



Bank Street Occasional Paper Series

Occasional
Paper
Series

Volume 2022
Number 48 *Learning Within Socio-Political
Landscapes: (Re)imagining Children's
Geographies*

Article 6

November 2022

Mapping Racespace: Data Stories as a Tool for Environmental and Spatial Justice

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Recommended Citation

Reigh, E., Escudé, M., Bakal, M., Rivero, E., Wei, X., Roberto, C., Hernández, D., Yada, A., Gutiérrez, K., & Wilkerson, M. H. (2022). Mapping racespace: Data stories as a tool for environmental and spatial justice. *Occasional Paper Series*, (48), 79-95. DOI: <https://doi.org/10.58295/2375-3668.1452>

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Mapping Racespace: Data Stories as a Tool for Environmental and Spatial Justice

Cover Page Footnote

The project presentation was supported by the National Science Foundation under Grant No. IIS-1900606. This project is a collaboration between UC Berkeley, North Carolina State University, and the Concord Consortium. Any opinions, findings, and conclusions or recommendations expressed in this material are those of the author(s) and do not necessarily reflect the views of the National Science Foundation, UCB, NCSU, or the Concord Consortium.

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Mapping Racespace: Data Stories as a Tool for Environmental and Spatial Justice

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As access to data rapidly increases, educators are being asked to use data in new ways. Recent anti-racist movements have highlighted the role that data can play in upholding, but also exposing and dismantling systems of oppression (Gillborn, Warmington, & Demack, 2018; Philip, Olivares, & Rocha, 2016). It is particularly important to note these tensions and possibilities in domains where data is often taken for granted, such as Science, Technology, Engineering, and Mathematics (STEM) contexts (Lee, Wilkerson, & Lanouette, 2021). Our research group develops **STEM curricula** that explore data, with a focus on socio-scientific issues.

In this essay, we share our experiences of leading a middle school data science workshop on the topic of environmental racism (ER), in particular, the disproportionate burden of pollution on communities of Color. During the workshop, youth explored case studies of local and global data-based environmental advocacy, analyzed datasets that we provided, conducted journalistic research, and created maps and other data visualizations. Our goal was to provide opportunities for youth to recognize the strengths and limitations of data, identify environmental inequities, and advocate for social change.

We planned to implement the curriculum in Oakland with middle school-aged youth, including those from the Black and Latine¹ communities who have been impacted by ER. To inform the design, our team—which is composed White, Latine, and Asian researchers—reflected on our own experiences of injustice and privilege and engaged with local environmental justice activists of Color. The curriculum introduces ER through a set of global case studies, then presents a detailed anchor case about the Black community in West Oakland, highlighting historical segregation and divestment as well as successful advocacy efforts of community members. Finally, participants researched a question of their choosing, in the Bay Area or beyond.

The workshop took place during the COVID-19 pandemic, which resulted in a change in format and, importantly, an unexpected shift in participants with little time to adjust our curriculum. We partnered with a local science center offering online summer camps. The center had an existing relationship with a parent advocacy group fighting to improve the quality of schooling in Oakland, and we advertised scholarships or youth affiliated with this group to attend free of charge. However, for reasons that remain unclear to us, the recruitment efforts resulted in the enrollment of 12 fee-paying participants. Most lived in affluent suburbs of the North and South Bay and identified as White (European), South Asian, and Middle Eastern.

Here, we report on designing the ER curriculum and implementing it with youth from privileged backgrounds. This essay represents the work of a large research team whose members contributed to the curriculum design and supported its implementation. However, much of this commentary reports the self-reflections of Emily and Meg, who were the workshop's two primary facilitators. We report on

¹ We use the term Latine as a gender-neutral plural term in our own writing, but in other places report the terms that others chose to use (e.g., Latina, Latinx).

theory that has come to shape our thinking about race, space, and data and the successes and challenges of the workshop, both as we observed them while teaching and as we continue to make sense of our participants' engagement. We offer these frank reflections to give insight into the potential power of integrating storytelling with data, but also to warn about the limitations of quantitative data to study racialized phenomena.

ENVIRONMENTAL RACISM

The term environmental racism (ER) refers to the disproportionate placement of environmental stressors in communities of Color. Although environmental injustice is sometimes framed as a natural result of economic processes, critical geographers have argued that it must be explained, at least in part, by racial dynamics (Pulido, 2015). Racism does not require deliberate acts of animus; it can be the result of structural inequities upheld by systems of power that are guided by the naturalized decisions of millions of Whites in a racialized society. This type of structural advantage is often referred to as White privilege.

Yet ascribing ER to White privilege obscures the agents of unjust actions by focusing on the benefits that Whites receive while overlooking the active processes by which resources are taken. Thus, critical geographers have argued for understanding ER as a form of White supremacy, in which actors, such as industries, extract resources from communities of Color, and governmental institutions collude through their failure to introduce regulations or to enforce regulations that are in place (e.g., Pulido, 2015). Racial inequities have catalyzed a robust environmental justice movement in the United States, in which low-income communities and communities of Color resist unjust actions taken by industries and fight for more equitable environmental conditions (Cole & Foster, 2001).

RACESPACE

Racial injustices, such as ER, have spatial dimensions. Across urban centers, racism has promoted structures that segregate communities on racial lines. In *The Philadelphia Negro* (1899), Du Bois described the sociospatial phenomenon of the "color-line," or the physical contours of racial segregation, as central to understanding racism in the United States. We adopt Philoxene's term "racesspace" to describe the ways that race and space are mutually constituted (2021); race influences the way space is organized, and space becomes the means through which race is constructed, understood, and lived (Neely & Samura, 2011; Omi & Winant, 2014).

