Rosebery, A. S., Warren, B., & Tucker-Raymond, E. (2015). Developing interpretive power in science teaching. *Journal of Research in Science Teaching, 53*, 1571–1600. https://doi.org/10.1002/tea.21267

Ryoo, J. J., & Kekelis, L. (2016). STEM-rich and equitable making: Lessons from a museum-based research-practice partnership. *Dimensions*, 45-51. https://www.exploratorium.edu/sites/default/files/pdfs/2016_JulyAug_Dimensions_RyooKekelis.pdf

Schon, D. A. (1983). *The reflective practitioner*. New York: Basic Books.

Shea, M. V., & Sandoval, J. (2020). Using historical and political understanding to design for equity in science education. *Science Education*, *104*(1), 27-49. https://doi.org/10.1002/sce.21555

Soja, E. W. (2010). *Seeking spatial justice*. Minneapolis, MN: University of Minnesota Press.

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. https://doi.org/10.1111/ips.12009

Strauss, A., & Corbin, J. (1998). *Basics of Qualitative Research: Techniques and Procedures for Developing Grounded Theory* (2nd Ed). Thousand Oaks, CA: Sage Publication.

Tan, E., & Faircloth, B. (2016). "I Come Because I Make Toy": Examining Nodes of Criticality in an Afterschool Science and Engineering (SE) Club with Refugee Youth. In S. Marx (Ed.), *Qualitative Research in STEM: Studies of Equity, Access, and Innovation.* New York, NY: Routledge.

Tolbert, S., & Bazzul, J. (2017). Toward the sociopolitical in science education. *Cultural Studies of Science Education, 12*(2), 321-330. https://doi.org/10.1007/s11422-016-9737-5

Trueba, E. T. (1999). Critical ethnography and a Vygotskian pedagogy of hope: The empowerment of Mexican immigrant children. *International Journal of Qualitative Studies in Education, 12*(6), 591-614. https://doi.org/10.1080/095183999235764

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. https://doi.org/10.1080/07370008.2016.1169817

Vossoughi, S., Escudé, M., Kong, F., & Hooper, P. (2013, October). Tinkering, learning & equity in the after-school setting. In annual FabLearn conference. Palo Alto, CA: Stanford University. https://doi.org/10.2307/j.ctt2204pqp.9

Vossoughi, S., Hooper, P. K., & Escudé, M. (2016). Making through the lens of culture and power: Toward transformative visions for educational equity. *Harvard Educational Review, 86*(2), 206-232. https://doi.org/10.17763/0017-8055.86.2.206

Warren, C. A., & Coles, J. A. (2020). Trading spaces: Antiblackness and reflections on Black education futures. *Equity & Excellence in Education,* 382-398. https://doi.org/10.1080/10665684.2020.1764882

Weis, L., & Fine, M. (2012). Critical Bifocality and Circuits of Privilege: Expanding Critical Ethnographic Theory and Design. *Harvard Educational Review, 82*(2), 173–201. https://doi.org/10.17763/haer.82.2.v1jx34n441532242

Young, I. M. (1990). Polity and group difference: A critique of the ideal of universal citizenship. In C. Sunstein (Ed.), Feminism and political theory (pp. 117–141). Chicago: University of Chicago Press.