Bank Street Occasional Paper Series

Occasional Paper Series

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

Article 9

November 2022

Learning Within Socio-Political Landscapes: (Re)imagining Children's Geographies

Kathryn Lanouette
William & Mary

Katie Headrick Taylor
University of Washington

Recommended Citation

Lanouette, K., & Taylor, K. H. (2022). Learning within socio-political landscapes: (Re)imagining children's geographies [Special issue]. *Occasional Paper Series,* (48). DOI: https://doi.org/10.58295/2375-3668.1476

Learning Within Socio-Political Landscapes: (Re)imagining Children's Geographies

Introduction

Kathryn Lanouette

Katie Headrick Taylor

Contributors

Alejandra Frausto Aceves

Daniel Morales-Doyle

Anna Lees

Megan Bang

Margaret Nell Becker

Natalie R. Davis

Roni Barsoum

Emily Reigh

Meg Escudé

Michael Bakal

Edward Rivero

Xinyu Wei

Collette Roberto

Damaris Hernández

Amber Yada

Kris Gutiérrez

Michelle Hoda Wilkerson

Jennifer Kahn

Daryl Axelrod

Matthew R. Deroo

Svetlana Radojcic

Abigail Kerlin

EllenMcCrum

Occasional Paper Series 48 | 11. 2022

Bank Street Occasional Paper Series

Table of Contents

Introduction

Learning Within Socio-Political Landscapes: (Re)imagining Children's Geographies

Kathryn Lanouette and Katie Headrick Taylor

Over a century ago, Lucy Sprague Mitchell, one of Bank Street College's founders, put into practice a vision of teaching and learning enmeshed in the physical, social, and political city spaces of young peoples' daily lives. Central to her work was reimagining geography, grounding the discipline in the *here and now* of children's neighborhoods, connecting with community members and city spaces as a means to explore complex relationships within the wider world. Mitchell considered working across different modes of engagement as an integral practice for children to learn about their worlds and their roles within it: physical movement, like walking and subway riding, and the construction of maps with varying scales, materials, and symbols (Mitchell, 1991). Mitchell also envisioned movement and mapping as essential for teachers' learning, leading multi-day **Long Trips** along the eastern seaboard to make visible educators' connections to contemporary social, political, and environmental realities, and connecting city and rural locales. Temporally, these practices and tools acted as playful intermediaries between visible and invisible interrelationships constituting children's and adult's lives and livelihoods.

In this special issue, we bring together educators and researchers to (re)imagine what it means to teach and learn within the immediacy of the here and now, an orientation crucial to confronting contemporary threats to children's lives, democracy, and the planet. We seek to extend and broaden Mitchell's original conceptualizations by centering the past and future alongside the immediacies of the now, elevating Black, Indigenous, and People of Color (BIPOC) perspectives in children's geographies and exploring potentialities of mapping in analog as well as emerging digital forms. We also aim to carry forward her commitments to listening to children with curiosity and care, rooted in a belief that young people know a lot about the world already and that they are fully capable of delving deep into complex processes and problems. As such, this collection situates young peoples' here and now within socio-political landscapes, the wider nested systems and structures that constitute and reconstitute land, place, and children's geographies.

We draw on the term *landscapes* to forge the agency of land together with the human construction of place. Lands exist on their own terms, changing with and without human intervention: coastlines shrink, canyons grow deeper, and mountainsides erode. Places, on the other hand, come to being through human-centered relationships with one another and our material surroundings. We borrow Doreen Massey's words to consider places as "a simultaneity of stories-so-far" (2005, p. 9). Our stories bring to bear the emotional, social, political, economic, and racialized forces on the lands where we live, learn, and play. Landscapes also help us to move away from anthropocentrism, a common orientation undergirding place-based education, in which humans dominate the planet. In *Ecology is a Sistah's Issue Too: The Politics of Emergent Afrocentric Ecowomanism,* Shamara Shantu Riley (2003) writes, "the social construction of race, gender, class, and nonhuman nature in mainstream Western thought are interconnected by an ideology of domination." Starting from a point of care and collective agency (Nickson, 2021) rather than control guides a different praxis "to challenge inequities arising along

racial, gendered, and species boundaries" that shape and are shaped by the local and global places we inhabit and sustain. Landscapes help us to see the land, water, and climate as constantly exercising their agency, willing humans and more-than-human counterparts to acclimate, migrate, or perish.

(RE)IMAGINING CHILDREN'S GEOGRAPHIES

Beyond adult-centric notions of political will

While young people's daily lives and their geographies remain a focus of the work of teachers and scholars in the decades since Bank Street's founding, we have seen major shifts in educators' orientations to the work. First, adults are increasingly recognizing the collective power and political ingenuity of young people (Shea & Jurow, 2020; Tivaringe & Kirshner, 2021); the COVID-19 pandemic was a distinctive time of youth organizing (e.g., Barton et al., 2021). Perhaps it is young people's well-being that has been most impacted during a time in which a global pandemic, racialized gun violence, and growing climate injustices have radically shifted our relationships with landscapes. Youth-led organizations like **Youth Over Guns, Uplift,** and **Grey to Green** exemplify ways to face these existential realities with care, clarity, and imagination. Uplift, for instance, focuses on the environmental destruction wrought by colonialism and capitalism in the US Southwest to build alliances with people and groups adversely impacted by energy extraction and pollution.

Our times of ecological, social, and political precarity require forms of teaching and learning that nurture young people to find joy and sustenance through building compassionate relationships with and within their local landscapes (Jurow & Shea, 2015; Taylor, Silvis, & Bell, 2018; Lanouette, 2022). Yet we also recognize young people's increasing rage at the slow and impotent response of policymakers to address the multiple injustices stemming from racial capital (e.g., race as foundational to the creation of capitalist spatial relations; Inwood, Brand, & Quinn, 2021) of which gun violence and climate change are both symptoms of these injustices.

Beyond human exceptionalism

We also see shifts beyond the centrality of human geography as a guiding discipline in place-based learning. Broadly speaking, human geography is:

> the study of interrelationships between people, place, and environment, and how these vary spatially and temporally across and between locations… human geography concentrates on the spatial organization and process shaping the lives and activities of people, and their interactions with places and nature. (**Dartmouth Library Research Guides**)

While relationships and spatiality persist as important qualities of learning, some place-based learning—especially that informed by Indigenous epistemologies—focuses on the agency of lands and waters over and beyond human existence (e.g., Marin & Bang, 2018). Such an orientation invites educators to question how human exceptionalism may be an underlying assumption of curricular designs. In practice, this could look like an outdoor curriculum in which the plants, animals, weather, and natural pathways encountered during the day guide the students' learning activities. It could also mean supporting young people to pay attention to the ways in which animals, plants, lands, and water *repair* disturbed or broken relationships outside of human intervention (Tsing, 2013). Storying the land, "a process whereby the land is invested with the moral and spiritual perspectives specific to Native American communities" (Yi, 2016, p. 1), may also be a method used for making sense of these place-based experiences, alongside note-taking, photography, and mapping. "Generalizing" or "scaling" a

curriculum, therefore, are not underlying values as much as being in relation with and responsive to the particularities of the surrounding worlds in which our daily lives are enmeshed.

Beyond White and ableist hegemony

Since Mitchell's early work, more educators are considering shifts beyond human geography to encompass frameworks that elevate geographies of race, sex/gender, and (dis)ability. Black geographies (McKittrick, 2006), for instance, "seek to highlight black agency in the production of space and black geographic experiences in the articulation of Black geographic visions of society" (Allen, Lawhon, & Pierce, 2019, p. 1002). In centering Black lives and agency *despite* White hegemony, Black geographies guide teacher-scholars to co-construct an "analytics of race," not about human suffering, but about human life. Put into practice, Black geographies support facilitators of young people's geographic explorations to elevate and center Black lived experiences, Black knowledges, and Black excellence, elevating the contributions Black people have made and make to the production and theorizations of space and place (Lipsitz, 2007). Doing this work necessarily opens up other geographic sources as valuable forms of knowledge production and spatial expression, including parades, protests, films, and music festivals. Situating inquiry into these kinds of large-scale, collectively produced spatial expressions highlights plurality—everyone experiences and makes meaning of places in their own way.

Perhaps there is no better landscape to see this plurality than the COVID-19 pandemic, during which the intersections of race, gender, and (dis)ability illuminated inequities in all facets of life, including physical mobility and immobility. While some people dramatically limited their mobility by never leaving home, others' daily rounds hardly changed at all, or even intensified. Essential workers, disproportionately Black and Brown people, clocked more trips and hours away from home than usual. Meanwhile those with arrested mobility had a much lower risk of infection, with much better health outcomes and rates of survival for themselves and their families.

Shifting maps and mobility

How would Mitchell have helped her students explore inequities across people's physical mobilities? Perhaps she would have asked young people to draw pathways between school, work, and home over canvas maps of the city, or build a "typical day" with wooden blocks, or take walking trips through the city to talk with essential workers. Today, innovations in geospatial and other mapping technologies, like augmented and virtual reality, open up new modalities for understanding, making it possible to differently **visualize places and enact forms of mobility,** connections, and insights (Marin et al., 2020). Young people can "fly around" their communities in **Google Earth,** they can chase after Pokémon moving through their neighborhoods via a mobile app (Silvis, 2022), and they can approach a building on foot, hold up their phones, and **overlay an image** of a more youth-friendly asset on top. There are also new digital media for map-making, enabling youth to overlay photographs, sketches, and text with local, regional, and global data sets, in turn making possible new avenues for disciplinary learning (Lanouette, 2019; Rubel et al., 2016), civic participation, and advocacy (Van Wart, Lanouette, & Parikh, 2020; Radinsky et al., 2014; Mitchell & Elwood, 2012). Various spatial technologies now also record and make visible the pathways youth travel (Taylor, 2017), along with the embodied exertions of such movements (e.g., oxygen inhaled, steps taken), allowing easy visualizations of this data to answer questions about one's own body (Taylor, 2020). With these changes in how spatial data can be generated and visualized, youth's daily map-making and map reading have become integral to forming social relationships, inquiring into family and neighborhood histories, and engaging in civic community issues.

LOCATING OURSELVES AND OUR CHILDREN IN DIVERGENT SOCIO-POLITICAL LANDSCAPES

As we write, our current socio-political landscapes are informed by our identities as White, cis-gendered, mother-scholars, raising children and doing our work—in collaboration with community organizations, schools, teachers, young people and their families—in two different locations in the United States. For Kathryn, her day-to-day life and work with young people takes place in Richmond, Virginia, a mid-sized city in the mid-Atlantic. For Katie, her daily interactions with young people are in Seattle, Washington, in a progressive corner of the Pacific Northwest. As we talked together over the last year, it was clear that variations in our socio-political landscapes matter for not only *what* young people learn, but for *how* they learn in schools, homes, and other out-of-school time environments. Our place-based perspectives may be situated on opposite coasts, but our Whiteness means we are both beneficiaries of a nation "founded upon a triumvirate of horrors" (Castillo, 2022; p. 100) perpetrated by White settler colonials and slavers. As we grasp this truth, we seek ways to divest from racial capital and hold other White folks accountable to do the same.

Place is socio-political; land is carved up by human-constructed borders and boundaries, often with names and specific rules, norms, and policies. The public school systems in and around Seattle, for example, affirm and promote the **13 Principles of Black Lives Matter.** Individual schools' Race & Equity Teams contact families to inform them that districts uphold these values. A commitment to these values means that teachers should practice restorative justice "for Black people, and by extension, all people"; affirm students who identify as trans and queer, and honor Black women, Black families, and Black villages. At the same time, many Seattle public schools continue to remain segregated along racial and socioeconomic lines, with unaffordable housing magnifying inequities within and outside school walls. Concurrently, in other parts of the US, school boards, state legislators, and governors are trying to ban—or have successfully banned—teachers from saying "gay," or acknowledging how White men's ruthless perpetuation of chattel slavery since the year 1619 enabled our nation's development. These district-by-district differences in public school policy mean that some schools starkly support educators while others surveil educators as they talk with our children about racism and sexism, shaping how we conduct educational research and interventions. What kinds of questions can we ask? Who will be willing to collaborate and participate? How will the institutions that employ us provide support, or even protections?

Different sociopolitics alter land itself in particular ways, affording or constraining forms of access and mobility for young people. City and county planning policy, for example, reveal the ways in which sociopolitics shape where and how learning opportunities can emerge. Sidewalks, bus routes, bike lanes, and highways—overlaid on longstanding patterns of redlining—facilitate vastly different routes for walking, wheel chairing, biking, and driving. We see this focus on infrastructure in efforts to enhance public transit options for Seattle- and Richmond-area youth by making bus and light rail ridership free of charge. In other parts of the US, voters in places like Nashville, Tennessee, repeatedly struck down efforts to democratize transit, creating mobility deserts for non-driving or car-less residents (e.g., young people and the elderly). These variations in public mobilities contribute to shaping the potential learning opportunities we design with and for youth (Pinkard, 2019), as well as our own travels with our children along streets and across neighborhoods. What kinds of movements are possible for young people, educators, and researchers in particular places? Along what pathways or corridors through city, suburban, and rural byways is mobility possible, and for whom?

Distinctive socio-political landscapes for living, learning, teaching, and researching shape relations with land. This past year, Katie's first grader son, for instance, spent many school days preparing for a trip to the tidepools of the Puget Sound to see, touch, and smell camouflaged sculpin, crimson-colored blood stars, and mossy chiton. In bringing his multi-modal tidepool explorations home, Katie's son taught her—a child of a land-locked section of the Appalachians—about an ecosystem she could not have imagined as a first grader. In contrast, Kathryn's first-grader stayed within the schoolground's grass and asphalt schoolyard, far removed from nearby local waterways flowing into Chesapeake Bay. These variations make possible or foreclose particular types of interactions young people can have with land and waters and more-than-human life, shaping young peoples' connections and considerations to questions such as: Who lives and thrives here? Who are our neighbors? What interspecies and intergenerational relationships are we entangled with?

In this special issue, we are excited to learn with and from contributing authors, in the pursuit of learning and teaching that centers: 1) young people's here and now as a basis for making sense of and participating in complex socio-ecological, political, racialized systems; 2) the integral role of mapping and movement in teaching praxis; and 3) the concerns and ideas young people have for acting on injustices in their local geographies. We view these orientations as having the potential to nurture pedagogies of care and curiosity emergent within these emplaced learning endeavors.

CONTRIBUTIONS TO THE SPECIAL ISSUE

The authors in this special issue extend, critique, and reimagine what it means to center young people's worlds and ways of knowing to make sense of the here and now. As educators and researchers, they share the pedagogical, technological, and emotional complexities of teaching and learning, in turn imagining and enacting more just, ethical, and joyful futures within particular socio-political landscapes. Building from Mitchell's earlier works almost a century ago, contributors to this issue center the historical past and future imaginings along the immediacies of now, elevate the plurality of BIPOC geographies, and explore the potential of analog and digital mapping technologies.

Alejandra Frausto Aceves and Daniel Morales-Doyle reveal how disciplinary pursuits of engineering can be rooted not only in local infrastructure but simultaneously in community and civic participation and protest, in ways that are led by and with young people. As educators, researchers, and community members in a Midwest US city in a neighborhood where many residents have roots in Mexico, Frausto Aceves and Morales-Doyle describe how they supported a sixth grade class to advocate for repairs to the paint crumbling off the neighborhood water viaducts they walked underneath daily on the way to and from school. The paint flakes were full of toxic heavy metals. Drawing on pedagogies that center beauty and disrepair, along with local and Mexican traditions, they recount how students collected evidence about the lead-based toxicity of the peeling paint and shared their findings at community meetings, advocating for lead-paint remediation. The authors also recount the resistance on the part of an elected official who argued that the private ownership of the viaducts and incomplete data reduced her obligation to act on repairing community infrastructure.

