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STEM-Focused Academies in Urban Schools: Tensions and Possibilities

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Drawing on data from a study of learning, race, and equity in an urban high school organized around specialized learning academies, we examine the ways in which the design, framing, construction, and organization of learning spaces deeply influences the types of access to rigorous learning that students experience. We draw on the notion of racialized learning pathways to examine access to science, technology, engineering, and mathematics (STEM) learning spaces and the ways in which decisions about engaging these learning settings are bound up in notions of race, racial identity, gender, and belonging. We also take up the questions of how researchers and educators can intentionally design for positive racialization toward more inclusive school organization and classrooms. This article contributes to understanding of (a) how learning and identity development are mediated by broader processes of racialization tied to schooling organization and access structures and (b) how racial and gender inequities in STEM can be both reproduced and contested in large urban schools serving racially and socio-economically diverse students. We contribute to the literature on equity and

access in STEM by attending to the racialization processes that we argue are always at work in urban schools, particularly so in schools that are organized into pathways demarcated along racialized lines.

> [Bayside] will be a resource for Silicon Valley … We will stop the killing. We will stop the violence. We can. We will. We must.… The goal is Intel. The goal is Google. The goal is Facebook! (Tucker, SF Gate, May 28, 2015)

These are the words of a major civil rights activist during a speech he delivered to students at Bay Prep High School[1] (known locally as "Prep") in 2015. His visit to the school followed a recent announcement that a well-known technology company would donate $5 million to Prep and another school in the district, a deal that the civil rights activist worked behind the scenes to help broker. He was visiting the school primarily to meet the teachers and students of the Technology Academy, which would be the primary recipient of the funds. Prior to his speech, the civil rights leader joined the principal, a select group of staff, teachers, and students, and members of the local media for an informal luncheon in the teachers' meeting room. In between the small-talk and photo-ops, a reporter from a local news outlet asked Lupe, a 10th-grade Latina girl in the Technology Academy, whether he could quickly interview her about her experiences in the academy. She agreed, and after answering the first few questions was beginning to lose interest in the seemingly scripted questioning of the reporter. After praising Lupe for being a girl in technology, the reporter asked Lupe, "How can we get more girls interested in technology?" Lupe, true to her sharp wit and sociopolitical understanding of diversity issues in her school, shot back,

> It's not so much that girls and people of color are not interested, it's that they come to high schools and many computer, technology and just science classes in general have environments that are discouraging, they are usually dominated by boys and White people and that is just discouraging to the girls and students of color.

Not waiting for a response or a follow-up question, she abruptly walked away from the reporter.

Implicit in Lupe's shortness with the reporter was a frustration with an underlying narrative about diversity in technology that positions girls and students of color as inherently lacking interest in science, technology, engineering, and mathematics (STEM). Lupe's comment reflects a critique that the literature on diversity in STEM is beginning to advance: that the culture of STEM itself and spaces in which STEM opportunities are made available often reflect the values, interests, and experiences of the dominant culture and as a result are often unwelcoming to minority groups in those settings (Bang & Medin, 2010; Gutstein, 2005; Martin, 2013; Vakil, 2016). This article

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[1]The names of the city, the school, the academies, and all interviewees are all pseudonyms.

reports findings from a study of an urban high school with STEM-focused learning pathway programs and the way in which such programs filter which students attend by the culture inside the programs. It also highlights the possibilities for changing such inhospitable racialized and gendered cultures through pedagogical and curricular designs that expand traditional disciplinary boundaries.

PRIOR RESEARCH

STEM fields are increasingly viewed as a critical domain for academic preparation in urban schools and districts. This focus on STEM is related to a notion that STEM learning uniquely positions individuals to be competitive in an increasingly technological economy and a fear about the United States losing power as other nations surpass it in mathematics, science, and technology (Gutstein, 2007; Martin, 2003; Schoenfeld, 2004; Vossoughi & Vakil, in press). With these arguments as the backdrop, it is important to recognize efforts to expand access and equity in STEM opportunities to historically underrepresented groups (Moses & Cobb, 2001; Tate, 2001) while also being mindful of the sociopolitical and economic forces that often frame STEM education reforms in urban schools and communities in ways that equate equity with social mobility. This is profoundly different from undertaking such work with an accompanying agenda of social transformation. We join with other scholars and activists who conceptualize equity in STEM as fundamentally connected to issues of knowledge production, epistemology, culture, and power, not simply access or exposure (e.g., Cohen & Lotan, 1997; Medin & Bang, 2014; Pinkard, Barron, & Martin, 2008; Vakil, 2014). This article contributes to understanding of how equitable STEM spaces come to exist within urban schools and illuminates possibilities for new types of socially transformative learning that these spaces may engender.

One approach to expanding STEM learning opportunities that is frequently used by school districts is the development of specialized academies or learning communities in which STEM learning is the focus. This serves to draw STEM-interested students to schools in urban districts (similar to magnet programs), and it provides concentrated and linked opportunities for students to engage with a range of STEM content, including biology, chemistry, physics, mathematics, engineering, and computer science (CS). Although districts often tout the success and rigor of such programs, less attention has been paid to *which* students within the school have access to these spaces and *how* students are racialized and gendered within them. It is critical to understand how the framing, construction, and design of these environments carry explicit and implicit racialized and gendered notions of who does and does not belong in these classrooms (Hand, Penuel, & Gutiérrez, 2013; Nasir, Snyder, Shah, & Ross, 2013). It is important to ask how the organization and design of these programs enable or constrain equitable learning experiences and opportunities.

Building on a substantial body of research on sociocultural approaches to learning and identity (Gutiérrez, Baquedano-López, & Tejeda, 1999; Lee, 2008; Nasir, 2011; Nasir & Hand, 2006; Warren, Ballenger, Ogonowski, Rosebery, & Hudicourt-Barnes, 2001), the learning sciences has recently begun to develop theoretical accounts of how race and power play into processes of learning (Esmonde & Langer-Osuna, 2013; Nasir & McKinney De Royston, 2013). This scholarship has been instrumental in advancing equity-oriented educational research committed to not only studying but also working to transform unjust educational practices and systems. One way in which this work is manifested is in the theory and design of learning environments (and pedagogical approaches) that build on the cultural practices and strengths of learners (Bell, Tzou, Bricker, & Baines, 2012; Ladson-Billings, 2009; Lee, 2007) and that are rooted in antiracist and decolonizing pedagogies (Duncan-Andrade & Morrell, 2008; Freire, 2000; Gutstein, 2006; hooks, 1989; Paris, 2012).

More specifically, in the context of STEM education, where deep inequities by race and gender continue to persist, the learning sciences has contributed significantly toward providing nuanced accounts of how these inequities persist as well as exploring the social and material conditions under which historically underrepresented students are best supported in STEM learning and identity development (Medin & Bang, 2014; Nasir & Hand, 2006). Although theories of how race, gender, and power mediate learning and identity have been important to these efforts, they have been largely confined to classroom-level studies of equitable teaching practices (Nasir, McKinney de Royston et al., 2016) and interactional power dynamics between students and teachers (Cohen & Lotan, 1997; Esmonde & Langer-Osuna, 2013) and the theorizing of culturally and politically relevant pedagogies that support historically marginalized students (Howard, 2010; Ladson-Billings, 1995). The learning sciences has been less inclined to consider broader school-level processes of racialized and gendered messaging that may impact students' disciplinary identity formation, sense of belonging, and participation trajectories in urban schools, nor has it theorized well the connection between classroom-level processes of instruction and these school-level racialization and gendering processes (Nasir & Bang, 2012). In this article, we take up an analysis that intends to draw such linkages.