In Oakland, where our anchor case is set, racial patterns of segregation are clearly defined by geographic markers. Majority White communities in the hills are afforded safety and security by city institutions and resources. Meanwhile, in the Latine and Southeast Asian neighborhoods of East Oakland and historically Black West Oakland, which is near the port, violence and dilapidated infrastructure is normalized and suffering is seen as acceptable. Racialization is both a process and a product; anti-Black sentiment shapes our spatial realities, which, in turn, propagate the conditions for urban violence (Lipsitz, 2007, Philoxene, 2021). These dynamics have been and continue to be challenged by social movements; in West Oakland, patterns of racialized violence led to the emergence of community organizations including the Black Panther Party for Self Defense, whose community survival programs in the 1960s and 1970s laid the foundations for ongoing advocacy (Murch, 2010).

ER is a spatial phenomenon that inflicts and normalizes violence on communities of Color. White and affluent communities use their connections to power structures to advocate for the diversion of environmental hazards away from their communities. For example, communities in the Oakland hills

advocated to divert diesel pollution from truck traffic into the historically Black neighborhood of West Oakland. As a result of this and other inequities, life expectancy in West Oakland is fourteen years lower than in the Oakland hills (Beyers & Brown, 2008). Organizations led by activists of Color, such as the West Oakland Environmental Indicators Project, have effectively used quantitative data to identify these inequities and advocate for change (e.g., Gonzalez et al., 2011).

CRITICAL RACE THEORY AND CRITICAL RACE SPATIAL ANALYSIS

Critical Race Theory (CRT) provides a lens to understand the pervasiveness of racism in the United States, including in our educational systems (Ladson-Billings, 1998) and STEM contexts (Jones & Melo, 2020). CRT can also be applied to the analysis of data and maps. Vélez and Solórzano (2018) proposed Critical Race Spatial Analysis (CRSA) as a method for examining how structural and institutional factors, which are encoded spatially and demographically, influence racial dynamics and power dynamics over time. Although quantitative data and maps are often framed as neutral, they can show how color-lines result in inequitable distribution of environmental stressors and can be used to advocate for the redistribution of resources. In constructing spatial data visualizations, researchers make the overtly political choices of choosing whether and how to describe the communities that are affected and linking inequities to specific causes and actors.

Importantly, quantitative data alone is insufficient for analyzing racialized phenomena (Gillborn et al., 2018); processes of racialization require analysis of the structural and institutional factors that reproduce inequitable power structures. Considering quantitative data without corresponding structural analysis can naturalize the racialized patterns of residence, poverty, and adverse living conditions, rather than frame these patterns as a result of deliberate and cumulative actions by individuals and institutions (Lipsitz, 2007; Pulido, 1995). Additionally, quantitative data alone does not explain inequities and also risks reproducing dominant deficit discourses of communities of Color. For example, the lower life expectancy in West Oakland might be presumptively attributed to personal lifestyle choices, rather than systemic factors such as the concentration of diesel pollution from the port and freeways and reduced access to medical care.

CRT frameworks emphasize the power of counter-narratives to challenge such unjust conditions and dominant discourses about communities of Color (Solórzano & Yosso, 2002), such as educational inequities (e.g., Martinez & Broussard, 2018) and perceptions of violence (Philoxene, 2021). Data visualizations and maps can help construct counter-narratives that challenge common understandings of racialized phenomena. Lee and Soep (2016) describe how youth leveraged a form of digital storytelling that coupled maps, interviews, and time-series visualizations to track gentrification in West Oakland. They found that youth included multiple qualitative and quantitative information sources to complement data and maps, so that gentrification was not reduced to a limited set of quantitative indicators (e.g., counts of independent stores being shut down) but rather encompassed a broad set of systemic, lived impacts such as police activity.

Although data about physical and social geographies is often seen as apolitical, its interpretations are influenced by the power relationship between the viewer and the viewed (Abbott, 2006). The term “white gaze” refers to the pervasive and often unnoticed ideological formation by which the practices of White communities are legitimized as a neutral standard, while those of communities of Color are marked as different and inferior. Learning about privilege and injustice creates the conditions to challenge the invisibility of Whiteness, but only when historical and racialized power dynamics between communities and individuals are explicitly named and interrogated.

ENGAGEMENT WITH DATA AND DATA STORIES

Our work is grounded in syncretic theories of development that promote the expansive forms of learning that occur when youth put everyday and school-based contexts and practices in conversation with one another (Gutiérrez, 2014). In explorations of data, youth can leverage their personal connections to (and tensions with) data to make sense of it and create representations that matter to them. For example, youth might find that their personal or community experiences are not reflected in a data set, which may promote additional analyses and research.

In our work, youth engage in this type of integrative sensemaking through the construction of data stories (Wilkerson et al., 2021). We build on work that shows how youth can analyze data to recount personal experiences. For example, youth can use open, large-scale data sets to present family geobiographies that document experiences of migration (Kahn, 2020). In a data story, youth show how their personal experiences and narratives, as well as those of others, motivate decisions about visualizing, analyzing, and transforming data. By deciding and justifying what information to highlight in a data set or map, youth engage in the political act of reauthoring data as text to represent the past and imagine paths to more just futures (Gutiérrez et al., 2019).