Other contributors illuminate the pedagogical possibilities of land-based learning, when intentional space and time allow for children's movement, connections, and curiosities to focus on caring relations with land, waters, and more-than-human life. Drawing from a multi-year research and teaching collaboration in the Pacific Northwest, **Anna Lees and Megan Bang** describe a two-week summer program that intentionally supported "a part of" (rather than "apart from") relationships with complex

ecosystems, detailing how, as educators, they supported 6-to 8-year-old children to navigate Indigenous and western science epistemologies. In the process, Lees and Bang elevate the implicit nature-culture relationships inherent in place-based science learning, and articulate teaching approaches that support understandings of ecological flourishing beyond colonial framings.

Margaret Nell Becker, a fourth and fifth grade teacher in Manhattan, recounts how the two years of the COVID-19 pandemic transformed her and her students' relationship with Randall's Island, a city island in the East River, wedged between East Harlem, the South Bronx, and Astoria, Queens. The ongoing COVID-19 pandemic's disruption of daily life and schooling opened up new opportunities for Becker and her students to venture over to the island. These trips afforded new relationships with the saltwater tidal estuaries' plants, animals, and waters just a few minutes' walk from the school building. Specific locales unique to this particular socio-geographic confluence made possible new ways of learning, being, and caring—with the tides and trees, as well as with one another in the class community. Emerging from new pathways through the city, these changing pedagogies also shaped Becker and her daughter's walks and wanderings through their own neighborhood elsewhere in the city, revealing changing relations with more-than-human lifeforms across an educator's familial and classroom-based communities.

Centering the experience of Black and Brown youth within racialized understandings of place and space, several authors detail possibilities and challenges inherent in understanding teaching and learning within these settings. **Natalie R. Davis and Roni Barsoum** elevate Black children's understanding of their elementary school in a Southern city, a school designed explicitly to nurture Black children as critically and communally oriented citizens. Focusing on children's drawings about their school, the authors seek to understand how the socio-political intentions central to the school's formation and daily enactments are experienced and interpreted by students. Children's drawings and conversations reveal holistic and harmonious aspects of the school community alongside community discord and power imbalances, highlighting research methods that make room for hearing and seeing a school through a child's eyes.

Emily Reigh, Meg Escudé, Michael Bakal, Edward Rivero, Xinyu Wei, Collette Roberto, Damaris Hernández, Amber Yada, Kris Gutiérrez, and Michelle Hoda Wilkerson recount the possibilities and challenges of using spatial data and data storytelling in 12- to-14-year-olds' studies of environmental racism. Centering on local air quality injustices in Oakland, they articulate how young peoples' understanding of race and space relationships—using data-intensive maps—both fostered and stifled discussion of broader structural mechanisms and institutions shaping environmental injustices. Moving back and forth between the here and now to understanding historical events and future possibilities shaping racialized landscapes, the authors detail the tradeoffs when data, primarily quantitative data maps, are interpreted and storied by young people who do not share the same spatialized racialized histories.

Jennifer Kahn, Daryl Axelrod, Matthew Deroo and Svetlana Radojcic describe a multi-month collaboration with 11th grade students and their teacher in a primarily Cuban neighborhood in a Florida city. The authors recount how young people's family histories and experiences with first- or second-generation immigration were woven into their transnational identities and storytelling using data visualized across multiple spatial technologies. The authors detail youths' complex understanding of their immediate city streets and neighborhoods in ways that link local and global networks of relationships.

Many of the contributors also expand our understandings of children's map-making and movement, exploring both varied modalities and materials to elevate young peoples' expressions and understandings. **Abigail Kerlin and Ellen McCrum** describe their experiences making maps with elementary and graduate students in New York City, focusing on how map-making can be a generative lens for understanding the plurality of perspectives present within city blocks, school hallways, and nation state borders. The authors show how engaging in the process of collaborative map-making and map reading can make visible how place and space are co-constructed through (dis)ability, mobility, and multiple senses (touch, smell, sight, hearing), even with the simplest of materials (clipboards, pencil, and paper). Through processes of creating, sharing, and juxtaposing maps, the students gain insights into what is seen and what remains unseen in their own worlds.

Several of the authors also center varied mappings of youths' worlds. For example, Davis and Barsoum focus on Black children's drawings of their school, using pencil and paper as media for children to express their understandings of "what it is like here" in their school. These sketches in turn become ways for teachers and researchers to understand how the schools' strivings and strengths are felt and understood by children. Frausto Aceves and Morales-Doyle use Photovoice methodologies, blending photos and text to support youth capturing and sharing their perspectives on community infrastructures. Reigh and colleagues juxtapose several quantitative public datasets on social and environmental indices, using a digital data mapping interface (CODAP) to inquire into spatialized and racialized inequities. Kahn and colleagues bring together multiple sociohistorical spatial data platforms (e.g., Social Explorer, Snapchat, Padlet) to support youth in interpreting and storying their own cultural heritage and transnational identities within large data sets.

LEARNING AND TEACHING TO (REIMAGINING SPACE, PLACE, AND LAND RELATIONS

Teaching and learning have always been social and political, happening somewhere amidst a network of historical, contemporary, and future-building relations. Lucy Sprague Mitchell's efforts with young people and adults demonstrated this orientation to education decades ago. In this special issue, we aim to illuminate what it can mean to engage with this complexity—in the immediate here and now of young peoples' lives. Authors collectively elevate the agentive and dynamic elements of the local, which become visible only when we take seriously young peoples' perspectives and wholeness, as well as the dynamic socio-political landscapes within which they live, learn, and play (never mutually exclusive but always happening together). Throughout, authors reveal emergent and enduring forms of praxis that center holistic and pluralistic experiences of young learners, in turn making and remaking space, place, and land relations.

We hope this special issue captures an urgency—the essential role of learning and teaching for facing existential threats to children's lives, democracy, and the planet. The authors share a commitment to making learning matter beyond capitalist notions of education (e.g., testing, standards, grit), while also being responsive to how those notions have reinscribed racism, misogyny, ableism, and human exceptionalism. As policymakers create new avenues for chipping away at our mountains, voting districts, literacy, social studies curricula, and bodily and community sovereignty, learning within socio-political landscapes has never felt so essential. Therefore, we hope this collection provokes us all to (re)consider our approaches to education as an opportunity to collectively care for the people, places, and more than human relations made most systemically vulnerable.

ACKNOWLEDGMENTS

We are grateful to our colleagues, collaborators, and families, who motivate and make possible continual learning. We are also grateful for the reviewers who provided critical and caring feedback to the contributing authors, and for the authors for sharing their work through this special issue.

REFERENCES

Allen, D., Lawhon, M., & Pierce, J. (2019). Placing race: On the resonance of place with black geographies. *Progress in Human Geography, 43*(6), 1001-1019.

Calabrese Barton, A., Greenberg, D., Turner, C., Riter, D., Perez, M., Tasker, T., Jones, D., Herrenkohl, L. R., & Davis, E. (2021). Youth critical data practices in the COVID-19 multipandemic. *Aera Open, 7.* doi.org/10.1177/23328584211041631

Castillo, E. (2022). *How to Read Now.* Viking.

Inwood, J. F., Livia Brand, A., & Quinn, E. A. (2021). Racial capital, abolition, and a geographic argument for reparations. *Antipode, 53*(4), 1083-1103.

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

Lanouette, K. (2019). *The potential of place: Leveraging children's local knowledge and participatory GIS mapping to conceptualize ecological systems in elementary science instruction.* University of California, Berkeley.

Lanouette, K. (2022). Emotion, place, and practice: Exploring the interplay in children's engagement in ecologists' sampling practices. *Science Education, 106,* 610-644. doi.org/10.1002/sce.21702

Lipsitz, G. (2007). The racialization of space and the spatialization of race theorizing the hidden architecture of landscape. *Landscape Journal, 2*6(1), 10-23.

Marin, A., & Bang, M. (2018). "Look it, this is how you know": Family forest walks as a context for knowledge-building about the natural world. *Cognition and Instruction, 36*(2), 89-118.

Marin, A., Taylor, K. H., Shapiro, B. R., & Hall, R. (2020). Why learning on the move: Intersecting research pathways for mobility, learning and teaching. *Cognition and Instruction, 38*(3), 265-280.

Massey, D. (2005). *For Space.* Sage.

McKittrick, K. (2006). *Demonic grounds: Black women and the cartographies of struggle.* University of Minnesota Press.

Mitchell, L. S. (1991). *Young geographers: How they explore the world and how they map the world* (4th edition). Bank Street College of Education. educate.bankstreet.edu/books/10/

Mitchell, K., & Elwood, S. (2012). Engaging students through mapping local history, *Journal of Geography, 111*(4), 148-157. doi.org/10.1080/00221341.2011.624189

Nickson, D. (2021). The democratization of educational care: Spatial imaginaries, demographic change, and Black families continued educational advocacy. *Equity & Excellence in Education, 54*(3), 303-316.

Pinkard, N. (2019). Freedom of movement: Defining, researching, and designing the components of a healthy learning ecosystem. *Human Development, 62*(1-2), 40-65.

Radinsky, J., Hospelhorn, E., Melendez, J. W., Riel, J., & Washington, S. (2014). Teaching American migrations with GIS census webmaps: A modified "backwards design" approach in middle-school and college classrooms. *The Journal of Social Studies Research, 38*(3), 143-158.

Riley, S. S. (2003). Ecology is a sistah's issue too: The politics of emergent Afrocentric ecowomanism. In R. S. Gottlieb (Ed.), *This Sacred Earth* (pp. 412-427). Routledge.

Rubel, L. H., Lim, V. Y., Hall-Wieckert, M., & Sullivan, M. (2016). Teaching mathematics for spatial justice: An investigation of the lottery. *Cognition and Instruction, 34*(1), 1-26.

Shea, M. V., & Jurow, A. S. (2020). Student-led organizing for sustainability in business. *Cognition and Instruction, 38*(4), 538-560.

Silvis, D. (2022). Cherished world thinking: Developing a maintenance mindset in family caregiving contexts. *Cognition and Instruction,* 1-33.

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

Taylor, K. H. (2020). Resuscitating (and refusing) Cartesian representations of daily life: When mobile and grid epistemologies of the city meet. *Cognition and Instruction, 38*(3), 407-426.

Taylor, K. H., Silvis, D., & Bell, A. (2018). Dis-placing place-making: How African-American and immigrant youth realize their rights to the city. *Learning, Media and Technology, 43*(4), 451-468.

Tivaringe, T., & Kirshner, B. (2021). Learning to claim power in a contentious public sphere: A study of youth movement formation in South Africa. *Journal of the Learning Sciences, 30*(1), 125-150.

Tsing, A. (2013). More-than-human sociality: A call for critical description. In *Anthropology and Nature* (pp. 37-52). Routledge.

Van Wart, S., Lanouette, K., & Parikh, T. S. (2020). Scripts and counterscripts in community-based data science: Participatory digital mapping and the pursuit of a third space. *Journal of the Learning Sciences, 29*(1), 127-153. doi.org/10.1080/10508406.2019.1693378

Yi, I. (2016). Cartographies of the voice: Storying the land as survivance in Native American oral traditions. *Humanities, 5*(3), 62.

ABOUT THE AUTHORS

Kathryn Lanouette, GSE '06, is assistant professor of learning sciences and science education at William & Mary's School of Education. In collaboration with schools and museums, her research and teaching explore how place-based pedagogies and emerging technologies can be central to young people's learning about science and data science in ways that build towards more joyful and ethical futures. Her scholarship is shaped by her teaching experiences in Washington, DC and New York City. Lanouette has published in *Science Education, Educational Researcher, The Journal of the Learning Sciences,* and *Mathematical Thinking and Learning.*

Katie Headrick Taylor is associate professor of learning sciences and human development at the University of Washington's College of Education. Research-practice partnerships led by Taylor center racial and gender equity in STEM, data science, and digital literacy. These collaborations have occurred across museums, public libraries, public schools, homes, undergraduate courses, and family-serving organizations in New York, Chicago, Nashville, Seattle, and nonmetropolitan areas of East Tennessee. Her scholarship and teaching focus on community well-being through the digital re-mediation of learning, foregrounding the ingenuity that young people from immigrant and/or communities of color have within and across contexts. Taylor's commitment to care as a design value for digitally-mediated learning interventions has been fundamentally shaped by her roles as mother, daughter, educator, and writer. Funded by, among others, the National Science Foundation, the NAEd/Spencer Foundation, and the Heising-Simons Foundation, Taylor's research and public scholarship can be found in venues such as *The Conversation, The Journal of the Learning Sciences, Cognition & Instruction, Connected Science Learning,* and *Learning, Media, & Technology.*

More than Civil Engineering and Civic Reasoning: World-Building in Middle School STEM

Alejandra Frausto Aceves and Daniel Morales-Doyle

Ay, mis ingenieros civiles y asociados
No crean que no me duele irme de su lado
Pero es que yo pienso que ha llegado el tiempo
De darle lugar a los espacios sin cemento

Por eso yo ya me voy
No quiero tener nada que ver
Con esa fea relación de acción
Construcción, destrucción, ah, ah

Oh, my civil engineers and associates
Do not think that it does not hurt me to leave your side
But I think that the time has come
To give place to spaces without cement

That's why I'm leaving
I don't want to have anything to do
With that ugly relationship of action
Construction, destruction, ah, ah

—Café Tacvba, "Trópico de Cáncer"

El trópico de cáncer is an imaginary line in the Northern Hemisphere marking the northernmost latitude at which the sun can be fully overhead, which occurs on the summer solstice. It is also the title of a song by the Mexican band Café Tacvba that captures tensions encountered when nations in the Global South emulate the development of the North. The song tells the story of an engineer, fittingly named *Salvador* (savior), called upon to rescue his country, México, by modernizing the nation-state. The lyrics in the epigraph explain Salvador's decision to stop participating in engineering that ignores humanistic, ecological, and Indigenous realities and imaginations in order to build a more "modern" world. Salvador laments that although he loves his profession and his colleagues, he sees engineers engaging in an "ugly relationship of action, construction, [and] destruction" (Café Tacvba, 1994, stanza 7, lines 3–4) that does not attend to the unsustainable and unjust impacts of their built worlds.

Almost three decades after the song's release, its themes remain relevant and stand in contrast to the ways in which science, technology, engineering, and mathematics (STEM) education communicate a false vision of the STEM enterprise as value neutral. As recent reforms in the United States, like the Next Generation Science Standards (NGSS), aim to broaden exposure to engineering education by carving out a place for it in kindergarten or even earlier, racial equity remains a central concern (National Academies of Sciences, Engineering, and Medicine, 2022). Equity in STEM education has multiple facets and has been conceived in multiple, sometimes contradictory, ways (Philip & Azevedo, 2017). Taking themes of development, sustainability, and justice into consideration alongside the push for engineering education among younger students recognizes that students deserve opportunities to develop realistic and hopeful understandings of engineering as a range of professions and practices with embedded values and politics that shape our built world.

There are few examples of K-12 engineering education that explicitly weave together sophisticated STEM practices with equally robust considerations of values and politics. In this narrative essay, we focus on a project led by Alejandra with her sixth-grade students at a neighborhood public elementary (K-8) school. In our city, the vast majority of elementary schools include kindergarten through eighth grades. There are very few stand-alone middle schools. Thus, in our context and in this essay, the term

elementary school includes the middle grades. Aguila Elementary[1] is located in City Field, a working-class neighborhood in a large US city where most of the residents, like Salvador the engineer, have roots in México. Alejandra engaged her science class in investigating crumbling concrete viaducts that students walk under on their way to and from school. By considering how engineering practices are imbued with values and ideologies, we present an interpretive narrative about how students engaged in STEM education as world-making in the context of development and urban decay in this transnational community.