We do this by presenting findings from two phases of a study on race, equity, and learning in an urban school district in Northern California. The first phase of the study consisted of a set of school case studies that highlighted the experiences of African American and Black students in schools. We focus in particular on one of the case study sites, Bay Prep High School, which has in place a very strong academies model, including several academies or learning pathways focused on STEM. The second phase of the study was a design experiment conducted at the same high school with the goal of framing CS concepts and practices as relevant to addressing equity and social justice issues students face on a daily basis at their school. Taken together, findings from across these two phases of the study

provide insight into the deep connections between school-level processes around race and equity and classroom-level processes of teaching and learning.

Racialized Learning Pathways

We draw on the notion of racialized learning pathways to frame our findings and our analysis. This perspective conceptualizes learning as occurring along culturally organized pathways of learning and participation. These are constituted by learning activities that move (or do not move) one toward greater engagement and social recognition as competent in learning domains and situations (Nasir, McKinney de Royston et al., 2016). This framework draws attention to the specific resources that learners have access to over time, the ways in which learners are positioned within learning settings in which they participate, and the roles that identity and race play in learning. It also calls out the need for explicit attention to the institutional and society-level influences that provide or constrain access to particular learning environments in ways that marginalize or push some learners off of pathways. Learning pathways, as a frame, can "deepen our analyses of learning to attend to the ways that learning is fundamentally shaped by issues of culture and by structures that can empower or marginalize" (Nasir, McKinney de Royston, et al., 2016, p. 3).

The notion of learning pathways ties moment-to-moment instructional analyses to the broader set of social, political, and socioeconomic framings of experiences in classrooms. In other words, it allows us to jointly analyze the opportunities for learning and identity on a microgenetic time scale in classroom interactions (Gutiérrez & Rogoff, 2003; Saxe, 2002) and the way in which these microenvironments are part and parcel of sociopolitical, social, and political trends and patterns (Nasir, Scott, Trujillo, & Hernandez, 2016). Although the concept of learning pathways captures the deeply contextual, interpersonal, and even cultural aspects of learning pathways, we also, for the purposes of this article, attend to the specific issues of racialization and gendering within and between learning pathways. Thus, we use the term *racialized learning pathways* to highlight how race and gender frame access to learning pathways and define interactions within them.

We draw on a definition of race from Omi and Winant (2014) that views race as "a concept which signifies and symbolizes social conflicts and interests by referring to different types of human bodies" (p. 110). Thus, by *race* we refer not only to membership in racial groups but also to a tradition that uses racial categorization to justify stratification and unequal distribution of societal resources. Racialized learning pathways, as a theoretical frame, highlights how learning pathways are profoundly connected to the racial stratification and sense making about that stratification that pervades society. To attend to racialized learning pathways is to attend to several interconnected aspects of learning environments, including a concern for the identities students do and do not have the opportunity to develop in a learning setting; the ways in which power, privilege, and marginalization play out in relation

to race and gender in learning settings; how students are positioned through micro-interactions in learning settings; and how access to learning settings is structured and enacted.

Participation in STEM learning pathways is also highly gendered (Cheryan, Plaut, Handron, & Hudson, 2013; Margolis & Fischer, 2003; Master, Cheryan, & Meltzoff, 2015; Scott & Zhang, 2014). Gender, like race, is socially constructed. With respect to STEM, there are myriad stereotypes and assumptions about the biological and social capacity of girls and women to excel in STEM fields (Cheryan, Master, & Meltzoff, 2015), and girls are routinely advised and counseled out of STEM learning settings (Eisenhart et al., 2015). Thus, gender is a key dimension along which stratification in STEM occurs and is a central factor in how learning pathways are opened up or closed down for particular students. It is important to note that gender and race do not operate in isolation of each other but rather are experienced by students intersectionally (Crenshaw, 1993), such that both operate simultaneously and interactionally. In the Findings, we consider both the racialized nature of learning pathways and also how such pathways play out in key ways with respect to the intersections of race and gender.

RESEARCH CONTEXT

Bay Prep High School has been identified within its district as a school with tremendous potential. Prep boasts one of the strongest academic profiles within the district, with higher test scores and better graduation rates compared to other schools in the district. Moreover, unique within the district, Prep offers a multitude of academic pathways and academies, such as the highly coveted Excelsior and Mathematical Sciences Academies. Some of these programs have been in place for decades, and many families enroll their children at Prep for the sole purpose of gaining entrance into these rigorous academic spaces. Graduates of these programs consistently matriculate into competitive postsecondary universities, from Ivy League schools to the University of California system. In many ways, Prep belies common perceptions of dilapidated, run-down, and failing urban schools. Yet, although on the surface the school offers expanded learning opportunities to students of color, digging beneath the surface reveals that students of color, particularly Black and Latina/o students, are largely excluded from the benefits widely attributed to the school at large.[2] We focus on two learning communities: a prestigious (but mostly White and Asian) Mathematical Sciences Academy and a less prestigious (but much more racially diverse) Technology Academy.

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[2]Evidence to support this claim is presented in "STEM Contexts Carry With Them Affordances and Constraints for Racialization; Such Environments Can Reproduce Racial and Gender Inequality."

METHODS

This article draws on two phases of a larger study of equity, race, and learning. The first phase was an ethnographic study across elementary, middle, and high schools in a large urban district in Northern California. Out of the larger data corpus, we focus specifically on field note and interview data from Bay Prep, a high school where we saw extreme inequities around STEM experiences. The second phase was a design study with the goal of creating opportunities for students to address school-level equity issues in a CS course at Bay Prep.

In the first phase, we engaged in participant observation of the two learning communities and conducted semistructured interviews with students, teachers, administrators, and counselors. Our focus was understanding how various stakeholders were experiencing and making sense of issues of race and equity across the two STEM-focused learning communities. Data from the first phase of this study included seven teacher, 12 student, two parent, and five school administrator interviews and field note observations gathered twice weekly over the course of an academic year. All interview data were transcribed and, along with the field note data, were entered into Dedoose, a qualitative data analysis program. During the first phase of analysis, we independently open-coded all of the field notes, which led to several analytic categories representing our shared interpretation of the data (Emerson, Fretz, & Shaw, 1995; Miles & Huberman, 1994). Using these new categories, we engaged in another round of coding of the field note data, which drew our attention to four salient issues related to equity, race, and learning: racial and gender disparities between various academies and pathways, differential academic opportunities, social isolation, and patterns of racialized participation. To understand how the various stakeholders at the school were interpreting these facets of equity, race, and learning, we turned our attention to the interview data.