CONTEXT, PARTICIPANTS, AND POSITIONALITY

The workshop was designed and facilitated by a team of undergraduate students, graduate students, and researchers at the University of California, Berkeley. All members of our design team study education, have an interest in STEM, and promote social and racial justice in their work. The first two authors of the paper were the lead facilitators, and they discussed their current neighborhoods with participants. Meg, who identifies as White and Latina, lives in West Oakland. Emily, who identifies as White, lives in Menlo Park, an affluent White suburb in the South Bay. Other members of the team who worked directly with the students shared information about their backgrounds in data stories that were presented to youth. Michael, who identifies as White and Jewish-American, is from a predominantly White neighborhood of Oakland. Damaris, who identifies as Latina, is from a Latinx immigrant community in the Greater Los Angeles Area. Xinyu, who is Chinese, is from a historical city in Henan Province.

Recruitment was conducted through a local science center in conjunction with its online summer programming. The advertisement indicated that participants would learn about why communities of Color were disproportionately impacted by COVID-19 and pollution and create a data story that “calls upon others to join you in environmental and social action.” 12 fee-paying youth who ranged in age from 12 to 14 participated in the workshop. Of these, five identified as White, five as South Asian or Middle Eastern, and two as Latine. Some were from immigrant backgrounds and reported that previous generations of their family had experienced environmental injustice.

CURRICULAR DESIGN

Here are the details of the curriculum we designed to address the topic of ER, including efforts to mitigate issues that commonly arise when race is addressed in STEM contexts. Figure 1 shows an outline of our ER curriculum, which was implemented in a week-long, online workshop that met for 150 minutes each day.

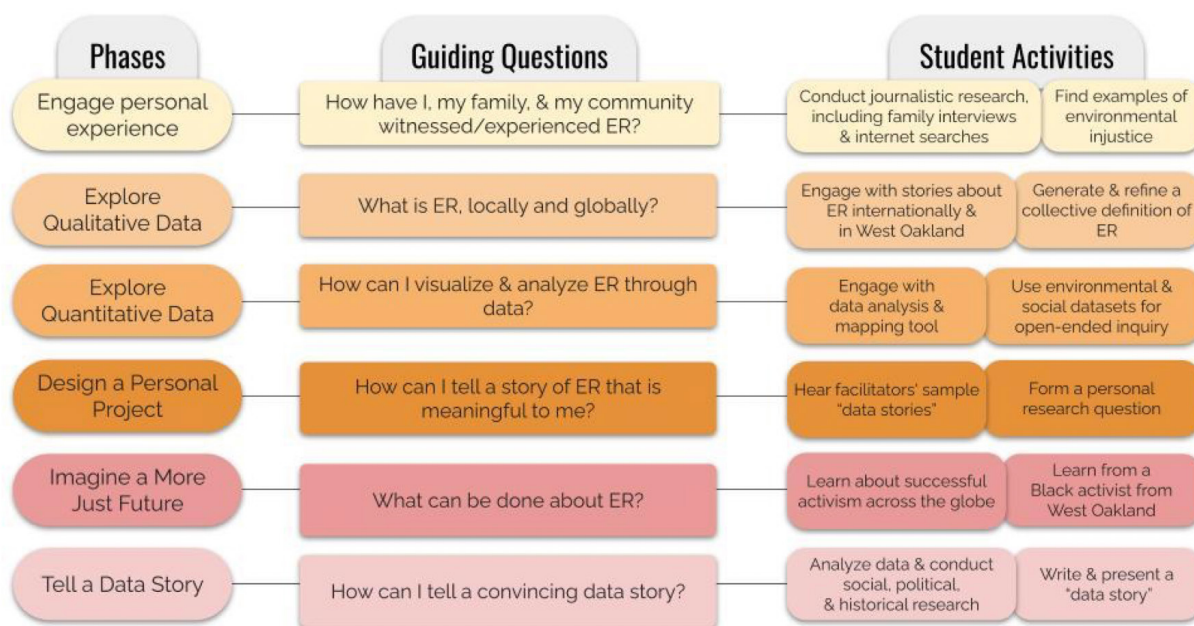


Figure 1. Curricular design

Reflexive

We provided opportunities for youth to reflect on their own experiences with injustice and proximity to privilege. After reading a set of [global case studies](#) on environmental racism, participating youth were invited to interview a family member or conduct internet research to find a local example of environmental injustice. Facilitators presented sample data stories that drew from our own experiences. Michael's data story ([video](#), [slides](#), [CODAP](#)) discussed how his neighborhood had lower asthma rates than West Oakland (see Figure 2); Damaris's data story ([video](#), [slides](#), [CODAP](#)) discussed the disproportionate effect of COVID-19 on Latinx communities across California, including her own; and Xinyu's data story ([video](#), [slides](#), [CODAP](#)) discussed the decisions to divert polluting industries from Beijing into nearby Hebei province.