This story begins with a project in Alejandra's sixth-grade science classroom that intertwines science education with civic engagement. We explain how the project and the students helped us to see local urban infrastructures as political artifacts of civil engineering and sites of learning. As students communicated with an elected official, they mobilized scientific evidence as part of their civic reasoning. But they also began to understand how the professions and practices of engineering contribute to building our world in value-laden ways. We propose moving beyond notions of civil engineering and civic reasoning that are connected to projects of nation-building to more pluralistic and internationalist approaches. Problem-posing and world-making approaches to engineering education can lead to students' participation in more complex and authentically situated learning *que le da lugar a* (giving space and place to) students' contributions to the world (Barajas-López & Ishimaru, 2020). Our story includes examples of students engaging with NGSS science and engineering practices (SEPs) in ways that explicitly consider values. We contend that to educate youth as world-makers with the capacity to dream and the power to act implies encouraging them to see the world as it has been made and to take up an ethic of care by relying on "*should we* questions" (Tzou et al., 2021). In the context of engineering education, this means encouraging students not just to design solutions, but also to probe the *should we* dimensions of the engineering challenges we present to them. Imagining possibilities therefore includes thinking and making decisions with the implications and consequences of those possibilities in mind.

Even as we became frustrated with the way the elected official responded to students' use of scientific evidence, the young people themselves remained hopeful and committed. Thus, we call on teachers to cultivate SEPs that take seriously the rightful presence of youth and their communities in service of disrupting the world as it is and moving toward speculative civic possibilities and imaginations that allow for the dreams of our youth to take root (Calabrese Barton & Tan, 2020; Garcia & Mirra, 2021).

CIVIC REASONING WITH SCIENTIFIC EVIDENCE

The classroom project described in this paper was supported by the youth participatory science (YPS) collective, a local group of teachers, scientists, and community organizers dedicated to engaging young people in authentic scientific investigations about local issues of environmental racism. We write as members of the YPS collective and also as residents of the City Field community. Every day, we walk our own children under the viaducts to attend Aguila. As community members who share a background in chemistry and years of involvement with urban environmental issues, we suspected that the peeling paint on the viaducts was a potential source of heavy metal contamination. But we were surprised by some of the ways in which students took up the issue of urban infrastructure as their own.

For us, linking science education with civic engagement is grounded in our commitment to our neighborhood and our profession. This link pushes back against the tendency for science education

1 The school, neighborhood, and people have been assigned pseudonyms.

to discourage students' community and political involvement. At the undergraduate level, STEM majors tend to be less socio-politically engaged than their peers in other disciplines (Garibay, 2015). As engineering becomes a priority for younger students, we hope to avoid reproducing this tendency of postsecondary engineering education in K-12 settings (Vakil, 2018). With this story, we hope to contribute to the collective imagination about ways to resist an engineering education in which young students are raw materials for the STEM pipeline and future contributors to the national gross domestic product (Morales-Doyle & Booker, 2022). As this project began, we were not intentionally engaging in engineering education nor explicitly thinking of our work as world-making. And yet, as Café Tacvba (1994) invites us to notice in "Trópico de Cáncer," we are all participating in the building of worlds. As we elaborate below, the ways in which students took up urban infrastructure and built worlds as meaningful themes informed the ways we thought about the possibilities of our work. Thus, our focus here is to tell a story that may inform educators who position their students as community members and co-contributors toward more just and equitable present and future worlds.

DARLE LUGAR A LOS ESPACIOS SIN CEMENTO

Using a photovoice activity, our investigation began by problematizing the decaying viaducts (de los Rios, 2020). The problem-posing activity asked students to take four photos: one of something clean, one of something contaminated, one of something ugly, and one of something beautiful. We have discussed this activity elsewhere in terms of posing problems while avoiding damage-centered perspectives (Morales-Doyle & Frausto, 2021; Tuck, 2009). For our purposes here, there are two important points to highlight with respect to the intersection of engineering with values. First, this photovoice activity explicitly connected students' values, in terms of aesthetics, to the NGSS SEPs of defining problems. Second, we highlight that several students photographed cement structures as the representation of something ugly in their neighborhood and submitted photos of the large community park or other greenspaces as their example of local beauty (see examples in Table 1). Through these photos, students were echoing Salvador's plea in the lyrics to "Trópico de Cáncer" (Café Tacvba, 1994, stanza 6, line 4) to *"darle lugar a los espacios sin cemento"* (give place to spaces without cement).

In reflective conversations about this project, students raised crumbling infrastructures as a problem in their communities. For example, when asked about challenges faced by the community, Rocio responded, "Some of the problems in the community are like you walk around and it's not that clean. The sidewalks are messed up and then there is a lot of potholes on the roads." While we identified peeling paint on the viaducts as a potential problem for students to investigate, we were surprised that students picked up on and expanded these themes, identifying deteriorating urban infrastructure as a broader concern. It was only upon reflecting on student responses that we saw how Alejandra's teaching was taking up issues of civil engineering in addition to our original focus on civic reasoning and scientific investigations. Rocio explained that science class with Alejandra was different because "she teaches with us and she learned with us. Not like other teachers who just tell you a book." While this kind of teaching is often idealized, it actually happens when teachers experience uncomfortable tensions of co-conspiring and co-authoring while at the same time being responsible for teaching rigorous and developmentally appropriate science. Hence, these learning activities do not reflect a simple distinction between projects that are teacher-directed and those that are student-centered—especially when we are open to co-constructing problems and learning from and with our students (Vossoughi et al., 2021).

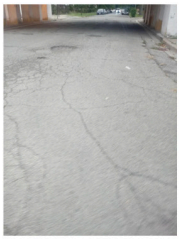
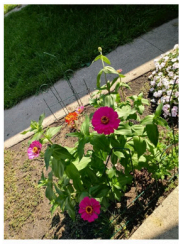
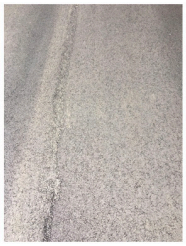
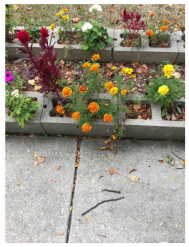
Student	Clean	Contaminated	Ugly	Beautiful
Ramona				
Manuel				

Table 1. Student photovoice contribution examples

HOLISTIC EARLY ENGINEERING EDUCATION

A Framework for K-12 Science Education (National Research Council, 2012) inserted engineering education as a priority for all levels of school science instruction in an unprecedented way. This priority was articulated explicitly in the three strands of the resulting NGSS. It is most prominent in SEPs, which were elevated to the same level of importance as disciplinary core ideas that also include a category for engineering, technology, and the application of science (ETS). Science as taught in schools has long propagated an idealized vision of basic science that does not reflect the realities of research and development as they have evolved since the mid-twentieth century (Aikenhead, 2006). The changes encoded by the NGSS potentially provide students with a more realistic interdisciplinary sense of the STEM enterprise, as long as students also experience an active role in producing knowledge (Stroupe, 2014).

The NGSS replaced vague notions of inquiry in the previous standards with a commitment to teaching practices as much as concepts. At the same time, the *Framework* defines engineering in open-ended ways that gaze toward systemic designs and analyses of human problems, systems, and processes:

> We use the term engineering in a very broad sense to mean any engagement in a systematic practice of design to achieve solutions to particular human problems. Likewise, we broadly use the term technology to include all types of human-made systems and processes—not in the limited sense often used in schools that equates technology with modern computational and communications devices. (National Research Council, 2012, pp. 11–12)

In this broadly conceived extension of engineering education into elementary and middle grades, we see an opportunity to affirm and extend the ways that K-8 teachers tend to view their work as teaching children, while educators of older students tend to view their work as teaching specific disciplines. A critical synthesis of these viewpoints reminds us that students' engagement with SEPs is not

disconnected from who they are, since disciplinary engagement happens within historical and cultural contexts that are imbued with power and values (Agarwal & Sengupta-Irving, 2019; Krist & Suárez, 2018; Nasir et al., 2006). (W)holistic science teaching in the middle grades emphasizes connections between students' science learning and their well-being, which includes connections with the broader community, realistic views of racialized and gendered inequities, and affirming and caring classroom experiences (Patterson & Gray, 2019).

ENGINEERING AS WORLD-MAKING

Aguila students' photovoice responses and reflections on their project suggest that local urban infrastructures are potential sites of this kind of holistic learning. Investigating our built worlds implicates not just the engineering practices used to construct those worlds' components, but also their underlying values and how we interact with and participate in the built world. De la Cadena (2015) uses the term "worlding," from Haraway (2008) and Tsing (2010), "to refer to practices that create (forms of) being with (and without) entities, as well as the entities themselves. Worlding is the practice of creating relations of life in a place and the place itself" (p. 291). She further contends that worlding, "or ways of making worlds" (De la Cadena, 2015, p. 4) creates pluralistic worlds, not mere hybrids, and thus positions the dominant and subordinate to exist simultaneously. Implicit here is that the world as it has been built is not a single, universally agreed-upon vision; rather, the built world is contested. To see the world as it has been built implies also examining how our values are upheld or ignored in world-making.

Recognizing world-making is thinking about how our worlds have been (or are) built. The role of engineering in world-making is visible in the examination of infrastructures as technologies. Winner's (1980) notion of artifacts as political contends that engineered technologies can uphold or perpetuate ideologies. Drawing on Winner's framework, we conceptualize pedagogical practices that support young learners in engaging with urban infrastructures in local contexts. Engineers, like Salvador in the lyrics to "Trópico de Cáncer" (Café Tacvbo, 1994) play a key role in realizing the made worlds of nation-states. Our built worlds are not accidents. They were constructed by people for specific visions of development and modernization that have social, political, ecological, and economic dimensions worth examining. Even when unintended, the technologies of engineers are not value neutral because they have consequences (Miller, 2021). The infrastructures themselves, through their places and uses in our built worlds, contain deep-rooted ideologies we can teach our students to evaluate. Whether built ten, 100, or many more years ago, infrastructures comprise not just the physical structures themselves but also the legacies or ghosts of their architects and the architects' politics and the worlds they participated in making (Graham, 1996). Just as we know that young children are capable of understanding and reasoning scientifically, so too are they capable of considering the ethical dimensions of the science they learn and practice (Eshach & Fried, 2005). By supporting students in seeing the world as it has been built, we contend that science class can create opportunities to ask *should we* questions in ways that position students to conceive and enact present and future worlds that are more just, ethical, and ecologically sustainable (Bang, 2020). The next two sections address how urban infrastructures provide an opportunity to engage students with the politics of artifacts and also with the NGSS SEPs.

URBAN INFRASTRUCTURES AS SITES OF LEARNING

In our city, as in many others, train tracks, highways, and other urban infrastructures separate neighborhoods. Viaducts are urban infrastructures that allow pedestrian and automobile traffic to continue uninterrupted below trains or highways, and thus provide an opening, a gateway, between

the divided communities. The hyper-segregation of our city was driven by red-lining and restrictive covenants, but it is structured by the built world, including train tracks, highways, and viaducts. Transportation structures throughout our city divide neighborhoods by race and class. As illustrated in Figure 1, Aguila sits on one side of a series of viaducts with freight train tracks in a neighborhood known as City Field. Decades ago, City Field was known as a hotbed of white supremacy and racial hostility but now is demographically split almost 50/50 between Black and Latinx residents. On the other side of the viaducts is New Field, a working-class neighborhood that has transitioned from a community of various European and Middle Eastern immigrants to one of almost exclusively Latinx residents over the last three decades. There is no way to get from New Field to City Field without walking or driving under the viaducts. Aguila's attendance boundaries include the west end of City Field and the adjacent east end of New Field. The resulting composition of the student body reflects the area immediately surrounding the school and is 95% Latinx and 4% Black.

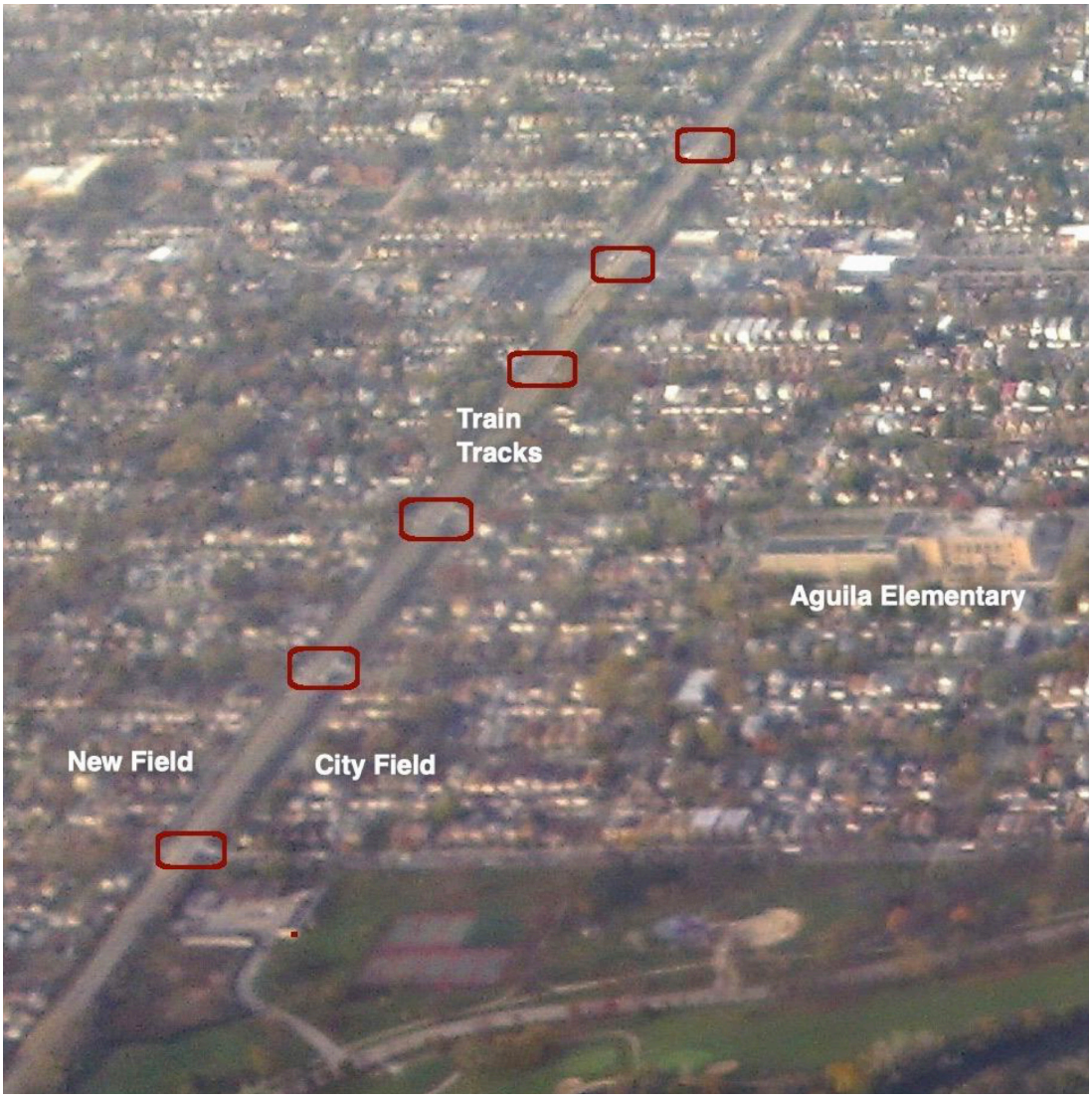


Figure 1. Aerial view of the freight train line and the two neighborhoods it divides.
The viaducts, labeled in red, are located every two blocks beneath the train line tracks

The freight railroads on top of the viaducts running through Greater Field (the area encompassing both New Field and City Field) form part of the infrastructure connecting various industrial corridors in our city. Railroads and viaducts are an important aspect of the modernization that Salvador lamented in the lyrics to "Trópico de Cáncer" (Café Tarvbo, 1994). Indeed, these structures have been instrumental in colonization and exploitation. They are physically and symbolically central to claims of manifest destiny that drove westward expansion of the United States to colonize Indigenous lands and recolonize a huge swath of México in 1848. The execution of engineered public works projects of building railroads for shipping industrial goods, which enriched the capitalist barons who financed the westward expansion, has historically been based on the presumption that workers were exploitable and dispensable. Throughout the construction of transportation infrastructure in the United States, industry took precedence over human life, the preservation of Indigenous lands, and ecological concerns—confirming that the ideologies of capitalism and settler colonialism undergird urban landscapes (Porter & Yiftachel, 2017). In one prominent example, in 1877 police killed dozens of protesting workers in "the battle of the viaduct," an incident that was a part of the first nationwide strike in the United States (Smith, 2020). Indeed, contestations over private property, public responsibility, and ecological harms remained salient and were an impediment to the Aguila viaduct project, as described below.