Similar to our approach with the field note data, we began by independently reading transcripts and writing analytic memos that highlighted major themes from the interviews and drew initial conceptual connections between these themes and the analytical categories derived from the field notes. We held research meetings to discuss our emergent understandings of the data, focusing primarily on congruencies and incongruencies between our field note observations and the ways in which various stakeholders were seeming to make sense out of issues of equity and race in the school. These insights led to a further narrowing in our analysis. For example, our field note observations had clearly documented racial and gender disparities between various academies as well as how certain academies offered more inclusive and welcoming environments for students of color. In our interview data, we learned that although all stakeholders were in agreement about the existence of racial and gender disparities in the school, there was a range of explanations as to why these disparities existed, some of which did not highlight alienating aspects of the learning environments

themselves but rather placed the onus for the disparities on students and families. This insight directed our attention to understanding how these divergent perspectives around equity and race in the school were themselves part of the complex social ecology that mediated the issues of race, equity, and learning at the center of our inquiry. We discuss findings from this analysis later but briefly reference one now that held particular implications for the social design experiment that constituted the second phase of this study. Based on early insights from field note data as well as teacher and student interviews, we found that despite the formal adoption of a nationally recognized culturally relevant CS curriculum, the interactions and discourse within the Technology Academy implicitly framed issues of race, equity, and politics as tangential to the teaching and learning of CS.

The second phase of the study was a social design experiment (Gutiérrez & Vossoughi, 2010) conducted within two 10th-grade CS classrooms in the Technology Academy. Social design experiments share features with design-based research approaches but have a more deliberate focus on designing for equity and social transformation. Similar to more traditional forms of design-based research (Brown, 1992; Brown & Campione, 1996; Cobb, McClain, & Gravemeijer, 2003; Penuel, Fishman, Cheng, & Sabelli, 2011), social design experiments aim to create novel learning opportunities in specific educational contexts as well as contribute to theories of learning—particularly in ways that account for how learning and participation are intricately connected to the social ecologies in which they occur. However, beyond taking the social context into account in designing and studying learning in situ, social design experiments aim to transform the systems and structures that work to disempower particular groups. In this vein, social design experiments are often conducted alongside and in solidarity with students and communities of color (Vakil, McKinney de Royston, Nasir, & Kirshner, 2016) and in addition to learning and theoretical goals carry an explicit social change agenda (Gutiérrez & Jurow, 2016).

Rooted in previous work exploring culturally relevant and critical pedagogy approaches to CS (Vakil, 2014; van Wart, Vakil, & Parikh, 2014), we collaborated with the director of the academy, Mr. Mayson, to design and teach a 10-week unit (Designing for Equity at Prep [DEP]) that drew connections between design, computing, and educational equity issues at the school. Students worked in groups to identify and research educational equity issues (e.g., racialized and gendered inequities at the school) and then to design a technological artifact (e.g., a game, app, or website) to address the issue. DEP was designed to create a more socially inclusive and intellectually expansive learning setting by providing opportunities for students to connect their racialized and gendered experiences at the school level to the learning of CS and design-related concepts and practices in the classroom. From this phase of the study, data included student artifacts, including final project portfolios, and more than 30 hr of video recordings of class sessions, group work, and student presentations. The data were collected to understand whether and how the DEP unit offered intentional opportunities for

students to challenge some of the racialized and gendered discourses around equity and learning operating at the school level.

CS Unit: DEP

The DEP unit was embedded within the second semester of an introductory CS course that was organized using the Exploring Computer Science Curriculum developed by teachers and researchers at the University of California, Los Angeles (Goode & Chapman, 2011; Ryoo, Margolis, Lee, Sandoval, & Goode, 2013). Prior to the unit, students had been introduced to the basics of Web technologies and had begun experimenting with creating their own blogs and Web profiles. They had also had some exposure to programming basics through an introductory HTML/CSS project and Visual Basic .NET projects. The unit was introduced to students as a project that would give them the opportunity to create a digital artifact that could address an educational equity topic of their choosing. In the first 2 weeks of the unit, students formed groups to identify, discuss, and analyze educational equity topics. Examples of equity topics students identified included racialized disparities across the academies (the most common equity topic), the quality of school food, recycling options in the school, the devaluing of girls' sports teams, teacher quality, over-crowded classrooms, and gender inequality within the Technology Academy itself. The unit was organized around a few key assignments that became elements of the final design portfolios. The key assignments are described in the Appendix.

FINDINGS

We report here two key findings from the study, each associated with one of the two phases of the project. The first finding is that designed STEM contexts carry with them affordances and constraints for racialization, and such environments can reproduce racial and gender inequality through the ways in which they provide access to different racialized learning pathways for students. The second finding, rooted in Phase 2 of the study, is that STEM contexts, when designed intentionally, can work to support the disruption of negative racialization and inequality that is reinforced by structural forces at the school level. Such intentionally designed contexts can constitute new and more expansive racialized learning pathways. At Prep, this occurred through curricular and pedagogical opportunities for students to engage in structural critiques of their school through equity discussions and technology design within an introductory CS course. Here we describe each finding, drawing on multiple sources of data to detail the processes and tensions within each.

STEM Contexts Carry With Them Affordances and Constraints for Racialization; Such Environments Can Reproduce Racial and Gender Inequality

Our first finding highlights the fact that although the various academies on the surface were not racialized—they were organized by different interests, and students could choose to apply to them or not—they were enacted in ways that were highly racialized. Thus, the academies themselves, as enacted, constituted racialized learning pathways—pathways that sorted by race (and gender), that reproduced patterns of privilege and marginalization, and that provided access to very different identities for different students. At Bay Prep, this was true at the inception of the academies, in that some were started in part as a way to broaden the appeal of the school to middle-class and White city residents whereas others were explicit attempts to recruit higher numbers of students of color. It was also true in the current enrollment of the academies, in that there were observable differences in the racial and gender makeups of the student populations of the various academies. Table 1 shows the demographics of the

TABLE 1
Demographics of Academies and Pathways

Academy	% Male	% Female	% African American	% Asian	% Latina/o	% White	% Other
Technology Academy (average GPA = 2.48)—Prepares students for career or college pathways in computing, computer science, and related fields.	73	27	40	23	17	15	3
Mathematical Sciences Academy (average GPA = 3.77)—Provides vocational and academic classes in areas related to civil and mechanical engineering. Project-based curriculum.	55	45	5	28	5	58	2
Arts and Design Academy (average GPA = 2.44)—Offers art instruction in music, dance, and theater arts as well as a broad spectrum of training in rehearsal, crafts, design, and performing arts.	45	55	68	3	12	10	4
Health Academy (average GPA = 2.98)—Strong science curriculum prepares students for college and careers in the health sciences, health care, or related fields.	26	74	34	23	22	16	2

Note. GPA = grade point average.

students in each academy or learning pathway along with the mean grade point average for each academy.

The demographic data told a story that was familiar both to the body of scholarship on racialized tracking within schools (Oakes, 1992) as well as to the school administration. It had long been clear to the school leadership that there was differential participation by race across several of the learning pathways and academies and by gender in the Technology Academy and Health Academy. School personnel and students alike understood these academies as very different racialized learning pathways, as evidenced by the racial demographics of the students and by the racialized experiences within classroom walls. But what was novel in our findings from interviews with students, teachers, staff, and administrators was that the story of *why* these inequities existed was more complex than the school leadership had previously thought and had to do with the interaction between student identities and racialized learning pathways, in that students found the experiences within academies to be incongruent with their racial and gender identities. We argue that these findings are key in elucidating how STEM environments at Bay Prep became a mechanism for carrying out the production of racialized and gendered inequality.