Step 1: Learning More about Asthma	Text
What Did you learn? I learned that the West Oakland community is more exposed to air pollution than other communities throughout the bay area. There are many big factories in West Oakland, and many trucks come in and out of those factories each day, transporting goods. Those trucks use diesel, which pollutes the air and causes people in the communities nearby to have much higher rates of asthma. Asthma is a disease that affects the lungs, making it harder to breathe. People with asthma often need to use inhalers, and it makes it harder to participate in sports and other activities. I also learned from CODAP that rates of asthma are higher in African Americans. Because of housing discrimination, African Americans are more likely to live in areas where there are high levels of air pollution, such as West Oakland. I also learned that people like Margaret Gordon are organizing youth in the community to measure air pollution in their communities and then take action to stop it. I thought it was pretty cool to learn about the ways people are working together to create positive change, and the long history of communities in Oakland fighting against racism.	Why does this issue matter? Can you connect it to your own life and your own community? I grew up in North Oakland, just a few miles away from West Oakland. Those few miles make all the difference in terms of air pollution. I had a lot of friends who grew up in West Oakland, and it makes me upset that politicians and other leaders have not done more to protect the air we breathe. This issue matters a lot because people's health is at stake. I believe all kids have a right to grow up healthy, and how can you grow up healthy when your air is polluted?

Figure 2. Model data story from a facilitator on asthma

Grounded in Local Historical, Political, and Social Structures

Data may not give access to the structural and ideological contexts in which it is situated and the embedded issues of power (Philip et al., 2016). To model contextualizing data, our workshop presented an anchor case of the historically Black community of the 7th Street corridor in West Oakland, a cultural hub in the 1940s (see Figure 3). This community was uprooted in the 1950s through eminent domain (the power of government to expropriate private property for public use without the owner's consent) to construct the Bay Area Rapid Transit (BART) overland transportation system, a large postal office, and freeways for truck transit. We showed comments in a local Facebook group from displaced Black families to demonstrate the value of stories as historical data. We contrasted West Oakland's history with that of the largely White and affluent communities in the hills, who were able to leverage political power to secure below-ground rail transportation and divert truck traffic away from their communities.



Figure 3. Images of West Oakland in the 1940s

Race-Explicit, Thrivance-Centered, and Action-Oriented

We engaged students with race data from the census on maps to make visible the types of racial inequalities that are often not addressed in STEM contexts. We also questioned the static and limiting racial categories on the census and highlighted how race is constructed by ongoing social and political processes. We showed images of thriving Black communities (Figure 3) to counter the historical narratives of urban blight used to justify their displacement, and our group spoke with **Ms. Margaret Gordon**, a local African American environmental activist from the **West Oakland Environmental Indicators Project**, to highlight ongoing efforts of Black resistance and successful advocacy.

Inquiry-Based and Tool-Mediated

Youth used the **Common Online Data Analysis Platform** (CODAP) data visualization tool to engage in open-ended investigation and transformation of public data sets on social indicators (e.g., income, race, health) and environmental indicators (e.g., air pollution, water pollution, pesticides). We supported open-ended inquiry through three design principles: modeling, structured play, and multiple pathways. We modeled how youth could answer a question that was prompted by a story by selecting and analyzing variables. We supported structured play through providing small data “sandboxes” for participants to explore after an initial orientation to CODAP. Finally, we supported multiple pathways in participants’ final projects by offering a **large CODAP dataset** in the Bay Area with numerous variables. Some participants found their own datasets and visualizations online. In other cases, we were able to provide them with additional CODAP datasets.

FINDINGS

We first present a series of successes in engaging youth with the topic of ER through a syncretic approach to data, illustrating each with examples from the implementation. The student work that we reference can be reviewed in greater detail [here](#).²

Success 1: Leveraging Personal Experience

We found that youth were able to draw from their own and their families’ experiences to engage with social inequities. Specifically, interviewing family members and providing case studies from around the world seemed to facilitate youth from a wide range of socioeconomic, cultural, and racial/ethnic backgrounds in engaging with the topic of environmental justice.

Some youth discussed their families’ histories of migration from Central America to the United States. Other youth of South Asian descent shared stories of environmental inequities in India.

For example, Karun reported:

Today I asked my mom about a case of social injustice. I learned that in some poorer parts of India, people throw away water bottles/containers, and some scammers reuse the bottles to fill it with unclean water just to make profit when selling. This affects a lot of people, but especially poor/middle classes, as they want cheaper options for water bottles.

Drawing from these examples, youth engaged enthusiastically in sensemaking about the distinction between environmental injustice and racism. In one example, participants identified the caste system as a source of injustice that inflicted environmental harm on low-income communities in India. Yet the group was unable to identify a connection to race, and ultimately decided that it was a case of injustice rather than racism.

2 Grammatical errors in student graphs have not been edited.

When considering the range of global examples, however, participants noticed that environmental injustice is felt across large groups of low-income communities and communities of Color. They also asked critical questions about the agents of the action (“Who is the bad guy?”) and identified industries as primary culprits. Thus, they demonstrated an understanding of environmental injustice as systemic and deliberate and related to class and race (Pulido, 1995).

Success 2: Explicit Exploration of Race

Participants’ questions about the interrelationships of race, income, and environmental factors also successfully supported deep engagement with data and the integration of multiple sources of information. **Nala’s data story** explored how forest fires in California might negatively impact some communities more than others. She investigated Latinx communities as she knew that their members often work in agriculture and may be more likely to live in the rural areas where fires are more likely to take place.

In her analysis, Nala generated a map of forest fires (Figure 4, left) and a map of the percentage of Latinx community members by zip code (Figure 4, right). She filtered the zip codes in the highest quintile (zip codes marked in red) and visually compared the two maps, noting that fires tend to occur inland in communities with high percentages of Latinx residents.

Now, looking at these two graphs side by side, you can see that it isn’t necessarily a coincidence. You see a pattern too, right? It looks like most of the fires are not by the coast/more inland. And, where is the Latinx community mostly concentrated? More inland also.