Our attention to the viaducts was originally related to the paint peeling off their ceilings and walls and littering the sidewalks and streets around them (see Figures 2 and 3). This decaying paint was not merely an eyesore; from our involvement in the YPS collective, we knew that paint manufactured before 1978 was likely to contain the toxic heavy metal lead. Leaded paint has been most dangerous indoors, where young children, who are most vulnerable to its effects, are more likely to ingest paint chips or contaminated dust by crawling or playing on the floor and putting their hands in their mouths. In this case, we were concerned about neighbors tracking paint chips from the viaducts on their shoes into their houses. We were concerned that the chipping paint would continue to contribute to the high background levels of lead that are found in most urban soils as the result of pollution from leaded gasoline and other industrial products. We worried that city workers might sandblast the viaducts to remove graffiti, which would send particulate lead dust into our neighborhood air.

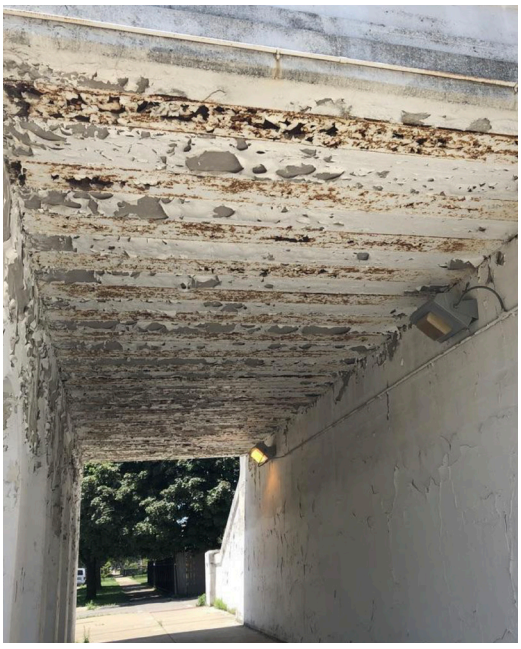


Figure 2. Decaying paint peels from the walls and ceilings of viaducts

Figure 3. Sidewalks are littered with paint chips from dilapidated viaducts

SEPS TO ANALYZE BUILT WORLDS

With Alejandra, students engaged in the NGSS practice of *planning and carrying out an investigation*. Specifically, they designed a data-collection plan to determine whether the decaying viaducts were contributing to lead contamination in the surrounding environment. As former high school chemistry teachers, we used our knowledge of laboratory safety along with guidelines from experts in the YPS collective to arrange for students to safely carry out their plans to collect samples of soil and paint from the ground around the viaducts. Students wore nitrile gloves and used garden spades to collect samples in plastic bags and removed their disposable gloves and thoroughly washed their hands immediately after sampling. Rather than disturbing paint clinging to the structures, students took samples that were lying on the ground, like the paint chips shown in Figure 3. One weekend, we independently brought a ladder to collect samples of peeling paint directly from the ceilings of the viaducts ourselves, as adult community members. A chemist from the YPS collective arranged for the samples to be analyzed for lead in her university laboratories. Aguila students took a field trip to the campus to hear directly from the chemists who analyzed the samples and to see the laboratory instruments. They also took a campus tour and ate lunch in a student dining hall.

The analysis of the samples collected by students showed background levels of lead in the soil that are typical for urban environments and well below state thresholds for requiring any kind of environmental remediation. The paint chips collected from the ground seemed to be mostly composed of recent layers of paint with minimal lead. But the peeling strips we collected directly from the ceilings of the viaducts were composed of lead-based paint from before 1978. Alejandra shared these results with her class as raw data to facilitate a sense-making discussion. Here SEPs were combined with civic reasoning as students were asked to use their analysis to write a letter to Councilwoman Cervantes, the neighborhood's municipal representative.

Taking up this authentic investigation with students compelled us to deal with uncertainties inherent in doing science in a way that we viewed as supporting students' complex reasoning (Manz & Suárez, 2018). During the data-analysis discussions, one of the students, Ramona, conducted independent research about the specifics of lead paint policy. She found that the United States Consumer Product Safety Commission set the limit of lead in paint at 90 parts per million (ppm). Ramona went on to determine a ratio (170:1) to compare the amount of lead in the ceiling paint samples with this limit. An excerpt from Ramona's own letter to Cervantes shows how she used this ratio to advocate for the remediation of the viaducts:

> We need you to do something about it. According to the research we did, the limit for lead is 90 parts per million. What we got back from the 2 samples we sent to [the university] was not 90 parts per million at all. One of the samples came back as 15,455 parts per million and the other 18,259 parts per million … These results are more than 170 times the limit.

While Alejandra engaged the class in the NGSS SEPs of *analyzing and interpreting data,* Ramona wove this practice together with others like *using mathematics and computational thinking and engaging in argument from evidence* to advocate for environmental remediation on behalf of her community. She used these practices to create a powerful tool for students to use in thinking about the problem. Almost half (11 of 23) of the student letters to Councilwoman Cervantes in that classroom cited Ramona's ratio as evidence.

Ramona's use of the ratio connected scientific evidence with civic reasoning in the context of civil engineering artifacts and hyper-local urban neglect. It led to student questions about how chemicals are regulated and who is responsible for building and maintaining infrastructures. These lines of questioning underscore how the SEPs of *asking questions and defining problems* are not neutral or objective practices. As biologist Mary O'Brien (1993) argues:

> Asking certain questions means not asking other questions, and this decision has implications for society, for the environment, and for the future. The decision to ask any question, therefore, is necessarily a value-laden, social, political decision as well as a scientific decision. (p. 706)

The questions scientists ask and the ways engineers define problems have ramifications for the types of worlds that are built. Thus students of engineering, at any level, should be encouraged and supported in learning not just problem-solving but also problem-scoping—asking questions to define "the nature and boundaries of a problem" (Watkins et al., 2014, p. 43).

As students began to ask more critical questions, they became interested in having people in power do something about the dilapidated viaducts with toxic peeling paint. Alejandra mobilized this engagement to implement a process for synthesizing students' writing into a collective class letter. During this time, Alejandra encountered Cervantes, who was door-knocking in the neighborhood near the school. This meeting was serendipitous, but it only occurred because Alejandra lived in that community. She got the councilwoman's direct contact information, emailed the class letter, and soon secured a date for Cervantes to visit Aguila. Meanwhile, students rehearsed their presentation in class and at a conference organized by the YPS collective for students doing similar projects around the city.

The students' presentation provided another opportunity to view the practices of engineering through ethical and ideological lenses. For his part, another student, Carlos, took up the question of why lead was added to paint and used online research to create a slide for the presentation (see Figure 4). Carlos's slide correctly indicates that chemical engineers took advantage of lead's properties to formulate durable paints, but it does not include the information that chemical engineers were also well aware of lead's toxicity when they developed those paints. Lead-based paints continued to be produced for decades and were even marketed for use in children's bedrooms, although those paints were known to be toxic (Markowitz & Rosner, 2013). The viaducts with toxic peeling paint illustrate how the values of engineers shape our world. World-making begins with considering how the world in which we live was constructed. Freire and Macedo (1987) famously referred to this process as *reading and writing the world*.

Figure 4. Slide prepared by Carlos for the presentation to the Greater Field City Council representative

THE CILANTRO DESIGN CHALLENGE

The examples of Ramona and Carlos's work illustrate that students used NGSS SEPs to prepare to speak with Cervantes about the reasons to remediate the contaminated peeling paint on the viaducts. In our work with the YPS collective, we previously struggled to connect some civic science projects to the NGSS. Unlike the SEPs, the disciplinary core ideas of the NGSS were not well aligned with environmental justice issues (Morales-Doyle et al., 2019). One solution to this misalignment was to engage students in learning about the mechanisms through which the scientific instruments could precisely measure environmental contamination. An inductively coupled plasma atomic emission spectrometer (ICP-AES), the instrument employed by our university partners, cost tens of thousands of dollars and require hours of training to operate, even for graduate students or professors. Our partnerships enabled us to buy simpler, more affordable instruments designed for use in high school classrooms (visible spectrophotometers). These simpler instruments rely on the same scientific principles as the more sophisticated instruments, so the YPS collective designed a series of laboratory activities where students could use the spectrophotometers as a model of how the university instruments work.

Having worked for years as a high school chemistry teacher, Alejandra believed that it was possible to modify this series of activities to make them developmentally appropriate for sixth graders. In the previous school year, students' use of the spectrophotometer (see Figure 5), and their classwork affirmed that they were able to describe some of the procedural and technical functions of the instrument. For example, Karina wrote the following end-of-the-year reflection about what she learned by working on the first iteration of the project at Aguila:

> The way the spectrophotometer works is you have to plug it into your computer and download a(n) app that tells you the data of your sample so then you turn on the spectrophotometer and wait for it to warm up afterwards, put in your sample and then it will give you the data.

She went on to describe some of the scientific principles undergirding how the spectrophotometer "will give you data" by writing, "different substance(s) absorb different wavelengths of light because maybe they have some kind of connection." While Karina's writing demonstrates an impressive recall of the functionality of the instrument, Alejandra believed that given more opportunities, students could develop even more sophisticated understandings. While some of Karina's classmates literally referred to the spectrophotometer as a "black box," critical engineering education resists this tendency to treat technology as devices that simply "give you data." The goal in year two was for the students to be able to explain to Cervantes how they knew that the lead in the peeling paint exceeded legal limits.

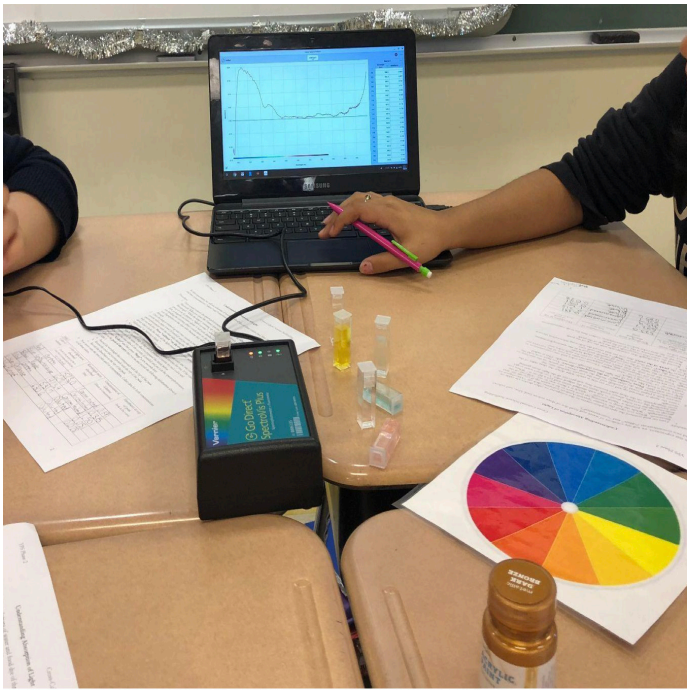


Figure 5. Students working with the spectrophotometer during the first year of the project

Driven by a belief in her students' ability to understand complex scientific phenomena and inspired by an Advanced Placement chemistry activity authored by another member of the YPS collective, Alejandra designed an additional learning activity to serve several purposes: (a) to provide students additional practice using the spectrophotometer and interpreting data from it; (b) to help students conceptualize how an ICP-AES works, as a spectrophotometer does, to identify the presence and concentration of different heavy metals in environmental samples; and (c) to make culturally sustaining connections between Aguila students' heritage and the science they were learning. In the YPS collective, we had previously had several conversations about cilantro's ability to clean soil. Alejandra's own ancestral ties to México further motivated making connections to research there about cilantro's ability to remove metal contaminants. After locating a source that was developmentally appropriate and relevant, Alejandra assigned students a magazine article about a collaboration between Mexican and US researchers in the Tule Valley, near Mexico City (Sifferlin, 2013). The article describes how, after testing several local plants for their bio-absorbent properties, the research team began engineering water filters with cilantro to address heavy metal contamination in the valley. This progression from experimenting with the properties of cilantro to using it to design solutions to problems illustrated the relationship that the NGSS articulate between science practices and engineering practices.

After the students read the article, Alejandra gave them a challenge: to design and build filters, using cilantro, that were capable of partially decontaminating a sample of water that contained copper ions, and then test their prototypes. Like several other experiments, this activity used a copper compound as a proxy for toxic heavy metals because it is safe to work with and has a visible blue color when it dissolves in water. Figure 6 shows an example of a student design. Students tested the effectiveness of their filters by using the spectrophotometer to measure the amount of copper ions in their water before and after it passed through their cilantro filter (see Figures 7 and 8).

Promoting science learning that presents the "excellence, thoughts, and contributions" from the Global South requires an intentional disruption of who is given credit for being scientific (Frausto Aceves et al., 2022, p. 219). The cilantro design activity was also an opportunity to call attention to international scientific collaborations in general and to collaborations with scientific communities in México in particular. Cilantro is an ingredient familiar in Mexican cuisine, but it is not Mexican in origin. Rather than making crude or tokenistic connections to students' heritage, this activity expanded the examples of STEM innovations beyond those made in laboratories or in wealthy countries in the Global North and beyond human-designed technologies, separate from nature. Alejandra also introduced students to floating gardens in Mexico City, known as chinampas, that are an example of ingenious Indigenous engineering and sustainable permaculture. Chinampas illustrate engineering that literally *le da lugar a los espacios sin cemento* (gives a place to spaces without cement), in one of the largest cities of the world. This example disrupts notions of engineering as synonymous with modern development by highlighting engineering that relies not only on formal science, but also on traditional wisdom—wisdom that, like formal science, has an empirical basis. The chinampas example considers other ways in which peoples have engaged with the natural world and designed solutions to problems. As teachers integrate more SEPs into their curriculum, it is important to attend to *other ways* of understanding and building worlds because our ideologies of human-nature relations are embodied in what we build (Bang et al., 2015).