Indeed, the racial inequality of the highly prestigious Mathematical Sciences Academy was one of the reasons why the alternative Technology Academy was started. The Mathematical Sciences Academy was created in the late 1980s as a way to deepen the science and mathematics content in what was then the vocational curriculum of the school. Over the years, the vocational focus gave way to a more career-oriented focus. A closely linked sequence of courses was developed that, while providing abundant project-based learning opportunities, was rooted in foundational courses such as physics, chemistry, and advanced mathematics. With the support of wealthy parents and corporate sponsors, the academy gained an excellent reputation as a pathways program for students interested in pursuing engineering- or science-related degrees in the nation's top universities. This program drew primarily White and Asian students and families, thus perpetuating the idea that a STEM pathway is a racialized learning pathway designed to support STEM learning and identities for some students but not others.

The origins of the Technology Academy were tightly linked to the lack of diversity in the Mathematical Sciences Academy. Mr. Mayson, born and raised in Nigeria, came to Bay Prep with the intention of spreading his passion for computing to students of color he knew were underrepresented in the field. Given his background in STEM, he was asked to teach in the Mathematical Sciences Academy. Not aware of the structural and racialized inequities of the school, he accepted the position. But on realizing that most of the students he wished to reach (minorities and girls) were not enrolled in the academy, he worked with the leadership of the school to create another academy, the

Technology Academy, that would specifically target underrepresented students. Mr. Mayson described it as his "passion" in an interview. He said,

> I felt like, um, that would be difficult really for me to try to change these type of things, why don't I just stay with my passion it is you know computing and all that and start a computer thing so I you know started a [technology] academy that was based on interest.

He also talked about having the opportunity to work with Bob Moses (founder of the Algebra Project) in the late 1990s and how Moses's vision of mathematics literacy as a civil right deeply informed his own approach to creating a Technology Academy at Prep that offered opportunities to students of color at the school.

It is important to note that this intentionality around creating a technology-focused space that had equity goals at its center was not lost on students. One Technology Academy student, an 11th-grade African American boy named Gerald, saw the purpose of the Technology Academy as follows:

> … uhh most likely for Blacks and African Americans I would say it's because like since there are so many Caucasian White people in kinda in all these top industries and stuff like that I think most of what Tech is trying to do because of the Technology Academy their tryna like implement things like girls who code where they get girls into the computer science field or African Americans into the computer science field so that it's more diverse in that field. But I'm not sure about any of the other academies cause I haven't been but that's what I know about the [Technology] Academy.

Gerald and Mr. Mayson both saw the Technology Academy as a space whose design was intended to disrupt the troubling racialization and exclusion occurring in the Mathematical Sciences Academy. They viewed it as an alternative racialized learning pathway intentionally designed to open up new opportunities for identity and to disrupt existing dynamics of power and privilege. As we describe later, our interview findings further demonstrated that students and administrators perceived that the most rigorous academic spaces (e.g., the Mathematical Sciences Academy) at Bay Prep were not easily accessible to Black and Brown students and that the few high-achieving students of color or girls who did gain acceptance to these academies did not feel supported. They felt that this alienation led some to perform poorly and/or leave these programs, reinforcing the perception and reality that these programs served to reify differential racialized learning pathways.

Rigorous Spaces Not Accessible.   There was significant evidence in the interview data that members of the school community viewed the academies as

constituting racialized learning pathways. Parents, teachers, students, and administrators alike all acknowledged that the school's most rigorous academic spaces were not easily accessible to students of color. For instance, this parent drew a distinction between the social diversity and the academic diversity:

> To be honest, I don't know how [diversity] affects the culture, but when I say diverse, I mean that's what I see. I'm not talking about Whites talk to Blacks. My daughter's pretty sociable so she has friends from numerous different cultures, but I think that when it comes to the academics, it's not as diverse. It's segregated, there's a culture and a culture here. You know what I mean? So I would like to see that diversity in academics as well. Not just we go to the campus and we have Whites, Blacks, and Latinos. I need to see it more in academic settings, and I don't think it's like that.

This parent differentiated a multicultural social experience from the learning pathways her daughter had access to. This perception was shared by teachers; one teacher described his reaction on first seeing the demographics of the Mathematical Sciences Academy:

> I knew there was something wrong by just looking at the crowd and the students.…
> And I said, "This doesn't represent the school why is it?" It's kind of a, I mean a, disproportion you know … So I … I knew there was something … It was more White students.

Not only did school community members perceive the Mathematical Sciences Academy to not be a representation of the broader Prep student body, they also felt that it garnered more than its share of the school resources—it was a racialized learning pathway that enacted power in its unequal access to resources. Both teachers and administrators noted that because the White population of the school was "from private schools," more than a fair share of the school's resources went to supporting the spaces on campus that they occupied.[3] One example given by a teacher was that the master schedule was planned by meeting the needs of the two most highly rigorous (and least diverse) academies/pathways first, and "then whatever is *left* they give to other people. And only because they couldn't do otherwise. Every attempt to try to change that even from the district failed." This teacher went on to point out that this occurred because of the political power and privilege of the White parents to garner resources. This underscores the point that pathways serve to reify existing dynamics of power and marginalization.

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[3]Some counselors and teachers reported that many of the White students attended the academies in lieu of attending prestigious private schools.

Perceived Reasons for Racial Disparities in the Academies: Explaining Racialized Learning Pathways.   Although there seemed to be unanimous agreement that racialized inequities existed across the school and in particular across the academies, there was a diversity of opinions around why these disparities existed and why the pathways were racialized. It is interesting that although there was also clear gender inequality in the Technology Academy in particular, this was not frequently discussed in interviews (though in Phase 2 of the study gender emerged as a salient factor for girls in the CS class specifically). We found two dominant narratives in particular with respect to race in the interviews: (a) the deficit narrative, which argued that Black and brown students were not in the rigorous spaces (including the Mathematical Sciences Academy) because they did not work hard enough or were just not interested (or the more liberal version, which argued that they were ill prepared and came from communities in which education was either underresourced or undervalued); and (b) the critical narrative, which contended that students of color were not in the rigorous spaces because those spaces were hostile to the cultures, experiences, values, and interests of marginalized groups. In other words, participants held two different perspectives on how they made sense of the existence of racialized learning pathways, with some focusing on the shortcomings of the students and others focusing on the culture and climate of the academies.

The Deficit Narrative.   During interviews, some teachers made sense of the racial disparities across academies with a perspective that assumed that the African American students were less well represented in the rigorous spaces because they were unprepared or unwilling to do the work. This sometimes went along with an acknowledgment that identified the schools and communities that they came from as underresourced. This usually began with pointing out the disparities, for instance in the following quote:

> But this is important, that's why there's the big division. People say, "Well Bay Prep is really two different schools," but you know the reality is, *it is* two different schools. There's kids who are prepared for high school, there are kids who are not prepared for high school. That's the big problem with what you see the demographics of this program … I know [that] might be a question.