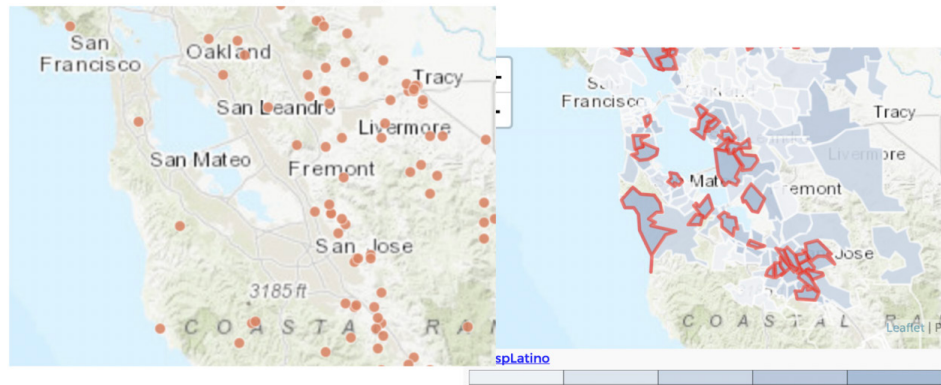


Figure 4. Maps in Nala’s data story

She then explored the income of communities with large Latinx populations. She created a visualization that grouped cities by the percentage living in poverty and marked those in the top quintile of Latinx representation (Figure 5, represented by a blue dot), demonstrating that they tend to be low-income. She also integrated information from a news article to argue that “Latinx families are less likely to have insurance due to their lower income which makes having a fire where you live much more terrible.” Overall, Nala’s justice-focused question prompted her use of complex data moves to look for relationships between race, poverty, and exposure to fire, as well as to draw from other sources of information to better understand the impact that fire might have on Latinx communities.

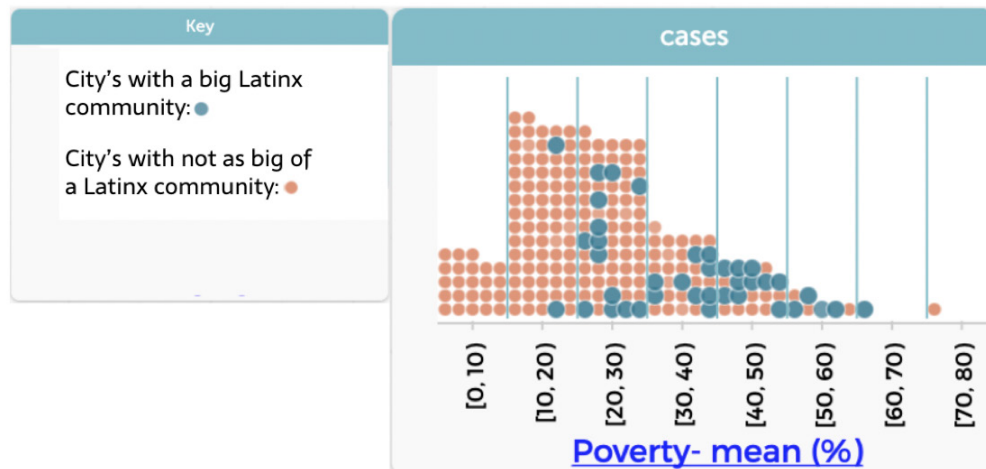


Figure 5. Graph in Nala's data story

Success 3: Exploration of Racialization as a Process

We found that some youth were able to make sense of race in complex ways, moving beyond quantitative data to explore the historical and ideological bases of the processes of racialization. Amy, who is of South Asian descent, conducted her final project on the disproportionate impact of COVID-19 on Asian Americans. In addition to reporting demographic data on infection rates, Amy discussed how former President Trump implicated China in the spread of the disease, calling it the “Wuhan flu,” and reported the concurrent rise in hate crimes against Asian Americans. In doing so, she considered not only demographic data on race, but on the ongoing socio-political processes by which Asian Americans were racialized early in the pandemic.

In another example, Eva moved beyond seeing race as a category to name processes of racialization that were tied to geography. Eva interviewed her father, who described her family’s immigration from Central America and their time as farm workers in California’s central valley, where they were exposed to air and water pollution. Although facilitators suggested that she write her data story on her father’s experience, she insisted on researching Ben Chavis, an African American environmental activist from North Carolina who fought against the dumping of toxic waste in his community (Figure 6, left). She explained: “I felt that I already had covered the topic of the Latin community ... and I wanted to also cover other kinds of races. Ms. Margaret [the guest speaker] talked about how they put factories next to an African American community and it inspired me.”

Eva’s data story involved multiple data moves. She first filtered the data, selecting Chavis’s home county and comparing it to a nearby county with higher income, marking both on the map. She then located and merged information on the racial composition of the two counties. Her argument thus coordinated data about income, race, and toxic waste to support Chavis’ claim that the dumping incident constituted an act of racism. She also searched internet articles for evidence of racial strife in the area. In doing so, she emphasized the lived experiences of African American community members that are not captured by demographic data or maps.