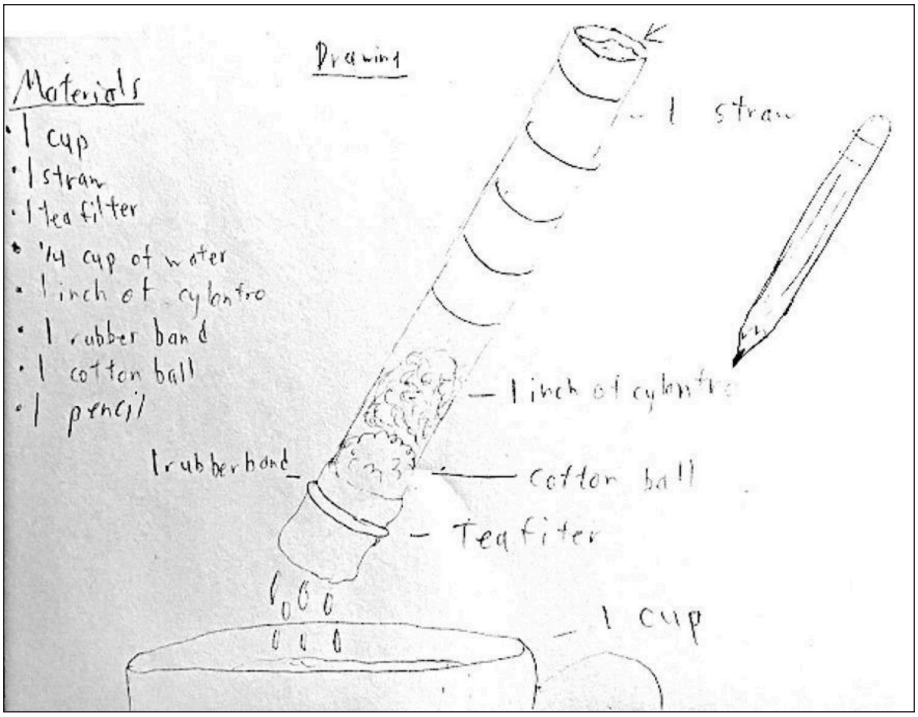


Figure 6. Cilantro filter prototype

Figure 7. Student using a pipette to add the filtered solution into the cuvette for analysis

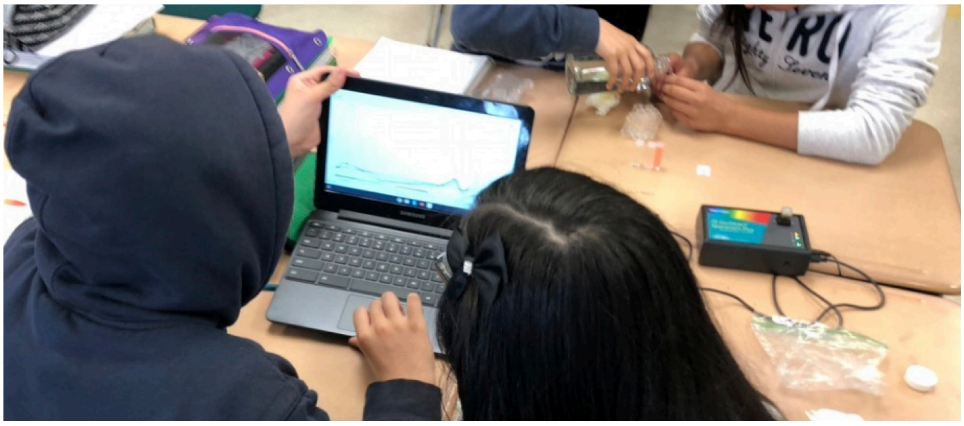


Figure 8. Students interpreting the graph produced by the spectrophotometer

Ultimately, students decided not to include an explanation of how the instruments worked in their presentation to the elected official. We have some evidence that several students did not fully connect the dots, suggesting the need for more explicit or scaffolded coherence between the cilantro design challenge and the viaducts project (Reiser et al., 2021). For example, in a conversation with Daniel, Carlos explained that while the viaduct project was real science, the cilantro design challenge was just for fun. In some sense, Carlos is right: cilantro filters are not a solution to the contamination of the viaducts, and Alejandra did intend the activity to be fun. At the same time, the cilantro design challenge was also intended to support students' understanding of their methods of measurement in the viaduct project, and Carlos's comment indicates that perhaps that connection was not clear.

MORE THAN CIVIC REASONING WITH SCIENTIFIC EVIDENCE

Cervantes visited Aguila on a warm sunny day in early June, near the end of the school year. The students' presentation started with infographics about lead that were designed for community members to learn about possible lead contamination in places like pipes and in products like juices, cosmetics, toys, and candy. Students then spoke about the viaducts, drawing particular attention to the ratio that Ramona had calculated and to Carlos's explanation about why lead was used in paint. They demanded that the viaducts be safely remediated by the city. Even more than that, they provided a vision for the beautification of the remediated viaducts, proposing that Aguila students create and paint murals under the viaducts after the peeling paint was removed. Their proposal is captured on the slide they created (see Figure 9). Their presentation combined SEPs like *engaging in argument from evidence* and *using mathematical and computational thinking* with explicit values of community environmental health, beauty, and important cultural symbols. The adjectives they included in the slide ("safe; inspiring; nice; by us") express the students' values and were referenced during the presentation to argue for our community's right to safe and decorated viaducts instead of those we currently have, pictured on the top right of the slide. The photos also reflected an aesthetic associated with particular social movements in México and in Mexican and Chicanx communities in the United States: a portrait of Frida Kahlo, an Indigenous woman's face, and the "*huelga* bird" flag of the United Farm Workers. Even the emphasis on public art, in the form of murals in city spaces, reflects a particular set of values about public space and the appearance of urban infrastructures.

Figure 9. Students' proposal to the Greater Field City Council representative

Cervantes listened attentively as students spoke and praised their work. She was kind and respectful, but almost as soon as they finished talking, she also began to explain why their vision might not be achievable. Her primary excuse was related to capitalist and settler colonial notions of the distinction between public and private property. The paint chips were falling on a public sidewalk but, Cervantes

noted, they were falling from a private structure which belonged to the railway corporation. She insisted that she could not remediate private property and would, instead, communicate our findings to the corporation. She left students with a hopeful message but made no promises. As adults with some experience in community-led efforts for environmental justice, we were immediately skeptical, angry, and frustrated. But fortunately, students were more hopeful and proud—feelings we encouraged them to embrace. After the presentation, Daniel asked Carlos, "What do you think will happen? Do you think Councilwoman Cervantes will do anything?" Carlos responded, "She said she would try to help us by communicating to the railroad tracks so they can do it. I feel like she is just going to send the people to do it but they have to ask permission from the railroad, from them, it's their property, so yeah." Carlos went on to describe how he was proud of his work, reflecting, "I got to present to the councilwoman. I had fun during this project and I learned a lot more stuff." He thought of his involvement as practice for his future career, saying, "It felt nice because my dream is to be a scientist, so this is, so if you practice something you like since you're little, like people that play soccer, they practice since they were little, and then now they are in the big leagues, that's what I mean." In addition to viewing the project as preparation for a career in STEM, Carlos later explicitly expressed that the values of professional scientists included caring for their communities.

OUR RESPONSIBILITY AS ADULTS IN CIVIC ENGAGEMENT AND WORLD-MAKING

Alejandra recently ran into Carlos, who now attends the neighborhood high school. He asked about the project and whether we had heard back from the councilwoman. Since Cervantes's visit to Aguila, Alejandra has continued to press her to remediate the viaducts properly. In one conversation, she asked the councilwoman why the city covers or removes graffiti from viaducts but does not feel obligated, or even able, to remediate the lead-contaminated paint. Cervantes's response was to ask for evidence that all of the viaducts, not just the one where we sampled ceiling paint, were contaminated. It is likely, from a historical and scientific standpoint, that all of the viaducts, which were built in 1929, were part of the public works created by civil engineers for the built worlds of industry and city infrastructure. It is also exceedingly likely that they were all coated in lead-based paint.

The councilwoman's stalling tactic demonstrates the potential downsides of using scientific evidence together with civic reasoning (Morales-Doyle et al., 2022). While students used evidence convincingly to argue for the remediation of the viaducts, we were met with requests for *more* evidence. But why was the burden of proof placed on a group of sixth graders or even on community members? Why were city officials or railway executives not responsible for collecting the evidence themselves?

Since we did not trust the city to fulfill that responsibility or to otherwise follow up on the evidence we had provided, and since we had access to the scientific means for collecting data, we sought more evidence ourselves. We put together a small group that included one of the scientists from the YPS collective; one of her undergraduate students, who had grown up near City Field; a teacher from the YPS collective who works at the neighborhood high school at which most Aguila students (including Carlos) matriculate; and a staffer from the councilwoman's office. As a group of concerned adults, we spent a summer morning collecting paint samples from each of the viaducts along a half-mile stretch of road that separates City Field from New Field.

As we composed this manuscript, we simultaneously wrote a community-facing report documenting the high levels of lead we found in each of our samples from the ceilings, which has since been released. Some of Alejandra's students are now reengaging with this project in their high school chemistry class

with the teacher from the YPS collective who collected samples with us in our small group. The railroad corporation promised they would collect samples again within the following month but refused to inform community representatives about its process until the corporation completed its analysis. The ideologies of capitalism and distinctions between privately and publicly owned infrastructures continue to shape the ways in which we interact with the physical structures in our neighborhood. Yet we remain hopeful that the viaducts will be safely remediated and ultimately adorned with art by neighborhood youth. Unlike hypothetical story lines that get wrapped up nicely at the end of a culminating assessment, our struggle continues.

DISCUSSION

As STEM-mania and associated school reforms push engineering education into the curriculum for young children, many K-12 teachers feel unprepared to meet these demands (Banilower et al., 2018). A deficit view of teachers would lead to policy prescriptions for required engineering courses in teacher education and for more professional development in STEM. But we choose to foreground teachers' assets. Viewing urban infrastructures as sites of learning provides an entry point to celebrate the best characteristics of elementary and middle school classrooms where each student is viewed (w) holistically as a unique human being in relationship with their environment (Patterson & Gray, 2019). This contrasts with the ways engineering education perpetuates a culture of disengagement that often dichotomizes older students between those who will be future members of the STEM workforce and those who should be weeded out from that career path (Cech, 2014). Teachers who view their work as supporting children's self-actualization are well positioned to engage students in considering what values are embedded in SEPs and eventually encoded in the built world.

We recognize this moment as a chance to avoid reproducing the pathologies of engineering education that has not been attentive to the values, ideologies, and politics that underlie it. It is time to stop teaching science and engineering in ways that do not ask students if we *should* do something or that falsely assume that ethical implications are not a part of scientific reasoning. Will we take this opportunity to break away from "that ugly relationship of action, construction, [and] destruction" that pushed Salvador *el ingeniero* away from his profession (Café Tacvba, 1994, stanza 7, lines 3–4)?

We emphasize that the story we share here is not meant for reproduction in other classrooms. It is deeply contextualized in ways that make this impossible. Instead, we hope that examples like the photovoice activity, the cilantro design challenge, and the connection to chinampas inspire teachers to be creative and attuned to SEPs as one among many rich ways of knowing. The broad ways in which the NGSS frame engineering leaves space for positioning students as world-makers. Problem-posing pedagogy can support students in understanding how the present world was constructed without binding them to the pathologies of industrial development and its underlying ideologies of racism, colonialism, nationalism, and capitalism (Benjamin, 2016; Freire, 1970). When we, as adults, were cynical about Cervantes's response, Carlos, Ramona, Rocio, and their classmates remained proud of their work and hopeful about its impact. Students can develop clear-eyed, contextual views of their built worlds and realistic expectations for the role of scientific evidence in civic reasoning without becoming cynical. By creating experiences that develop capacities for analysis and critique that ask youth to consider *should we* before we ask how, while leaving space for speculative imagination and hope, we create education for ethical innovators and visionary world-makers, not just proficient engineers (Garcia & Mirra, 2021; Tzou et al., 2021).

REFERENCES

Agarwal, P., & Sengupta-Irving, T. (2019). Integrating power to advance the study of connective and productive disciplinary engagement in mathematics and science. *Cognition and Instruction, 37*(3), 349–366. doi.org/10.1080/07370008.2019.1624544

Aikenhead, G. S. (2006). *Science education for everyday life: Evidence-based practice.* Teachers College Press.

Bang, M. (2020). Learning on the move toward just, sustainable, and culturally thriving futures. *Cognition & Instruction, 38*(3), 434–444. doi.org/10.1080/07370008.2020.1777999

Bang, M., Marin, A., Medin, D., & Washinawatok, K. (2015). Learning by observing, pitching in, and being in relations in the natural world. *Advances in Child Development and Behavior, 49,* 303–313. doi.org/10.1016/bs.acdb.2015.10.004

Banilower, E. R., Smith, P. S., Malzahn, K. A., Plumley, C. L., Gordon, E. M., & Hayes, M. L. (2018). R*eport of the 2018 NSSME+.* Horizon Research.

Barajas-López, F., & Ishimaru, A. M. (2020). "Darles el lugar": A place for nondominant family knowing in educational equity. *Urban Education, 55*(1), 38–65. doi.org/10.1177/0042085916652179

Benjamin, R. (2016). Catching our breath: Critical race STS and the carceral imagination. *Engaging Science, Technology, and Society, 2,* 145–156.

Calabrese Barton, A. & Tan, E. (2020). Beyond equity as inclusion: A framework of "rightful presence" for guiding justice-oriented studies in teaching and learning. *Educational Researcher, 49*(6), 433–440. doi.org/10.3102/0013189X20927363

Café Tacvba. (1994). Trópico de Cáncer [Song]. On *Re;* Warner Music Mexico.

Cech, E. A. (2014). Culture of disengagement in engineering education? *Science, Technology, & Human Values, 39*(1), 42–72. doi.org/10.1177/0162243913504305

de la Cadena, M. (2015). *Earth beings: Ecologies of practice across Andean worlds.* Duke University Press.

de los Ríos, C. V. (2020). Writing oneself into the curriculum: Photovoice journaling in a secondary ethnic studies course. *Written Communication, 37*(4), 487–511. doi.org/10.1177/0741088320938794

Eshach, H., & Fried, M. N. (2005). Should science be taught in early childhood? *Journal of Science Education and Technology, 14*(3), 315–336. doi.org/10.1007/s10956-005-7198-9

Frausto Aceves, A., Torres-Olave, B., & Tolbert, S. (2022) On love, becomings, and true generosity for science education: Honoring Paulo Freire. *Cultural Studies of Science Education, 17,* 217–230. doi.org/10.1007/s11422-021-10098-w

Freire, P. (1970). *Pedagogy of the oppressed.* Continuum.

Freire, P., & Macedo, D. (1987). *Literacy: Reading the word and the world* (1st ed.). Routledge. doi.org/10.4324/9780203986103

Garcia, A., & Mirra, N. (2021). Writing toward justice: Youth speculative civic literacies in online policy discourse. *Urban Education, 56*(4), 640–669. doi.org/10.1177/0042085920953881

Garibay, J. C. (2015). STEM students' social agency and views on working for social change: Are STEM disciplines developing socially and civically responsible students? *Journal of Research in Science Teaching, 52*(5), 610–632. doi.org/10.1002/tea.21203

Graham, L. (1996). *The ghost of the executed engineer: Technology and the fall of the Soviet Union.* Harvard University Press.

Haraway, D. J. (2008). *When species meet.* University of Minnesota Press.

Krist, C., & Suárez, E. (2018). Doing science with fidelity to persons: Instantiations of caring participation in science practices. In J. Kay & R. Luckin (Eds.), *Rethinking learning in the digital age: Making the learning sciences count, 13th international conference of the learning sciences* (Vol. 1, pp. 424–431). International Society of the Learning Sciences.