It is notable that this quote is from an interview with an administrator with significant ties to the admissions process for the academies. He continued his analysis, identifying the more specific factors that held back African American students:

> What happens is that the African American kids are not really prepared, and the ones that I accept, then get here and within a week or two, they drop out because

it's too much work. You know because I try and keep 'em and say, "You know, you're accepted, passed all this." You know, they say, "Well, it's just too much work, and I can't deal with this much work." Because they're not prepared and that goes back to, why aren't these kids prepared? You can't expect high schools to prepare the kids for high school. They're either prepared or they're not prepared when they get here … So it needs to go back to the middle schools and the elementary schools. They need to prepare those kids for math and science starting at elementary school.

A few moments later in the interview, to the rationale of work ethic, this same administrator advanced another explanation linking student identity to participation in STEM.[4] "The African American kids, the underrepresented kids … they're not math science kids so they're not coming." Yet in the next turn of conversation he described how some White students joined rigorous STEM academies:

They're just here because their friends are all here and they look at the drawings and they look at the projects like, "Wow, I wanna do that?" But it's interesting because I've had a lot kids, not a lot kids, but I've had several kids over the years come in with the intentions of I just wanna be here and do the projects, and then when they're here, they'll go, hey, I wanna be [here].

This contradiction—that Black students inherently lack interest whereas other students are given the space to develop interest—reveals a way of thinking that we argue contributed to the normalization and thus reproduction of racialized inequities in the school. Whereas White students' interest in math and science is viewed through a developmental lens, Black students are just "not math science kids," which suggests that not only are they disinterested in STEM but even more they lack the ability to develop this interest. What is important to note here is that this racialized sense making about student interest and work ethic lived alongside and in comfortable relation with the ready recognition of racialized disparities. In other words, although there was no denying the stark racialized disparities among the learning pathways at Prep, there existed a deficit discourse that rationalized the source of these disparities not in any flaw of the school structure or culture but rather in factors outside the control of the school or teachers, such as Black students' ability to work hard or their inherent lack of intellectual inclinations toward particular subject areas. It is important to note that this discourse was not necessarily *created* at Bay Prep but rather is consistent with a national discourse that draws on an abstract liberal notion of meritocracy (Bonilla-Silva, 2011).

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[4]It is notable that this administrator held power to greatly impact the admissions process and the course schedules for students in the academy.

The Critical Narrative.   The critical narrative, reflected in the recounting of Lupe's response to the reporter at the start of this article, argued that students of color (and girls) were less well represented in particular academies and pathways because these spaces were culturally inhospitable. Proponents of this narrative argued that racialized learning pathways were maintained by operating in a way that felt exclusive. Though this perspective was less common than the deficit perspective, it was salient in several key interviews. One example of this is an administrator who argued that students were struggling to determine where they fit, and when they did not see other students like them, they chose other environments:

> … I think um—it's like what I say for ninth grade, it's like who am I? I'm African American, but where do I really belong? Where do I fit? There is um sort of like different cliques, groups, you know am I the bookworm? Am I the athlete, am I the artist? But like, what am I? Um, it and even for our students who you know like whatever talking about the generally the whole group, I think that—that's a struggle, or sitting in a classroom and looking around saying, "I don't see other people who reflect me, you know, I'm the only person in the room that's African American," I mean just some of the things I have noticed when I've walked into classrooms.

This administrator highlighted the role of racial identity and the identity congruencies and incongruencies that students experience as key to whether students felt welcomed in particular classrooms. Ms. Carter, an African American parent we interviewed, was also well aware of the social and academic reputations of the various STEM academies. Namely, she talked about her awareness that the Mathematical Sciences Academy was considered to be more academically enriching though culturally inhospitable to students of color. Although she wanted the best for her son academically, she expressed concern about the social isolation he would potentially experience in this academy, specifically mentioning the "lack of friends and people to relate to" in the Mathematical Sciences Academy.

Microaggressions: Feeling Unsupported and Isolated.   We found that when African American or Latina/o students did join the rigorous academies at Prep, including the Mathematical Sciences Academy, they often felt unwelcome and unsupported there and reported experiencing microaggressions from teachers and peers. Almost all of the teachers and students interviewed articulated the isolation students experienced in these settings, isolation experienced either personally or through stories they were aware of about other students' experiences. During interviews, students both talked about the social challenges of being in a class where one was culturally different from one's peers and also described specific incidents in which they were targeted racially in interactions

with peers. At times, students also worried that they were being graded unfairly; although we cannot know whether this was true or not it is noteworthy as a part of their racialized experience that made them question themselves and their teachers.

One student, referring to her participation in the Mathematical Sciences Academy, simply noted, "I just didn't feel comfortable in it cause it was strictly White so I was like I don't think I can deal with this." Another student highlighted the social nature of experiences that he called "stressful" in which he felt "ostracized." He noted that he was one of only two African Americans in an advanced STEM class. Then he went on to say,

> Last year was stressful 'cause I did not know how to relate to others. It wasn't the same as if there were, you know, if was talking to a Black person, I feel like they can relate to me more cause they have the same experiences. I would really relate easier. Yeah. So I felt kind of ostracized when I was in [the academy]. Like it was just, yeah … I guess it was the simple things like talking, not everyone laughs at the same jokes, not everyone knew about the same stuff, when I talked about movies or music.

The absence of friends with whom one felt comfortable was a key element of what made these spaces uncomfortable. One student told a story about being separated from his one "Middle Eastern" friend in the class, feeling like he had no one to talk to, and saying out loud in class, "Holy crap, I'm the only Black person in here." His teacher reminded him that actually there were two African American students in the class. These experiences affected students' academics, by their own account, by causing them to doubt whether they were smart enough and whether they belonged. In the following quote, a student described this process:

> I was like that doesn't make a difference but whatever, I think it did kinda mess up my performance 'cause it's like if I don't do as well as them I kinda feel stupid in a way, that's also with my [Advanced Placement] calculus class it's like if I don't do as good as them then I shouldn't be in the class, or if I don't do as good as them then I'm not as smart as them and that just doesn't give you the motivation to do anything really. So I didn't even do my homework, I was like I don't really care about this class. I don't really need it 'cause it's just English and history and I want to go into computer science.

That same student described a racialized incident that occurred that made him doubt whether this could be a productive learning space for him:

> Someone said … I'm Black on the outside and White on the inside cause I like computers and so … and their like yeah then you're an Oreo and I'm like I'm not an Oreo. Well like I cursed in the class but I don't want to repeat it.

In this incident, being called an "Oreo" was experienced as a racial microaggression and a denial that he could be both Black and smart. Another African American male student remarked on teachers' perceptions of Black students in advanced classes and academies:

> The teachers don't understand where you're coming from. They just assume that you're lazy or something, and you're a bad student or something. And I know that's how it is with a lot of my friends. Something may have come up, and they may not have been able to do it. And then they become the bad student in class and they don't want to learn.

These perspectives indicate that racialized microaggressions (Solorzano, Ceja, & Yosso, 2000) were a salient experience for the few students of color enrolled in the advanced academic spaces of the school and constituted an important (and often overlooked) dimension of racialization.