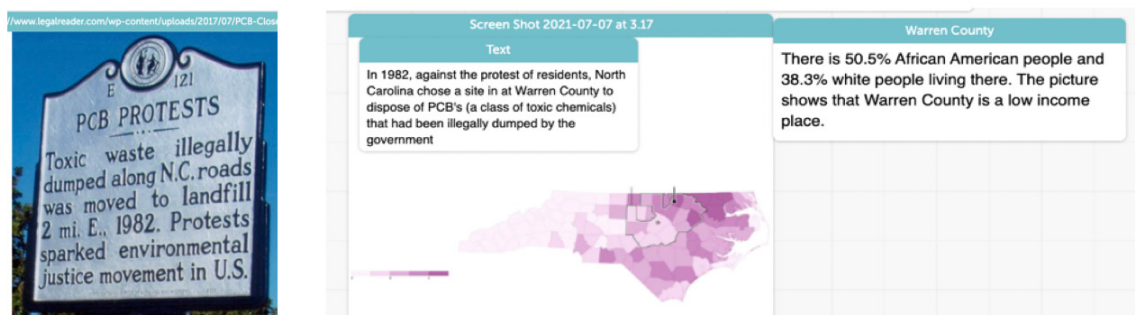


Figure 6. Pictures, explanations, and maps in Eva's data story

Through her research on Ben Chavis, Eva positioned herself as part of a larger political struggle by drawing relationships between her family's experiences in California and those of other minoritized groups in other states. Writing the data story was an opportunity for her to expand her view of local injustice to consider it as broad and systemic (Gutiérrez et al., 2019) and to highlight stories of resistance across communities.

Although we saw many successes in our work with youth, we also faced challenges in using data to understand the complexities of race and racism. For each challenge that we present, we discuss how we adjusted our approach in the moment in response to participants' sensemaking and how we plan to modify our curricular design in future iterations.

Challenge 1: Deepening Understanding of Systemic Injustice

Although we designed the course for youth from Oakland, we eventually worked with youth from affluent suburban communities in the Bay Area and nationwide. As they worked on their projects, we became concerned about them drawing conclusions based on patterns and correlations they noticed in the data without sufficient structural and historical analysis to understand the causes and identify agents. For example, one participant wrote in a draft of his project: "Remember that the money does not create the pollution itself, but places with higher pollution (because of toxic emissions from highways or factories/power plants) just cost less, which attracts the low-income people and the poverty."

Given our concerns, we followed up with each participant to discuss what they had learned about the potential causes of the patterns they observed in the data and what decisions, actors, or structures might have led to the patterns. As participants finalized their presentations, we led a group conversation to mitigate the tendency to draw conclusions without sufficient evidence. We emphasized the importance of researching the history of the area, rather than making assumptions based on limited data from the present. We also encouraged youth to identify questions that they were not able to answer yet and validated this act as a vital part of the scientific process.

Moving forward, we see the need to elicit and examine youths' understandings of racism and injustice more carefully. When we reviewed video from the course, we noticed that some youth only identified racism as a factor when there was clearly malicious intent. We also saw that the agents behind decisions that result in systemic injustice were sometimes obscured in our curricular materials and class discussions. We recognize the need to establish that racism can exist without animus or malice (Pulido, 2015), as well as to discuss the agents that lead to actions that reproduce systemic injustice when they can be identified.

Challenge 2: Supporting Race-Conscious Analyses

A related challenge is that several participants appeared to sidestep discussing race and instead reported on income, despite our explicit focus on race and racism in the curriculum. One student, Narun, reported on the Flint water crisis as an example of environmental racism earlier in the course, yet his quantitative analyses in his final project did not consider race as a factor. He reported that he “looked at a bunch of ... factors, but chose to do poverty and air pollution.” He investigated several types of air pollution, looking for the one with the strongest relationship to poverty, and settled on diesel emissions. In his final presentation, he also filtered to show the top quintile of poverty and demonstrated it on a graph (Figure 7, left) and a map (Figure 7, right).

Narun then drew relationships by referencing the map, claiming “poverty is high along the coast... and you also see that air pollution is high there too.” Narun did not report on the racial composition of these counties, even though it was provided in his data set and discussed in the course, nor did he identify the causes of the pollution. Narun’s analysis of poverty and income was well-reasoned and supported by the data, yet it was incomplete in that it did not examine the racial composition of these areas.

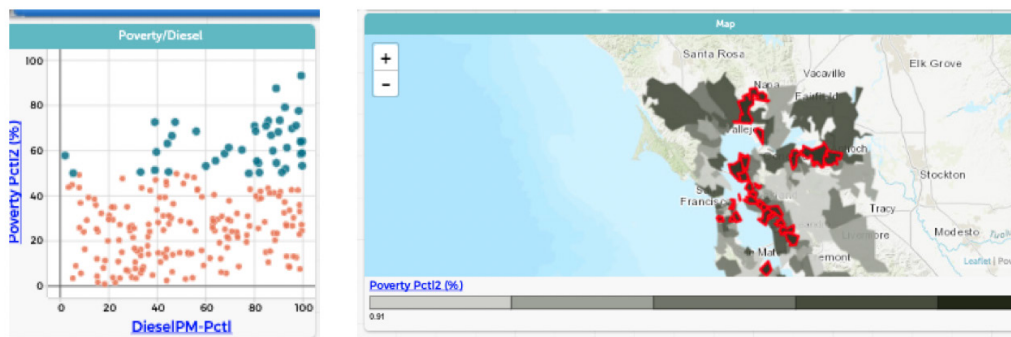


Figure 7. Plots and maps in Narun’s data story

As we noticed this pattern in the course, we followed up with each participant to ask questions to deepen their inquiry, including, “Which communities do you think are most affected?” However, as we reflect on our implementation, we realize that we may have inadvertently encouraged the race-evasiveness that we observed; in a review of our workshop, we found that we offered relatively few analyses of quantitative data on race and instead relied on historical accounts and narratives that highlight social and political forces. We also criticized the static and limiting demographic racial categories in the census that were the foundation of our quantitative data. Given the limitations that we highlighted, participants may have been hesitant to present a purely quantitative account of race. While some participants, like Eva and Amy, successfully offered multi-dimensional understandings of racialization, others may have needed more time and support to find other sources of evidence that could help to tell a more complete and complex story.