Manz, E., & Suárez, E. (2018). Supporting teachers to negotiate uncertainty for science, students, and teaching. *Science Education, 102*(4), 771–795. doi.org/10.1002/sce.21343

Markowitz, G. & Rosner, D. (2013). *Deceit and denial: The deadly politics of industrial pollution*. University of California Press.

Miller, B. (2021). Is technology value-neutral? *Science, Technology, & Human Values, 46*(1), 53–80.

Morales-Doyle, D., & Booker, K. (2022). Transforming the extractive politics of STEM education and CTE. In K. J. Saltman & N. Nguyen (Eds.), *Handbook of critical approaches to politics and policy of education* (pp. 205–217). Routledge. doi.org/10.4324/9781003145356-23

Morales-Doyle, D., Childress Price, T., & Chappell, M. J. (2019). Chemicals are contaminants too: Teaching appreciation and critique of science in the era of Next Generation Science Standards (NGSS). *Science Education, 103*(6), 1347–1366. doi.org/10.1002/sce.21546

Morales-Doyle, D., & Frausto, A. (2021) Youth participatory science: A grassroots science curriculum framework. *Educational Action Research, 29*(1), 60–78. doi.org/10.1080/09650792.2019.1706598

Morales-Doyle, D., Frausto Aceves, A., Canales Salas, K., Chappell, M. J., Rajski, T. G., Aguilera, A., Clay, G., & Lopez, D. (2022). Reflections on teaching and learning chemistry through youth participatory science. In M. F. G. Wallace, J. Bazzul, M. Higgins, & S. Tolbert (Eds.), *Reimaging science education in the Anthropocene* (pp. 229–242). Palgrave Macmillan. doi.org/10.1007/978-3-030-79622-8_14

Nasir, N. S., Rosebery, A. S., Warren, B., & Lee, C. D. (2006). Learning as a cultural process: Achieving equity through diversity. In R. K. Sawyer (Ed.), *The Cambridge handbook of the learning sciences* (pp. 489–504). Cambridge University Press.

National Academies of Sciences, Engineering, and Medicine. (2022). *Science and engineering in preschool through elementary grades: The brilliance of children and the strengths of educators*. National Academies Press. doi.org/10.17226/26215

National Research Council. (2012). *A framework for K-12 science education: Practices, crosscutting concepts, and core ideas*. National Academies Press. www.nap.edu/catalog/13165/a-framework-for-k-12-science-education-practices-crosscutting-concepts

O'Brien, M. H. (1993). Being a scientist means taking sides. *BioScience, 43*(10), 706–708.

Patterson, A., & Gray, S. (2019). Teaching to transform: (W)holistic science pedagogy. *Theory Into Practice, 58*(4), 328–337. doi.org/10.1080/00405841.2019.1626616

Philip, T. M., & Azevedo, F. S. (2017). Everyday science learning and equity: Mapping the contested terrain. *Science Education, 101*(4), 526–532.

Porter, L., & Yiftachel, O. (2017). Urbanizing settler-colonial studies: Introduction to the special issue. *Settler Colonial Studies, 9*(2), 177–186. doi.org/10.1080/2201473X.2017.1409394

Reiser, B. J., Novak, M., McGill, T. A. W., & Penuel, W. R. (2021). Storyline units: An instructional model to support coherence from the students' perspective. *Journal of Science Teacher Education, 32*(7), 805–829. doi.org/10.1080/1046560X.2021.1884784

Sifferlin, A. (2013, September 12). Cilantro: More than an herb, it can purify water too. *Time*. healthland.time.com/2013/09/12/cilantro-more-than-an-herb-it-can-purify-water-too/

Smith, R. (2020, May 1). The battle that Chicago forgot. *Chicago Magazine*. www.chicagomag.com/city-life/may-2020/the-battle-of-the-viaduct-1877/

Stroupe, D. (2014). Examining classroom science practice communities: How teachers and students negotiate epistemic agency and learn science-as-practice. *Science Education, 98*(3), 487–516. doi.org/10.1002/sce.21112

Tsing, A. L. (2010). Alien vs. predator. *STS Encounters, 1*(1), 1–22.

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

Tzou, C., Bang, M., & Bricker, L. (2021). Commentary: Designing science instructional materials that contribute to more just, equitable, and culturally thriving learning and teaching in science education. *Journal of Science Teacher Education, 32*(7), 858–864, doi.org/10.1080/1046560X.2021.1964786

Vakil, S. (2018). Ethics, identity, and political vision: Toward a justice-centered approach to equity in computer science education. *Harvard Educational Review, 88*(1), 26–52. doi.org/10.17763/1943-5045-88.1.26

Vossoughi, S., Davis, N. R., Jackson, A., Echevarria, R., Muñoz, A., & Escudé, M. (2021). Beyond the binary of adult versus child centered learning: Pedagogies of joint activity in the context of making. *Cognition and Instruction, 39*(3), 211–241. doi.org/10.1080/07370008.2020.1860052

Watkins, J., Spencer, K., & Hammer, D. (2014). Examining young students' problem scoping in engineering design. *Journal of Pre-College Engineering Education Research (J-PEER), 4*(1), 43–53. doi.org/10.7771/2157-9288.1082

Winner, L. (1980). Do artifacts have politics? *Daedalus, 109*(1), 121–136.

ABOUT THE AUTHORS

Alejandra Frausto Aceves is currently working on a PhD in Learning Sciences at Northwestern University. In 17 years as an educator, she has served in various roles, including teaching science and other content areas from 6th grade through adult students in an alternative setting, working as a curriculum coach and associate principal, and leading service learning for the third largest district in the U.S. Her research interests include transformative collective [science] learning, intergenerational & community-based co-constructions, imaginations, and praxis, as well as learning and pedagogies towards expansive and agentic present-futures.

Daniel Morales-Doyle is an associate professor of science education in the department of Curriculum and Instruction at the University of Illinois Chicago. He was a high school teacher in the Chicago Public Schools for just over a decade before joining the faculty at UIC.

We're Not Migrating Yet: Engaging Children's Geographies and Learning with Lands and Waters

Anna Lees and Megan Bang

Considering the places—the geographies—of children's learning, of human learning, is fundamental to seriously considering not only the "whats," or the content of learning, but perhaps more importantly, the "whys," or the purpose of learning, and the "hows," or the process of learning and the overall goals of education. That is, the values and pedagogical approaches in children's learning must be engaged as thoughtfully and intentionally as content understandings often are. The whys and hows of education construct what is deemed relevant and irrelevant, as well as what is rendered invisible to the "here and now" of children's lives (Apple, 2004; Iorio & Parnell, 2015; Nxumalo et al., 2011; Tesar, 2015). For us, the here and now includes not only the present reality of human communities (Mitchell, 1934/1991), but also the ecological place in which communities have come to be. Indeed, the two are co-constructed. We argue in our work that issues of place and relevancy to the here and now are always intertwined with constructions of relations between human worlds and the more-than-human natural world, as well as with the ways in which knowledge systems, culture, history, and power shape these constructions. We suggest that learning environments are always implicitly or explicitly constructing and teaching nature-culture relations and that more intentional constructions are necessary for cultivating culturally thriving, just, and sustainable futures.

In our work, we have focused on the design of learning environments that aim to support the navigation of Indigenous children through both Indigenous and western[1] ways of knowing. A central way of beginning this endeavor is through core models of relations between humans and the natural world. Scholars and communities have demonstrated that there tend to be two distinct models that impact knowledge, knowledge organization, reasoning, decision-making, and values. One model positions humans as distinct or *"apart from"* the natural world and often constructs more-than-human life as not having intelligent or communicative capacities. This model is often associated with western knowledge systems and tends to construct the idea that humans are a comparatively superior life form (Kimerer, 2013; Medin & Bang, 2014; Simmard, 2021). The second model positions humans as *"a part of"* and in kin relations with the rest of the natural world; it often sees more-than-human life as having personhood with a wide range of intelligent and communicative capacities and views humans as a dependent life form, like all life forms. This model is often associated with Indigenous knowledge systems (Kimerer, 2013; Medin & Bang, 2014; Simmard, 2021). Of course, these models are not absolutes, and increasingly, in some advanced disciplines, the intertwining of human and more-than-human life is central. Further, in fields like ecology and botany and in some evolutionary fields, there are paradigmatic shifts in understanding unfolding with respect to the intelligence and capacities of plants and to cross-species cooperation (Kimmerer, 2013; Simard, 2021).

However, thus far in education, children's geographies have largely been constructed within particular cultural paradigms of human relationships in which human beings are separate and distinct from the natural world (Medin & Bang, 2014; Washinawatok et al., 2017). Mitchell (1934/1991) made important

1 While the word "western" is typically capitalized when referring to a region or to the political, social, or cultural activities of a region, we choose not to capitalize western and resist other style guidelines that minimize Indigenous futures and continue efforts of colonization.

contributions to the ways in which children learn geographies by including human communities as part of children's studies and expanding the learning environment beyond the classroom walls. We further these efforts by asserting the essential role of lands, waters, and more-than-human beings in children's geographies. These shifts in base relational construals that assert a separation of humans from their more-than-human relations are intertwined with socio-political developments, particularly in settler colonial nations like the United States, both through the geographic structuring of lives and the forms of knowledge such relational construals facilitate. Settler colonialism is a distinct type of colonialism that functions through the violent erasure and dispossession of Indigenous populations and the acquisition (theft) of land as property to form a new settler society. Over time, the new settler society develops a distinctive identity and sovereignty (e.g., American), followed by the establishment of settler lifeways (including knowledge systems) as the normative benchmark from which to build social systems, including education (Wolfe, 2006). Settler colonialism takes place in today's education through varying aspects of school design, including curriculum, instruction, assessment, behavioral expectations, and the segregation of children by age, away from family and community (Brayboy & Lomawaima, 2018; Sabzalian, 2019). This is made visible in the exclusion of Indigenous peoples (e.g., Shear et al., 2015) and in the assimilationist design of western content and instruction in the majority of school curricula that makes western knowledge systems the norm and determines what is allowed or benchmarked within school-based learning.

A core unfolding in US settler colonial contexts is the embedding of "apart from" models of human-nature relations through the transition of children's geographies from lands, waters, and communities to a primarily indoor and stationary environment in schools. Containing children indoors, in classroom-based settings for the majority of their waking hours, premises learning through a design that we see as a disservice to all children. Indeed, over the past 50+ years, children have been spending less and less time outdoors. While the extraction of childhood from natural places to indoor settings is bad for all children, the compulsory schooling movement was deliberately designed to harm Indigenous children by removing them from their families and communities and placing them in schools (boarding schools) and other forms of US-based educational institutions. This separation of children from their families and from their lands and waters interrupts intergenerational systems of education and was intended to force children's adoption of colonial languages and knowledge systems (Lomawaima & McCarty, 2006). This forced separation of children from lands, waters, and community and forced assimilation of western colonial knowledge systems remains in schooling today. Most of children's school-based learning takes place indoors, using human-made materials and texts; for example, having children learn about the water cycle through representations on paper, on websites, or in books, rather than in connection to the actual watershed through outdoor engagements, observations, and wonderings. Nor do most children learn that there are multiple paradigms through which to understand the communicative capacities of more-than-human beings. We suggest that the persistence (and legislation) of indoor-based learning largely reinforces and facilitates humans as apart from the natural world, rendering children's geographies centered in coloniality.

Our work has been about returning children's learning to lands and waters, in and with intergenerational community, to remake forms of education in which children's geographies are defined by Indigenous ways of knowing and being, not by colonial paradigms of teaching and learning. We do so by designing learning environments, alongside community members, with lands, waters, and other more-than-human relations, where children's development can be fostered within Indigenous axiologies (values), ontologies (ways of being), and epistemologies (knowledge systems). These efforts

disrupt human supremacy and epistemicide (Paraskeva, 2016), the eradication of knowledge systems for colonial advancement, within education programming and instead value opportunities where children grow their relationships with more-than-human beings in a manner that recognizes the personhood of those beings. This work also engages Indigenous land- and water-based education (Bang et al., 2014; Calderon, 2014; Deloria & Wildcat, 2001; Simpson, 2017) that both critiques and extends the work of critical place-based education (e.g., Gruenewald, 2003; Smith & Sobel, 2010; Sobel, 2004) by addressing the ways in which criticality can fail to disrupt the perpetuation of western knowledge systems and settler colonialism. Indigenous land- and water-based education is further grounded in the recognition that all lands are Indigenous lands and centers or cultivates enacting resurgence in the everyday (Corntassel, 2012; Simpson, 2017). The examples offered in this article highlight children's interactions with more-than-human relatives and depict Indigenous education as an act of resurgence that enacts our Indigenous lifeways for our own purposes on our own terms in the here and now.

We come together in this writing as Anishinaabekwe scholars, teachers, sisters, mothers, aunties, and grandmothers. Anna is a Waganakasing Odawa descendent with Scottish, German, African American, Italian, and English ancestry. She spent her early career as a teacher in infant, preschool, and kindergarten classrooms, and has continued working with early childhood teachers to (re)imagine curricular design and teacher education that engage land and water relations within the confines of school-based learning. Megan is Ojibwe and Italian descent. She spent her early career as a teacher in a preschool classroom. She went on to teach at elementary, middle, and high school levels before becoming a researcher and teacher educator. She studies culture, learning, and identity development, with a particular focus on cross-cultural cognition about the natural world. Further, she designs innovative STEAM learning environments in efforts to develop forms of education that cultivate just, thriving, and sustainable futures. Anna and Megan collaborate in an Indigenous STEAM program (featured in this article), where we further possibilities of Indigenous education for participating children and families and for our own theorizing about and enactment of land- and water- education as an act of Indigenous resurgence and decolonization.

CONTEXT: INDIGENOUS STEAM

This paper emerges from an Indigenous science, technology, engineering, arts, and mathematics (ISTEAM) program that fosters education in and with lands and waters in intergenerational arrangements, serving learners from first to 12th grade. ISTEAM is a community-based design research project (CBDR), co-designed by Indigenous children, families, communities, scientists, artists, and educational scholars, that has been ongoing since 2002. The iteration in this paper is part of an NSF-funded project running from 2014 to 2019. The design of ISTEAM is informed by third-generation cultural-historical activity theory (Engestrom, 2011; Vossoughi & Gutiérrez, 2014), with ISTEAM designers and teachers enacting Indigenous relations and knowledge systems (Barnhardt & Kawagley, 2005; Cajete, 2005; Kovach, 2010) to engage children's development with Indigenous values, knowledges, and ways of being in the world. During co-design, we visit the places where ISTEAM will take place in order to build relationships with lands, waters, and more-than-humans to determine the kinds of learning experiences desired for our children—including the what, why, and how of their education in the here and now. These co-design experiences include extensive discussion around the histories and stories that come from and can be learned in relation to lands and waters and around how developing such relationships and understandings can work to bring about just and sustainable futures socio-politically and socio-ecologically. Some of the community co-designers go on to engage as facilitators within ISTEAM, and others participate solely as designers.

ISTEAM learning environments are therefore designed and then facilitated by community in and with lands and waters. ISTEAM programs include activities around children building relationships with plant and animal relatives, as well as with each other; walking through and with forests, beaches, ponds, rivers, and lakes; reading lands and waters; making cultural works of art like cedar baskets and clay pieces; engaging in Indigenous games and improvisation; storytelling, storylistening, and storymaking; and developing leadership capacities like ethical deliberation and decision-making that are needed to navigate the challenges of the 21st Century (see Bang et al., 2014; Barajas-López & Bang, 2018). This environment then asserts Indigenous knowledges, values, and ways of being for children as an act of Indigenous resurgence in the everyday (Corntassel, 2012; Simpson, 2011), with ISTEAM programs offering an opportunity for Indigenous children to learn through their culture rather than about their culture (Deloria & Wildcat, 2001; Simpson, 2017).