The Absence of Culturally Relevant Pedagogy and/or a Social Justice Curriculum.   Another mechanism of the perpetuation of racialized learning pathways was located within the dominant pedagogical and curricular approaches of the school. The teaching and learning activities common across STEM-oriented academies and pathways largely excluded social justice or culturally relevant pedagogical approaches in the classroom (Bang & Medin, 2010; Gutstein, 2006; Howard, 2010). It is interesting that although concerns around race and equity were common themes in the interviews, observations of classroom teaching and learning revealed that these issues were generally not brought up or discussed openly. We should note here that outside of STEM spaces, we found some examples of culturally relevant and social justice approaches, which included a ninth-grade English class we observed that connected course readings to school-level equity issues, a class for Black boys that we have written about elsewhere (Nasir, Ross, McKinney De Royston, Givens, & Bryant, 2013), as well as student-led clubs such as the Feminist Club that talked explicitly about gender inequities within the school. Yet on the whole conversations around race and equity appeared to be for the most part muted within classrooms and in particular within STEM classrooms. For instance, after one of the interviews had concluded with an African American male who had spoken extensively about the unfair treatment of Black students at the school, he spontaneously added that the only other space in which he had these kinds of honest conversations about race was in the informal banter he shared with his football friends during practice. Even within the Technology Academy, which originated specifically as a racial justice intervention and had formally adopted a nationally recognized culturally relevant curriculum, discussions about equity and race were absent

from our field note observations. We argue that the absence of conversations about race and equity was in itself a way in which the process of racialization described throughout this article was perpetuated within the school. Race talk (Pollock, 2009) or other forms of equity-oriented discussions apparently have no place in classrooms where the serious work of teaching and learning is done. Students are not aided in understanding the dramatic racialized disparities that plague their school. Teachers have more important matters to attend to in their classrooms. We argue that this is how the normalization of racialized inequities across the various learning pathways and academies was produced and reproduced at Prep.

Thus, findings showed that racialized learning pathways were maintained in multiple ways. In the Mathematical Sciences Academy, students reported that they viewed the space as a "White" space and saw Whiteness as being enacted through subtle exchanges and perceptions prevalent in the classrooms. The Technology Academy was experienced as a more equitable and inviting space for students of color; access to the setting was an intentional design consideration and reflected in the demographics of the academy. At the same time, the Technology Academy was a male-dominated space, and despite the formal adoption of a CS curriculum based on culturally relevant principles discussions of equity, race, and gender were absent from the teaching and learning activities of the classroom. Therefore, the racialization in these learning pathways was multifaceted and related to processes of access in the broader school environment. The nature of the teaching and learning environment of these two STEM academies, in conjunction with the ways in which students were sorted into these racialized learning pathways, worked to reproduce racial inequality within the classrooms and within the school.

STEM Contexts, When Designed Intentionally, Can Disrupt Negative Racialization and Inequality

So far we have explored how inequality in the school was reproduced through the maintenance of racialized learning pathways, and we have discussed the ways in which students of color may have experienced inhospitable cultures within certain STEM pathways and academies. The second phase of our study explored how STEM classrooms, when designed intentionally to provide opportunities to engage in sense making about inequity issues, can disrupt these processes of negative racialization and reframe the nature of racialized learning pathways to be more expansive. Although the social design experiment under investigation intervened at the level of the classroom, we simultaneously acknowledge that structural-level interventions are necessary to bring about racial and gender equity in schools. For the purposes of this study, we focus on exploring the possibilities of addressing school-level

inequities through the processes of teaching/learning that occur within class-rooms. We argue that when this is done, students are positioned as capable STEM learners, they are supported in developing identities in which their racial and gender identities may be aligned with their disciplinary identities, and a wider range of learners is invited into the learning pathway, disrupting the narrowness of its racialization.

Addressing School-Level Inequities Through Teaching/Learning Processes.   Our design study explored the learning and identity implications of equity-oriented approaches to CS education rooted in culturally/politically relevant and social justice traditions (Beauboeuf-LaFontant, 1999; Freire, 2000; Ladson-Billings, 2009) but focused specifically on processes of racialization and gendering particular to a public school context. The social design experiment (Gutiérrez & Vossoughi, 2010) was carried out in partnership with the Technology Academy. As we have discussed, the Technology Academy was racially diverse yet male dominated and was designed explicitly as an alternative to the racially exclusive Mathematical Sciences Academy. Yet we also found that despite the salience of equity, race, and gender issues in the school, these topics were in large part ignored in the CS classroom. From the dominant perspective that views STEM disciplines as objective and politically neutral, the absence of politicized issues such as race and gender in the classroom may be expected or even preferred. Our perspective, however, draws from conceptualizations of STEM and of CS (and the teaching and learning of CS) as inextricably tied to issues of culture and power (Margolis, Estrella, Goode, Jellison Holme, & Nao, 2008; Rogaway, 2015; Ryoo et al., 2013; Scott, Sheridan, & Clark, 2015; Vakil, 2014). From this perspective, we argue that when student experiences with race, gender, and marginalization are ignored in STEM classrooms, STEM is implicitly and falsely framed as irrelevant to sociopolitical issues, and students may develop identities in relation to STEM disciplines that exclude their racialized, gendered, and politicized identities (Vakil, 2016; Varelas, Martin, & Kane, 2012). For girls and students of color in particular, developing disciplinary identities that diverge from their sociopolitical identities carries important implications for their current and future experiences within CS learning pathways (e.g., students may leave learning pathways they feel are incongruent with their other identities).

We explore what it means for students of color (and girls of color in parti-cular) within STEM spaces to engage in the concepts and practices of CS in projects that attempt to surface and address school-level racialized and gendered inequities. The 10-week unit codesigned with the teacher of the Technology Academy was intentional in creating opportunities for students to bring to bear their experiences with race and gender *within* the learning process itself. Our analysis here explores how the design of such a learning environment can serve

to disrupt processes of racialization and gendering and in so doing can reimagine and recreate racialized learning pathways in ways that frame student experiences with marginalization as relevant to the learning of CS. We show that this disruption happens primarily through positioning, broadening identity options, and resisting negative stereotyping of girls and students of color in STEM. We examine the implications of these findings for classroom practice, for whole schools, and for the interactions between the two levels.

To illustrate these processes of disruption, we present the cases of Lupe and Candice, two students of color and close friends in the design study. We begin with a short introduction to the students and share their perspectives on how they experienced racialization and gendering within the Technology Academy as well as in other spaces at Bay Prep. Then we analyze their final technology artifact, a video game for girls of color, and examine how they framed this artifact in relation to their educational equity topic of racial and gender inequality at the school. Ultimately, we show how the process of creating this game was not only a powerful learning opportunity but in itself an instance of disrupting negative racialization and gendering processes they encountered on a daily basis as girls of color at Prep.

Candice and Lupe were best friends inside and outside of their CS class, self-identified feminists, and advocates of equity in their school and in their community. As part of an identity memo assignment, Lupe located social justice concerns as central to her identity:

> I really want to make a change in this school but also in general. I am a feminist and I feel like that covers intersectionality and the problems that people of color and trans people and disabled people and all the types of oppression that comes together in this world. In my experience as a girl I have felt uncomfortable and definitely annoyed with male teachers and just overall not the same environment as a female teacher environment.