As we consider teaching this course again, we are grappling with the complexity of representing race through different forms of data. We recognize the need to highlight the value of quantitative data on race to reveal inequity, but also to acknowledge its limitations in representing individual experiences and its power to reproduce damaging narratives. We are working to adopt the advice of Vélez and Solorzano (2018) to never let data and maps speak for themselves and we are also developing explicit prompts for participants to discuss and justify which variables they included and left out of their maps. Finally, we will give greater attention to the interrelationships between race and income to emphasize the political and historical structures that have prevented communities of Color from building wealth. Such discussion might support youth in communicating more proficiently about systemic racism.

In future iterations of this workshop, we plan to employ additional activities to support participants' understanding of the racialization of space, using methods such as ethnographic mapping (Hoops, 2020; Philoxene, 2021). Specifically, we plan to have youth draw maps that represent their own knowledge of environmental resources/stressors in their community and neighboring areas, as well as discuss the ways they make sense of the people, places, and events across communities. Through these maps, we can engage youth in understanding how race and space are co-constructed and examine the discourses of race that emerge. In doing so, we can critically examine how our own positionalities and proximity to Whiteness influence the way we make sense of different geographies and communities.

Challenge 3: Scaffolding the Integration of Qualitative Data

Related to the above challenge, we noticed that participants needed greater scaffolding to integrate quantitative and qualitative sources of data. Qualitative sources of data, such as personal stories, investigative journalism, or historical sources, provide necessary insight into the reasons behind the patterns in the data and are the basis for critical analyses. The racial stratification and inequality visible in data maps is a single, static representation of systemic inequities and processes of racialization. Other types of information are needed to understand the conditions that gave rise to this snapshot in time.

As we recognized the need for participants to integrate qualitative and quantitative data, we created a model for developing a data story that emphasizes the interplay between these two sources of information (see Figure 8). In particular, we highlighted that qualitative data, in the form of news articles, people's stories, or historical context, could motivate new explorations of the quantitative data.

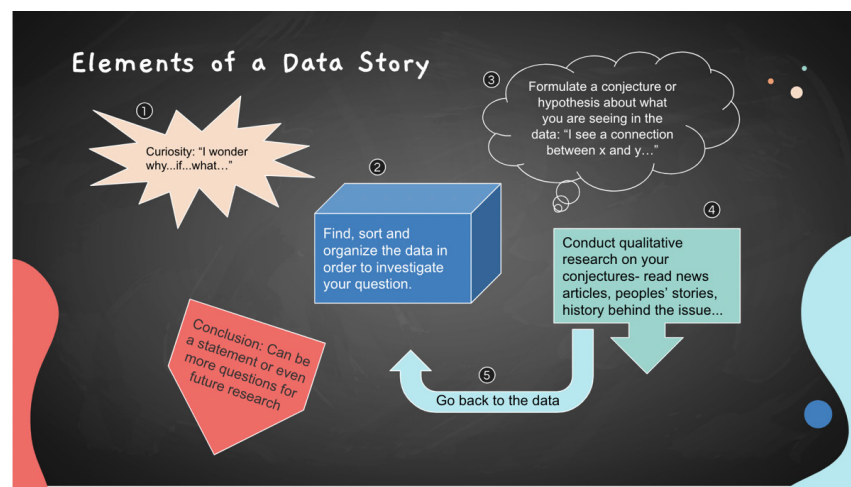


Figure 8. Model for developing a data story

Finally, we recognize that participants may need more time and guidance on how to integrate different sources of information to analyze the structural factors, political projects, and power relationships that underlie the patterns they see in data. In future iterations of the course, we plan to explicitly debrief one of the sample data stories to emphasize how qualitative sources can help to uncover the causes of the patterns in the data. In addition, we plan to have participants research qualitative sources of data on their question of interest sooner, so that they may be explored in conjunction with the quantitative data. With more time, we will arrange for participants to hear more stories from community members, particularly those who are close to the issues that they are researching, in order to supplement and challenge the quantitative data.

THE POWER OF DATA STORIES

We recognize several successes of the workshop, especially the potential of syncretic learning to support reasoning about systemic injustices (Gutiérrez, 2014). Through local and global cases of ER, youth from a wide range of backgrounds, including those from affluent communities, were able to engage their own experiences to pose questions about issues of injustice. To answer their questions, students analyzed and transformed data with facility. Storytelling of local community members was integrated through the inclusion of a guest speaker whose experiences provided needed sociohistorical context to phenomena present in the quantitative data. Drawing on these narratives and other resources, participants were able to overcome the limitations of quantitative data to represent the complexity of racialized phenomena.

Yet we also see the potential danger in engaging with racialized phenomena through analysis of quantitative data. Given our experience, we caution STEM educators that addressing racial inequalities through quantitative data requires intentional and extensive scaffolding of other sources of information and practices from other disciplines. Although our design integrated quantitative data with information about the social, historical, and political context, we still found that participants reported correlations without explanations or structural analysis. Such an approach can naturalize racial inequality and obscure the actions that caused it, which, in turn, reinforces the structures of White supremacy.