This project has multiple lines of research associated with it, from detailed study of student learning, educator practice, or familial engagement to the study of communal transformations from co-design as a form of educational self-determination. We collect pre- and post-interviews with children, teachers, and co-designers. In addition, we collect video and audio data across the full program. Because the program is outdoors (where capturing audio can be hard) and because of the way we configure activity (multiple small groups in multiple places), we have several audio and video data streams for any given activity. We have hundreds of hours of data across the project and have served over 200 children in the current iteration of it. All data is content logged and tagged for major themes. In addition, each year, data is reviewed and key events are identified as critical for further research, inquiry, and design work. For this paper, we have focused on the 2018 program for two primary reasons. First, because the paper includes data collected from that program that has been identified as a key case of expansive pedagogy; second, in part, because the two authors co-taught that program. We selected the focal clip as an example of teaching and learning and of children's developing expertise around complex ecosystems within Indigenous and western knowledge systems that forward thriving futures.

SPECIFIC ACTIVITY DESCRIPTION

During a 2018 two-week summer ISTEAM program in the Pacific Northwest, we featured an activity during low tide with the seven children from the youngest age group, which ranges from six- to eight-year-olds, and two adult teachers. While the clip (below) features two young adult facilitators and a group of children, the design of this experience and the beginning activity (not featured in the clip) engaged community co-designers across the lifespan. Thus elders and children alike had a role in creating the conditions for this experience. The activity took place on a local beach at very low tide. It was designed for children to learn about biodiversity in tide pools, the causes and impacts of ocean acidification, and human peoples' responsibilities in relation to what we called our beach relatives. It took place close to a large rock about 20 feet from the water that was covered with different species. Children moved about freely, making observations, asking questions, and playing in a variety of ways. For example, several children dug in the sand, covering their limbs with it while listening and asking questions about what other group members were noticing and the questions they were raising. Children would change their physical position fairly rapidly and shift their specific attention. We describe this because we think it is important to depict this freedom of children's movement, interest, and attention as we take the reader through the activity to consider what learning geographies with lands and waters looks like. The teachers prompted children's observations and interactions with tide pool animal relatives and facilitated inquiry while children explored the beach relatives' relationship with tidal

zones and, ultimately, the animal relatives' ecological systems. The teachers introduced specific topics of discussion, such as estuaries, animal's habitats and physical properties, changing climates, and human and more-than-human relationships. Teacher-directed observation and thinking were balanced with, and enacted in response to, children's exploration, play, interests, and developing expertise. The following analysis dives into specific moments and interactions in which children and teachers engage their understandings and interactions with geographies through three dimensions: content, attention, and care and dignity. While there are other important dimensions to explore, we focus on these because we think they are foundational to pedagogies that engage children in land- and water-based education.

CONTENT

Young children's capacities and their interests in the complexities of the world are astounding. Yet far too often, children are viewed through a deficit lens that implicitly or explicitly suggests that young children are not developmentally ready to engage with sophisticated phenomena like complex socio-ecological-political systems. In ISTEAM programs, we deliberately engage young children in learning about changing ecological systems and the social and political histories and presents that have created these changes. More importantly, we work to layer and pedagogically mediate children's conversations and inquiries into these complexities at the same time as we support children's navigation of multiple knowledge systems. We do this by recognizing the ways in which some ways of knowing are valued over others and shape the very foundational learning opportunities that claim territory in children's lives. In ISTEAM programs, we aim to support the development of knowledge and expertise in both Indigenous knowledge systems and others, like western science, in ways that transform historically powered construals. We value multiplicities of knowledge systems, elevating multiple Indigenous ways of knowing, not singular ones, in an effort to disrupt colonial dominance in children's learning and foster children's understanding and development within and across Indigenous axiologies, ontologies, and epistemologies. The activity in this clip occurred after ISTEAM activities around the role of human people in creating changing climates and its impact on more-than-human relatives. In this activity, children explore a wide range of beach-dwelling relatives, including anemones, worms, clams, mussels, crabs, and starfish, and engage in learning about their behaviors, needs, interactions, and habitats.

Further, the children continue learning about shifting ecological systems due to climate change. These engagements emphasize both the scientific content of a low-tide ecosystem and the Indigenous understandings of relationality and responsibility between human and more-than-human peoples in a time of changing lands and waters. We see this as a deliberate construction of a learning environment that weaves the social and political dimensions of learning with ecological or scientific dimensions of learning across multiple knowledge systems—a learning environment in which children are a part of the natural world.

In the clip above, the teachers are opening up space for learning about the impacts of climate change on oceans and ocean life through an emphasis on more-than-human personhood. The teachers are working toward children understanding the impact of ocean acidification on shellfish and toward connecting that to previous summers' inquiries into starfish and the starfish die-off that occurred on the Pacific Coast due in part to shifts in ocean temperatures. Emphasizing the experiences of shellfish as an indication of their right to a sustainable ecological future engages Indigenous knowledge and values in children's science education.

1. Teacher 1 (7:00):... so clams and mussels, they have a lot of calcium in their shells … that make them really hard and helps protect them from predators.
2. Children: Yeah, that's the reason why.
3. Children: But the predators that break the mussels open.
4. Teacher 2: Yeah… I wonder how they get the energy so that they can put all that calcium into their shells.

The first teacher focuses on the chemical makeup of shells, as well as the shells' function (to protect shellfish from predators). The children are eager to contribute and are already familiar with the function of shells, as seen in line 2. The children expand their observations further to recognize that predators can still break the mussels open. The second teacher further layers the complexity of the concepts to raise the question of how shellfish get the calcium in their shells and how they get their energy to do the work of shell-building. This opens the discussion to considering shellfish anatomy through the perspective of clams and mussels as more-than-human relatives with agency by recognizing that their coming to be as we know them in the world takes intentional effort and energy on their part. It also forwards an understanding of socio-ecological complexity in considering not just the function of shells, but also the relationship between predators and shellfish, as well as the active efforts of shellfish to protect themselves.

As children continue their observations and discussion around clams and mussels in response to Teacher 2's question while simultaneously engaging in sand play, the teachers transition the focus toward starfish. They draw on an earlier activity where they discussed the social conditions leading to changing ecosystems and the impact of climate change on the starfish population, as well as their observation of a starfish.

1. Teacher 1 (8:30): Starfish. Okay, so we learned earlier, they don't like high temperatures. And a few years ago, they almost completely died out around here. [crosstalk 00:08:39]
2. Teacher 2: Do you remember seeing that… did you all see the starfish back there?
3. Children: Yeah, I saw one sea-
4. Teacher 1: We were kind of lucky to see that, right? Because a lot of them can't live in this area anymore because it's too hot.
5. Children: But the way, there's caves. Yeah, the ones we found… well, we found a couple.

6. Teacher 1: Did you see, in the cave? So, they were in kind of shady spots, away from the sun.
7. Children: And then there was a starfish. [crosstalk 00:09:08]
8. Children: Because he was still wet. [crosstalk 00:09:10]
9. Teacher 1: Do you think maybe he got trapped right there? He didn't realize the tide was going out and he just wasn't in the preferred area?

Teacher 1 revisits content around climate change with a focus on starfish preference and biological need for cold water. The inclusion of starfish preference, and the starfish being referred to as he—not it—asserts more-than-human personhood and helps children to connect Indigenous axiologies, ontologies, and epistemologies with the curriculum content of starfish habitat and changing climates. The starfish die-off that occurred in previous summers provided the children with a lived, observational experience of the impact climate change is having in the here and now, and they have developed relationships in this place and with these shellfish relatives that foster an empathy toward the ecological challenges being discussed. Teacher 1 prompts children to consider the significance of observing starfish this summer (line 4), and children demonstrate their content understanding of climate change as they name the habitat where they noticed a starfish (line 5). The teacher expands the content depth to connect the presence of starfish to the cave habitat providing shade ("away from the sun") and thus, a cooler water temperature. The children continue demonstrating their understanding of starfish physiology in line 8 by indicating that while the starfish was seen at low tide, "he was still wet." In line 9, through a set of questions regarding why starfish may have been in the cave after the tide had receded, Teacher 1 continues prompting children's complex thinking around starfish needs, habitat, and intertwined relations with other ecological processes (tides). In this prompt, Teacher 1 again asserts starfish personhood by considering his preferred habitat and how he may have gotten "trapped" in the cave area during low tide. Developing complex scientific content understandings is necessary to bring about sustainable socio-ecological futures. In ISTEAM, we work intentionally to connect science content with Indigenous knowledge systems, values, and ways of being. These engagements offer an example of connecting the what of learning to the why and how, in the here and now.

ATTENTION

Understanding and recognizing children's brilliance through their attentional focus and their capacity to engage multiple attentions throughout a learning engagement can foster our teaching and children's development of complex thinking (Marin & Bang, 2018) while also supporting children's agency and allowing for playful interactions. Believing in children's autonomy and their right to participate in their education on their own terms is central to Indigenous values and necessary to facilitate children's learning beyond settler colonial framings. In this activity, we see children engage multiplicities in their attentional focus, along with their constant desire and repeated appeals to move into the water. We also see teachers following children's attentional shifts while maintaining a focus on the activity design. Teachers coordinate children's attentions and, in relationship with more-than-humans, engage children's complex ecological thinking and their understanding of the relations around and within the tide pools (Marin & Bang, 2018; Tzou et al., 2019). Children attend to teacher-prompted content while engaging their own interests, developing expertise, and acting on their desire to move into the water, demonstrating the co-facilitation and respectful relations within this context.

In the following excerpt, children direct their attention to observations of anemones and their physical attributes and then make a shift toward their own interest in water. The teacher furthers their observation and also reorients their water play back to the designed activity by introducing worms.

1. Children (0:30): Oh, I think I found one. I found one. Right here.
2. Children: It's sticking onto me.
3. Teacher 1: What'd you find?
4. Teacher 2: How'd you do that?
5. Children: I found these sticky dudes. You know how they stick on you?
6. Teacher 1: The anemones?
7. Children: These feel wet. [crosstalk 00:00:48]
8. Teacher 1: Okay, (child), we're not making [inaudible 00:00:48] please.
9. Children: Okay, grab some wet water. We need some wet water.
10. Children: Look right here, see, see? Right here. See?
11. Teacher 1: So this little puddle, we got some of those…
12. Children: I'm going to have to go in the water. [crosstalk 00:00:48]
13. Children: Oh. Ew! There's wet sand.
14. Children: He made a huge wave!
15. Teacher 1: You guys, there's some worms over here if you want to see.
16. Children: I love worms. [crosstalk 00:01:11]

In line 5, we see that children's observations and interactions with sea anemones are deeply focused as they describe the physical properties of sea anemones and recognize these beach relatives as more-than-humans with personhood ("I found these sticky dudes"). We also see the quick pace at which children shift attentional focus to their interest in moving into the water (line 12). When the children's attention moves away from observation of the tide pool beings, the teachers redirects their focus by prompting observation toward worms; thus, worms act as collaborators for intended instruction, as well as behavior guidance.

This cycle continues through the learning engagement, with children's attention toggling among observations, interests, and desires while the children engage in complex thinking and teachers parallel children's engagement while maintaining their planned teaching goals. In this next excerpt, we examine how teacher and child knowledge about and attention toward crabs and estuaries inform both the learning engagement and behavior guidance.

1. Teacher 1 (2:55): Have you guys heard the word estuary before?
2. Children: Yeah.
3. Teacher 2: Do you know what it means?
4. Children: No, I just heard it before.
5. Teacher 1: Heard it before?
6. Children: But I don't know what it means.
7. Teacher 1: So it's an area where, kind of the saltwater gets with the freshwater [crosstalk 00:03:10] like when rivers are going toward the ocean.
8. Children: I'm a crab! I'm a crab!
9. Teacher 1: You look like it.
10. Children: I'm a crab. Crab. Crab. [crosstalk 00:03:14] I need to go in the water! [crosstalk 00:03:14]

11. Children: Are you guys using this? [crosstalk 00:03:14]
12. Children: I can't breathe inside! I need to go in water! Bye, guys!
13. Teacher 1: We're not migrating yet.
14. Teacher 2: Let's stay over here. Let's talk about what we see right now. What we're…
15. Children: I see worms.
16. Teacher 1: So, over here, there was a crab. Why do you think he might like this spot?
17. Children: He could climb on it.
18. Teacher 1: Over here, there's a crab [inaudible 00:03:42] and we're not going to touch him though, because we don't want to freak him out.

Teacher 1 introduces the term estuary at just about three minutes into the clip, having offered ample time for open exploration and self-guided observation of the tide pool. While the teacher explains the meaning of estuary, a child begins embodying a crab both physically (moving like a crab) and biologically (line 12). We see children's developing expertise here in utilizing their knowledge of ecology and of the biological needs of crabs, as well as demonstrating their ethical respect for the crab's personhood and well-being to leverage their argument for moving into the water. As his attentional focus is shifting away from the teacher-led discussion, the child maintains complex, scientific reasoning (Bang et al., 2007; Hackett et al., 2019). Simultaneously, the teacher affirms and joins the child's engagement ("I'm a crab! I'm a crab!"), saying "You look like it" (lines 8–9) while also engaging the play-based scenario to refocus attention to observations in the tide pool (line 13). The child enacting the crab's behaviors demonstrates his understanding of crab biology ("I can't breathe inside! I need to go in water!") and his creative, informed persistence to play in the water. The teacher's response to this, joining the play, also displays her depth of ecological knowledge (e.g., crab migration) and Indigenous pedagogies of relationality with both humans and more-than-humans.

Because this teacher holds a developed relationship with the lands and waters, she is able to use her sophisticated knowledge of the more-than-humans as they are situated within this particular place to facilitate this engagement; that is, because of her land/water relations, she knew where crabs would be in that moment. And because of the established relationship between the teachers and children, the continually shifting attentional focus occurs fluidly within the learning experience. We see this in line 16, where in response to children's embodiment of crabs and desire to move into water play, she invites their observations of an actual crab. This interaction continues and cultivates children's thinking in Indigenous knowledge systems through discussion about the crab's preferred habitat and food source; the activity transitions with a child's quick return of attention to their previous desire to move into the water. This interaction offers an example of what community co-design looks like in ISTEAM, where adults and children reciprocally participate in the construction of the activity in relation to each other. "We're not migrating yet" became an important point of analysis in understanding how teaching about complex ecological systems through Indigenous knowledges, values, and ways of being takes form in practice.

CARE, DIGNITY, AND CHILDREN'S LEADERSHIP IN INDIGENOUS RESURGENCE

Demonstrating relationality with more-than-humans offers an example of what Indigenous resurgence looks like with young people in practice, in the here and now (Simpson, 2017). Relationality between humans and more-than-humans is premised on, among other values, expressed and implied care and dignity (Kimmerer, 2013; Van Horn et al., 2021). To be in kinship, a necessary lifeway to enact

resurgence, we must engage reciprocally in fostering each other's positive development across the life span; we must care for each other through difficult and joyful times and sustain each other's dignity (Bang et al., 2015). Because relationality and kinship have been intentionally excluded from traditional school-based curriculum, we offer extended examples of how care and dignity can and must be central to positive learning environments. Throughout the learning engagement, we see examples of both children and adult teachers articulating and embodying thoughtful relationships with more-than-humans, showing that care and dignity are valued as important aspects of the how-tos in learning geographies. One example of this can be seen in a discussion and observation of worms, where children converse around their like or dislike of worms and demonstrate their care for worms by ensuring they are not harmed through human interaction.