Lupe (Latina) and Candice (African American) repeatedly stated the deep connections between race and gender issues. In her identity memo, Candice drew links between her out-of-school interests and her own racial and gender identity:

> Feminism is important to me because I'm a BLACK GIRL [caps in the original] which is 2 minorities wrapped into one … I'm in a lot of clubs at school like film club which is where we watch movies and feminist club where we talk about feminism and QSA [Queer Student Alliance] where we talk about queerphobia.

For Lupe and Candice, their racial and gender identity was central to who they were and shaped many of their interests outside of school. Yet the narrow content focus of the Technology Academy often relegated the kinds of knowledge and

passions Lupe and Candice had as irrelevant, thus reifying itself as a racialized (and gendered) learning pathway designed for males and students from dominant backgrounds. The unit on educational equity, in contrast, provided an opportunity to draw on these interests and experiences, positioning students' experiences with and knowledge of race and gender issues as relevant to the content and practices of their CS classroom.

Opportunities for Positioning.   The unit created opportunities for students of color, in particular girls of color, to be positioned as authorities in relation to teaching and learning activities of the classroom. This was demonstrated perhaps most clearly through an episode of group work captured in a video recording early in the unit. Candice and Lupe were the only two girls in an otherwise all-male group discussing various educational equity issues. The task was to identify an important equity issue and discuss its relevance and root causes with group members. When the topic of diversity came up, students in Candice and Lupe's group agreed that racism was a problem but disagreed on how racism manifested in the daily life of the school. A South Asian male student, Rajeeb, simultaneously acknowledged and dismissed racism as a serious issue by stating, "Yeah … it exists … I get called names as one of the few Indian students all the time … but it's not a big deal … you just brush it off." Candice responded to Rajeeb and rejected his framing of racism as merely prejudiced interpersonal encounters by offering a different, more structural view that linked racism in the school to housing practices in Black communities that lead to segregated neighborhoods:

> Racism is a system of oppression … there is White supremacy and White power, White people are at the top, and they're screwing everyone else over, people of color don't have the social, economic, or political power to be racist to White people.… Like [volume of voice raises and her gaze shifts toward Rajeeb] racism is *more than like saying* a racial slur, racism is like White people saying like Black people are poor but then White people made a law that says Black people can't live in neighborhoods that look nice like this, we're going to section you guys off.

Lupe was listening carefully and linked Candice's theory of racism as structural to educational issues at the school, explaining that although there may not be direct forms of interpersonal racism preventing students of color from accessing some of the rigorous academies, the culture of those spaces indirectly discourages students from joining and feeling comfortable within them:

> That's where I think racism connects to academies because like when you look at it anybody can apply, that's what the academy people say, like, "Oh, well, people of color can apply, we can't help that right?" first of all there is no affirmative action

… It's also really intimidating to go into a whole room of White kids … that's literally like … the worst nightmare.

The boys in the group, all students of color, nodded in agreement with Lupe and Candice's analysis of racism and inequity in the school. Rajeeb, in a bid to realign himself with the girls' perspectives, timidly said, "So, I guess the [Technology] Academy is the most racially diverse academy." Lupe and Candice acknowledged this as correct but quickly added that although there was racial diversity the Technology Academy suffered from gender inequality and backed up their claim with statistics on the number of girls enrolled as well as examples of sexism they had personally experienced.

The activity not only provided an opportunity for the girls to resist Rajeeb's narrow and individualized view of racism but also gave them the intellectual space to activate this perspective on racism into an understanding of equity issues in their own school in a nuanced way that acknowledged both issues of race and gender and how they play out within racialized learning pathways. The episode illuminates how creating opportunities for Candice and Lupe's knowledge about and experiences with racism and sexism to be directly relevant to classroom activity positioned them as authoritative in relation to their male peers and in doing so provided the basis for an innovative design project they worked on over the course of the next several weeks of the class.

Providing Opportunities for Resisting Racialized and Gendered Stereotyping.   After students identified an educational equity problem along with a working explanation that helped them articulate the underlying causes of their problem, they began brainstorming and then designing technological artifacts that could address their problem. To connect their design ideas to the computational concepts and practices covered before the unit began, students were free to design a game, website, or other form of digital media, as long as projects entailed computer programming. All students were asked to mock up their ideas using the industry standard wireframing software Balsamiq.

Candice and Lupe came up with a video game idea to help girls of color resist negative stereotyping in STEM environments. The idea incorporated their interest in gaming but more important was deeply informed by their racialized and gendered understanding of equity issues at their school and directly connected to the early conversations about diversity, race, and gender they led in their groups. Moreover, the idea emerged from their own experiences as girls of color in hostile learning environments. As Lupe explained in her politics of technology memo,

The tech world has so many guys but there really aren't a lot of girls and when there are, they're in a male dominated environment that makes them self-conscious

about their abilities, purpose, and a lot of other things. We know this because this is how we feel. One time we were doing a lab where we take apart a computer and this boy came and super patronizingly asked us if we needed help. He said we looked like we needed help because we were going a little slower than everyone else. That would be a huge reason for girls not wanting to be in STEM. And then I think for girls of color it's because there's no representation. You rarely see anyone that looks like you that's painted in a good light in the media if you're a girl of color, so you probably really won't see one in STEM.

We want to emphasize here the degree to which the students' racialized and gendered thinking was woven into the design of the game. For Lupe and Candice, the thinking and attention to the nuances of racial and gender narratives that the game would embody were also sites of rich, complex thinking. Going beyond a vague notion of "helping" girls in STEM, the students were wrestling with how exactly the game would address and frame the equity issues they were focusing on. In doing so, they took up the opportunity to align their identities as girls of color with a CS identity. Lupe elaborated in her politics of tech memo:

> The game we had originally created was for young girls on like beginning coding things but that didn't really make sense with our analysis of the problem and so we came up with this idea of a game modeled sort of after the Kim Kardashian game in that it's a person just doing normal things basically but it's a girl character you can customize (all skin colors and body types) and she's a scientist or coder.

Lupe and Candice designed a game that was consistent not just with their general focus on gender inequality in STEM but importantly with the specific and personal understanding they had of the equity issue. Recall Lupe's quip to the reporter informing him that the problem was not student interest but rather the hostile, unwelcoming culture of the spaces themselves. This perspective was embedded in the narrative of the game itself. Also embedded in the game was the recognition that forms of privilege and marginalization occur within the CS classroom.