We recognize the limits of our own design and facilitation team—most of whom come from privileged backgrounds and many of whom are White. To strengthen our work, we continue to develop relationships with community members with different perspectives and cultural practices to co-design and implement our curriculum. As we continue to develop this work, we are increasingly mindful of the ways that we did and did not make race, particularly our own proximity to Whiteness, visible to our participants. In our ongoing work, we are analyzing video data of our class sessions and curriculum artifacts to investigate: 1) when race was explicitly discussed and avoided across different data sources and class participation structures; 2) when agents, power structures, and racial formations were invoked to explain environmental and social outcomes and when they were obscured.

We hope to identify the conditions that supported youth in making sense of race as a lived experience and racism as a structural phenomenon. We also hope to identify aspects of the curriculum and facilitation that need to be modified to focus participants' analyses more clearly on White supremacy, including engaging privileged youth in considering their positionalities. As an example, we are exploring how to reframe our anchor case about Oakland to focus on the White and affluent communities that advocated for their spaces to be protected.

For other educators interested in taking up this work, we emphasize the importance of grounding explorations of racialized phenomena in richly described local cases to which youth have personal connections. Although we provided multiple case studies of ER that were relevant to the diverse backgrounds of our participants, the anchor case of West Oakland, which was less familiar to them, was critical for modeling how to contextualize quantitative data. In future work, we will continue to research the hyperlocal histories and activism of any featured community. To that end, we realize that we should have given more attention to the particularities of the context of West Oakland, including clearer linkages to the ways that anti-Blackness undergirds local institutions.

Finally, we recognize that our work represents, in many ways, a best-case scenario; our participants chose to participate in a course that addressed racism, and we live in the Bay Area, where such conversations may be more encouraged than in other parts of the country. We acknowledge that this work would be challenging to conduct in other political contexts, especially given the current backlash against Critical

Race Theory. Yet we see potential for educators in these settings to encourage critical perspectives through designing curriculum that explores the tensions between personal stories and data about issues of their choosing.

Despite the limitations of our work, we remain hopeful about the power and possibility of data stories as a catalyst for activism. We found that the process of developing stories that investigate our spatial, sociohistorical, and racialized surroundings holds potential to foster sensemaking about the present and to imagine new futures. Youth can imagine a world in which the poor quality of water for farm workers is not accepted, asking, “Who did this?” and “Who has tried to stop it?”

A data story that explicitly investigates *racesspace* can help youth to develop new understandings of what it means to be Black and live in a neighborhood surrounded by freeways, asking, “What was here before?” and “Whose neighborhood is being protected at the expense of this one?” Across their explorations, they ask, “What is my role in changing this system?” Through integrating data and narrative, youth can position themselves as part of broader collective action against systems of oppression and dream of new futures together.

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ABOUT THE AUTHORS



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Meg Escudé is a PhD student at the University of California, Berkeley who takes a critical approach to the learning sciences. Her research engages community-based after school educators in the co-development of liberatory learning experiences for young people. Meg has over 12 years of experience as an educator and program director in which she worked to create out-of-school learning environments that honor the diverse ways in which non-dominant children and youth express their brilliance, particularly in work that intersects STEM, cultural practice, and art.



Michael Bakal is PhD candidate at the University of California, Berkeley Graduate School of Education, where he co-designs and studies youth participation in environmental justice programs. A former high school biology teacher and media advocacy trainer, Michael has worked since 2009 with the community-based organization Voces y Manos in Maya-Achí territory in Guatemala. Working with that organization, his dissertation is focused on youth engagement in agroecology programs as a response to the climate crisis.



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Xinyu Wei is a master's student at the University of California, Berkeley studying learning sciences. An international scholar from China, she is passionate about making STEM education more accessible for students from socioeconomically minoritized communities and helping students interpret the real-world meaning of knowledge like mathematicians and scientists do. Xinyu desires to scaffold students to position their cultural practices and interests as grounds for expansive learning. She also focuses on examining the affordances of task-based interviews to mathematize students' in- and out-of-school experiences during formative assessments.



Collette Roberto is a PhD student at the University of California, Berkeley working at the intersection of computer science (CS) education and learning sciences (LS). Collette is interested in the design of new approaches to CS Education that reject the notion that science is neutral and objective. The design of such approaches requires that we take a meaningful stake in the communities we serve, and similarly rejects the notion of researchers as unbiased observers. Instead, Collette believes that the way forward is to engage in co-design with students and teachers for new CS learning experiences.



Damaris Hernández is a middle math teacher in Chicago and a graduate student at Relay School of Education through Teach for America. As an undergraduate at the University of California, Berkeley, her interdisciplinary program of study addressed the issue of inequitable access to quality math education for students from nondominant communities. Her research focuses on rehumanizing mathematics classrooms and centering student voices and stories through culturally sustaining curriculum. As a first generation Latina, she hopes to inspire her students to see themselves as mathematicians and to use math to learn about their community and make the world a better place.



Amber Yada is an American studies major and education minor at the University of California, Berkeley. She is pursuing an interdisciplinary undergraduate degree with a focus on race, media, and education that explores questions of identity, representation, and learning. She is also an animator who nerds out over animated shorts with counter-hegemonic narratives.



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