The project was an opportunity for Candice and Lupe to connect their knowledge of computational practices and concepts with racialized and gendered narratives they experienced in the classroom and the school at large—to connect their identities and experiences of marginalization as girls of color with CS experience. Although they stated that the game would allow users to customize the appearance of the main character, the default position they assigned was that of a Black girl, depicted in Figure 1. By projecting a racialized and gendered identity onto their avatar, they were disrupting dominant stereotypes about who can be in STEM spaces. It is important to note, however, that not only was their avatar a woman of color in a STEM space but she was a STEM activist for
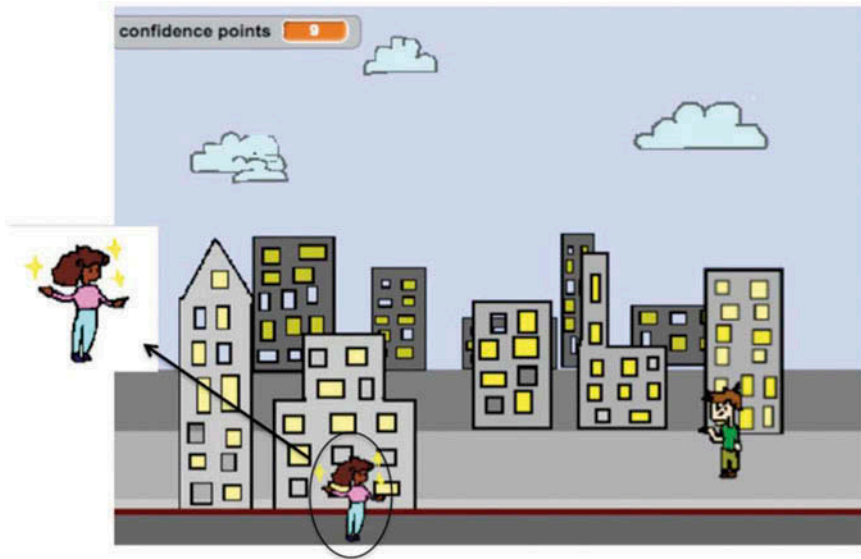
FIGURE 1   Screenshot of Lupe and Candice's video game created in Scratch.

women of color, another form of disruption (what kind of person one can be in a STEM space). She was empowered by actively resisting (in the game this was jumping over) White male characters who had condescending or negative things to say, such as "Good job sweetheart," as well as by building solidarity with other women in the space.

By explicitly tying the object/content of the learning to students' experiences at school and in the community, the design treated students' material experiences with oppression and marginalization as intellectually worthy and positioned students as having knowledge that was viewed as valuable in the classroom.

We argue that because of the discourses around STEM as a politically and culturally neutral body of knowledge and practice (Nasir & Cobb, 2002), the normalcy of silencing experiences and knowledge about race, gender, and other forms of social experience within mainstream curriculum go unquestioned, relegating students of colors' experiences, understandings, and perspectives on these issues as irrelevant or unwelcome to the more valued work of learning STEM content. We argue that the design intervention, then, served to disrupt negative racialization by intentionally creating spaces where these norms were not upheld, where the unspoken sanctions on race talking were lifted, giving students the freedom, through curricular and pedagogical avenues, to bring their knowledge, emotion, and experience on issues of race and gender into the center of the learning

experience, which provided opportunities for positioning, broadening identity, and resisting negative stereotypes. In doing so, it reframed and argued to expand the racialized (and gendered) learning pathways of the Technology Academy.

CONCLUDING THOUGHTS

Addressing issues of racial and gender diversity in STEM in 2016 means something quite different from what it may have meant over the past three decades, when issues of diversity were framed primarily around representation. Data from the studies presented in this article signal that although issues of representation are still pressing, they are also deeply connected to more foundational and complex issues around identity; school structure; how STEM content is framed; and the role of students' experiences and perspectives in the classroom, in the school, and in their community writ large. At Prep, students and teachers were struggling to make sense of the racialized learning pathways that took shape in relation to the unequal representation of students of color in the STEM academies, and they developed a range of sense-making strategies to do so, which included school-level interventions such as the creation of the Technology Academy as well as within-classroom interventions such as the design study reported on in this study.

The opening quote from the civil rights leader reflects a dominant narrative around diversity and technology that positions students as the problems ("Stop the killing" as an extreme case of this). This is troubling and not in line with students' increasingly sophisticated ideas about the structural nature of the racism that they face every day. Indeed, such statements are underwritten by a philosophy that assumes that young people must change who they are in order to be acceptable in prestigious STEM work environments (e.g., Google, Apple, and Facebook). This narrative, beyond its racially harmful ideology, does nothing to problematize STEM learning spaces or STEM workplaces, which themselves have complicated and racialized links to the communities in which they interact (e.g., technology companies' arrivals often lead to the displacement of working-class communities of color in many major U.S. cities). Moreover, it fails to connect the learning of coding, design, or STEM more generally to broader social and racial justice issues. Code for what? For whom? For which purposes? Whose problems are being coded for? Which questions are being asked? (Vakil, 2014, 2016; Vossoughi & Vakil, in press). It is also significant that the civil rights leader's visit was intended to celebrate/focus on diversity in the Technology Academy, and the reporter's interview with Lupe was in that spirit as well. Lupe reframed the narrative to reject the implicit deficit narrative offered up by the reporter, and the event as a whole, and instead argued her own perspective on diversity in technology. The context of the class offered an opportunity to channel this critique and fold it into the learning process and into the design

process. This allowed her to create something that reflected her technical knowledge but also her sociopolitical critique as well as her racialized and gendered experiences. It provided a space where her racialized and gendered identities could be aligned with her sense of herself as a learner of CS.

We argue that disrupting negative cycles of racialization and opening up more expansive and inclusive opportunities to youth requires dismantling narrow conceptions of what it means to do rigorous thinking and learning in STEM disciplines. Only then will we begin to move toward equity.

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APPENDIX

Identity Memo

The identity memo, inspired by the researcher identity memo in Maxwell's (2012) qualitative research methods, asked students to write 1- to 2-page biographical statements that contextualized their chosen equity issue in their own lived experiences. Students were asked to situate their equity topic within their current as well as past schooling experiences. The goals of this assignment were for students to tap into their own histories as a resource for understanding their topic and develop a deep, meaningful personal connection to their equity issue.

Problem Analysis Presentation

Group work was emphasized throughout the unit. After identifying important equity issues that students cared about, groups of four or five students worked to identify a theoretical framework that helped them analyze the root causes of the equity topic chosen. For example, although various groups decided to examine diversity within various pathways, students' reasoning about diversity varied greatly. Some students identified structural or systemic causes for racial/gender inequities in the school, and others characterized student apathy or motivation as underlying explanations for the lack of diversity in certain academies or pathways. The problem analysis presentation was a group assignment that culminated in a presentation to the class to highlight the significance of the problem identified and the way the group identified root causes of the problem.

Design Ideation and Politics of Technology Memo

This activity marked the turning point in the unit—student groups were asked to brainstorm various technological solutions for their equity issue and identify how their solution was framing the problem they were attempting to address, in other words, the *politics of their technology.* Significant whole-class discussion and accompanying activities led up to this assignment, helping students understand how various solutions, technologies, and artifacts are embedded with political values and sociocultural worldviews. A salient example here is a group of Asian American males whose equity issue was interpersonal racism experienced by Asians in the school. Their solution was to install video cameras throughout the school, including the bathrooms, to increase surveillance and thus security for Asians at the school. In discussing the politics of their solution, the students discussed the tradeoff between student safety and privacy, ultimately arguing that although they recognized that their solution compromised the overall freedom and privacy of other students, it was worth it because "safety comes first." The goal of this assignment was precisely this, for students to name the tensions, contradictions, and possibilities inherent in the various solutions they had identified for their final projects and to ultimately understand and be able to articulate the politics of their technologies.

Final Designs and Portfolio

The last 3 weeks of the unit were devoted to students working in smaller groups to first create mockups of their solution using the Balsamiq wireframing software. Students then designed initial prototypes using either the Scratch programming environment, Web development using HTML/CSS, or application development using visual Basic. net. At the end of the unit, students were asked to compile all of the class assignments, along with their final projects, into a comprehensive design portfolio.