1. Teacher 1 (1:23): No. Guys come and look at the worms. Guys, come feel these worms. Very gently, though. Very gently.
2. Children: Oh my… Look at those… There's a baby worm.
3. Teacher 1: Have you guys seen these before? The ones sticking out of the sand?
4. Children: Oh yeah, I
5. Teacher 2: Boys, do you like worms?
6. Children: Yeah… No!... Yeah.
7. Teacher 1: Do you happen to remember what it's…
8. Children: There's some over here, Ms. will show you.
9. Teacher 1: Yeah, come look. Come check these out. Be just very gentle though, if you touch them. See those things sticking out?
10. Children: Can I?... I like worms, they
11. Teacher 2: Do you think that the sand is…
12. Children: Look. They're moving on me. I really like [crosstalk 00:02:00] they're very interesting.
13. Children: I'm putting on sunscreen. [More talk about sunscreen]
14. Teacher 1: This one might be a water worm so it might prefer to be in the water.

In this excerpt, we see teachers directing children's attention away from the water and guiding their observations toward worms in the tide pool (line 1). Teacher 1 premises the invitation to "feel these worms" with guidance around how to touch worms with care ("very gently"), as the children's immediate response to her invitation is to touch and feel. In line 5, as one group of children observe and begin interacting with worms, Teacher 2 entices other children to shift their attention from sand play (and desired water play) to worm observation by pointing them to Teacher 1, who again pairs the invitation with guidance around how to interact with worms carefully and gently (line 9). This pattern of inviting children to observe and touch worms and providing a structure for doing so with care assumes a commitment to the dignity of all beings—both children and worms. Teacher 1 emphasizes the need for children's careful touch in their interactions with worms in an effort to articulate the need to uphold the worms' dignity and well-being. She also assumes the dignity of children by encouraging their desire to touch and, as she provides reminders, shows that she trusts that they can do so ethically and in good relation with the worms (Bang et al., 2015).

We can see children's enactment of care through their dialogued interest in worms and affirmative response to the guidance around interacting with care, as well as through their association of small worms as babies (line 2). We also see a child, who enthusiastically expressed that she loved worms early in the clip, carefully hold a worm and closely observe the worm's movement on her skin, and express

how interesting worms are (line 12). Teacher 1's response to this child's interest and focused observation is respectful to both the child and the worm, as she gently encourages the child to place the worm back in the wet sand (line 14). In doing so, she expresses valuing the worm's desire, indicating a recognition of the worm's personhood, as well as a regard for the child's dignity by sharing information about the worm's preferred habitat and believing the child has the worm's best interest in mind.

Continuing an enactment of care and regard for dignity toward animal relations, Teacher 1 asks children to consider why a crab is situated in a particular location on the beach (line 16, previous excerpt). Again, she upholds the personhood of crabs by considering their desires rather than focusing solely on their physical needs. Inquiry around crabs continues, and Teacher 2 asks children to consider why Teacher 1 has set an expectation of refraining from touch.

1. Teacher 2 (3:58): Why do we not want to touch him?
2. Children: Because we don't want him to die.
3. Children: We don't want him to get scared.
4. Teacher 1: Yes, scared and stressed out. So we can look at him. But why do you think he likes this area? Do you see anything around here that he might like to eat?

Teacher 2 offers an opportunity for children to narrate their consideration of the crab's well-being, and they reiterate Teacher 1's attention to the crab's emotional state and also consider risk to the crab's life. Teacher 2 furthers consideration of care for the crab's emotions, stating that he could get "stressed out" (line 4). Focus on touch concludes, and the teachers circle back to the crab's preferred habitat and then his food source. This transitions back toward a framing of ecological thinking that maintains a personhood stance around the crab's preferences that moves beyond biological need and thus values the dignity of more-than-human relations.

We see a continuation of expressed care and dignity in children drawing Teacher 2's attention to her proximity to an animal.

1. Children (5:09): Wait, wait, stop! You're in a place where an animal is!
2. Teacher 2: What? Really?
3. Children: You guys, I can't. I found something.
4. Teacher 2: Where at, where at?
5. Children: You almost stepped… he's right here.
6. Teacher 2: Where are we going? Let's not feel it.
7. Teacher 1: Guys be very gentle, okay?

Teacher 2 upholds children's dignity by listening to their appeals that she had the potential to harm an animal. While just before this excerpt, Teacher 2 was redirecting children's behavior, stating, "let's not throw sand," she still listens to children's contributions and takes their appeals seriously. And again, she maintains an emphasis on care for more-than-human relations (line 6). Teacher 1 then reiterates this expectation (line 7).

Children's care for more-than-humans extends to their thinking around animal-animal relations. As part of an extended discussion around snail and mussel shells functioning as defense, children consider how changing climates are placing clams at greater risk of becoming a food source.

1. Teacher 1 (7:31): Yeah. And then, in [Teacher 3's 00:07:32] workshop, we learned that the calcium in their shells breaks down, right? When all the carbon dioxide gets in the water. What do you think… and that made their shells really soft. So, what do you think is going to happen if their shells get too soft?
2. Children: Then they'll break it open [inaudible 00:07:51]
3. Teacher 1: Yeah, predators can break it open real easily.
4. Children: We don't want that to happen.

Children express their understandings of the techniques predator animals use in breaching the hard shells that protect clams, and, in their response to Teacher 1's question about the impact of shells becoming softer, of how predators have an easier time getting to the clams. The children express care for clams and concern for changing climates, stating, "we don't want that to happen" (line 4).

We close this article with a discussion around the importance of content, attention, and care and dignity as integrated dimensions fostering children's complex ecological thinking as they learn about geographies on and with lands and waters.

CONCLUSION

Examining the engagements and physical positions of children and teachers through a lens of content, attention, and care and dignity offers us specific insight regarding how returning children's learning to lands and waters fosters their complex ecological reasoning and understanding of geographies beyond colonial framings. We argue that by beginning with Indigenous axiologies, ontologies, and epistemologies in the design of learning environments, ISTEAM nurtures Indigenous children's development and their understanding of socio-ecological-political systems in the here and now that guides them toward adulthood in a way that allows them to thrive. It is important to note, though, that we believe deeply that what we have put forth here through an Indigenous learning context benefits all children. While we frame each dimension above through a separate analysis, what we see in the video clip is an integrated engagement where the dimensions intertwine and build collectively in children's learning through play, inquiry, and social interactions. Fostering opportunities for children to further develop relationships with each other and the natural world through the kinds of activities included in ISTEAM supports their complex reasoning and sets the foundation for future ethical decision-making. Considering the way teachers in this activity fostered rich cognitive and ethical considerations toward a more just world, while respecting children's intelligence and autonomy, offers an example of how we may imagine school-based learning beyond the confines of indoor learning that often makes use of skill-driven instruction and behavioral control. Educators' developing a practice of joining in with children's play and perspective-taking to guide their engagement and deepen their content understandings through caring and respectful interactions, as demonstrated in the example of crab migration scenario, creates the kinds of learning environments where all children can thrive. Continuing to expand land and water education will deepen children's engagement with multiple knowledge systems and support teachers interested in (re)imagining curriculum. Engaging these efforts collectively holds the potential to disrupt coloniality as a central tenet of public education, and together, offer all children opportunities to be their whole, joyful selves.

REFERENCES

Apple, M. (2004). *Ideology and curriculum*. Routledge.

Cajete, G. A. (2005). American Indian epistemologies. *New directions for student services, 2005*(109), 69-78.

Bang, M., Curley, L., Kessel, A., Marin, A., Suzukovich, E. S., III, & Strack, G. (2014). Muskrat theories, tobacco in the streets, and living Chicago as Indigenous land. *Environmental Education Research, 20*(1), 37–55.

Bang, M., Marin, A., Medin, D., & Washinawatok, K. (2015). Learning by observing, pitching in, and being in relations in the natural world. In M. Correa-Chávez, R. Mejía-Arauz, & B. Rogoff (Eds.), *Advances in child development and behavior: Vol. 49. Children learn by observing and contributing to family and community endeavors: A cultural paradigm* (pp. 303–313). Academic Press.

Bang, M., Medin, D. L., & Atran, S. (2007). Cultural mosaics and mental models of nature. *Proceedings of the National Academy of Sciences, 104*(35), 13,868–13,874.

Barajas-López, F., & Bang, M. (2018). Indigenous making and sharing: Claywork in an Indigenous STEAM program. *Equity & Excellence in Education, 51*(1), 7–20.

Barnhardt, R., & Kawagley, A. (2005). Indigenous knowledge systems and Alaska Native ways of knowing. *Anthropology & Education Quarterly, 36*(1), 8–23.

Brayboy, B. M. J., & Lomawaima, K. T. (2018). Why don't more Indians do better in school? The battle between US schooling & American Indian/Alaska Native education. *Daedalus, 147*(2), 82–94.

Calderon, D. (2014). Speaking back to manifest destinies: A land education-based approach to critical curriculum inquiry. *Environmental Education Research, 20*(1), 24–36.

Corntassel, J. (2012). Re-envisioning resurgence: Indigenous pathways to decolonization and sustainable self-determination. *Decolonization: Indigeneity, Education & Society, 1*(1), 86–101.

Deloria, V., Jr., & Wildcat, D. (2001). *Power and place: Indian education in America*. Fulcrum Publishing.

Engestrom, Y. (2011). From design interventions to formative interventions. *Theory & Psychology, 21*(5), 599–628. doi.org/10.1177/0959354311419252

Gruenewald, D. A. (2003). The best of both worlds: A critical pedagogy of place. *Educational Researcher, 32*(4), 3–12.

Hackett, J., Bang, M., Goulter, A., & Battista, M. (2019). Crossing risky boundaries: Learning to authentically and equitably co-teach through design and practice. Teaching and Teacher Education, 86, 102889.

Kimmerer, R. (2013). *Braiding sweetgrass: Indigenous wisdom, scientific knowledge and the teachings of plants*. Milkweed Editions.

Kovach, M. E. (2010). *Indigenous methodologies: Characteristics, conversations, and contexts*. University of Toronto Press.

Iorio, J. M., & Parnell, W. (2015). Rethinking readiness in early childhood education: Implications for policy and practice. Springer.

Lomawaima, K. T., & McCarty, T. L. (2006). *"To Remain an Indian": Lessons in democracy from a century of Native American education*. Teachers College Press.

Marin, A., & Bang, M. (2018). "Look it, this is how you know:" Family forest walks as a context for knowledge-building about the natural world. *Cognition and Instruction, 36*(2), 89–118.

Medin, D. L., & Bang, M. (2014). *Who's asking?: Native science, western science, and science education*. MIT Press.

Mitchell, L. S. (1991). *Young geographers: How they explore the world and how they map the world* (4th ed.). Bank Street College of Education. (Original work published 1934)

Nxumalo, F., Pacini-Ketchabaw, V., & Rowan, M. (2011). Lunch time at the child care centre: Neoliberal assemblages in early childhood education. *Journal of Pedagogy/Pedagogický Časopis, 2*(2), 195–223. doi:10.2478/v10159-011-0010-4

Paraskeva, J. M. (2016). *Curriculum epistemicide: Towards an itinerant curriculum theory.* Routledge.

Sabzalian, L. (2019). *Indigenous children's survivance in public schools.* Routledge.

Shear, S. B., Knowles, R. T., Soden, G. J., & Castro, A. J. (2015). Manifesting destiny: Re/presentations of Indigenous peoples in K–12 US history standards. *Theory & Research in Social Education, 43*(1), 68–101.

Simard, S. (2021). *Finding the mother tree: Uncovering the wisdom and intelligence of the forest.* Penguin.

Simpson, L. B. (2011). *Dancing on our turtle's back: Stories of Nishnaabeg re-creation, resurgence and a new emergence.* Arbeiter Ring Publishing.

Simpson, L. B. (2017). *As we have always done: Indigenous freedom through radical resistance.* University of Minnesota Press.

Smith, G. A., & Sobel, D. (2010). Place- and community-based education in schools. Routledge.

Sobel, D. (2004). Place-based education: Connecting classroom and community. *Nature and listening, 4*(1), 1–7.

Tesar, E. (2015). *Te Whāriki* in Aotearoa New Zealand: Witnessing and resisting neo-liberal and neo-colonial discourses in early childhood education. In. V. Pacini-Ketchabaw & A. Taylor (Eds.), *Unsettling the colonial places and spaces of early childhood education* (pp.108–123). Routledge.

Tzou, C., Meixi, Suárez, E., Bell, P., LaBonte, D., Starks, E., & Bang, M. (2019). Storywork in STEM-Art: Making, materiality and robotics within everyday acts of Indigenous presence and resurgence. *Cognition and Instruction, 37*(3), 306-326.

Van Horn, G., Kimmerer, R., & Hausdoerffer, J. (Eds.). (2021). *Kinship: Belonging in a world of relations.* Center for Humans and Nature Press.

Vossoughi, S., & Gutiérrez, K. (2014). Studying movement, hybridity, and change: Toward a multi-sited sensibility for research on learning across contexts and borders. *National Society for the Study of Education, 113*(2), 603–632.

Wolfe, P. (2006). Settler Colonialism and the Elimination of the Native. *Journal of genocide research, 8*(4), 387-409.

Washinawatok, K., Rasmussen, C., Bang, M., Medin, D., Woodring, J., Waxman, S., Marin, A., Gurneau, J., & Faber, L. (2017). Children's play with a forest diorama as a window into ecological cognition. *Journal of Cognition and Development, 18*(5), 617–632.

ABOUT THE AUTHORS

Anna Lees (Little Traverse Bay Bands of Odawa Indians, descendant) began her career as an early childhood classroom teacher in rural northern Michigan. Now, an associate professor of early childhood education at Western Washington University, she partners with schools and communities in teacher preparation. Dr. Lees is committed to developing and sustaining reciprocal relationships with Indigenous communities to engage community leaders as co-teacher educators, opening spaces for Indigenous values and ways of knowing and being in early childhood settings and teacher education. She is currently engaged in research around a land education professional development model led by tribal nations and a relationship-based site-embedded professional development model with tribal early learning programs.

Megan Bang (Ojibwe and Italian descent) is a professor of the learning sciences and psychology at Northwestern University and recently served as the senior vice president at the Spencer Foundation. Dr. Bang studies dynamics of culture, learning, and development broadly with a specific focus on the complexities of navigating multiple meaning systems in creating and implementing more effective and just learning environments in science, technology, engineering, arts, and mathematics education. She focuses on reasoning and decision-making about complex socio-ecological systems in ways that intersect with culture, power, and historicity. Central to this work are dimensions of identity, equity, and community engagement. She conducts research in both schools and informal settings across the life course. She has taught in and conducted research in teacher education as well as leadership preparation programs. Dr. Bang currently serves on the Board of Science Education at the National Academy of Sciences. She also serves as an executive editor of *Cognition and Instruction* and is on the editorial boards of several other top tiered journals in the field.

How Urban Forest School Gave Us the Connections We Needed During the Pandemic

Margaret Nell Becker

> Happiness is the greatest skill we'll ever learn… Happiness *is* our potential.
> –Katherine May, *Wintering*

My school building sits along the East River in New York City. If you stop to look out the windows of our hallways and classrooms, you will catch a breathtaking expanse of water and sky. You will also see an island, full of lush greenery and gigantic trees, so close to where you stand, you imagine that, weather permitting, it would be an easy swim.

This is Randall's Island, which has been the site of our fourth/fifth grade classroom's forest school for the past two years, since the fall of 2020. In this essay, I argue for the importance of learning in nature, for what Hooven, Kissling, and Woods (2021) call "emergent earthen curriculum" (p. 20), and show how this emergent learning lends itself to students' creation of significance in their here and now, based on the relationships they forge with the world around them. I describe how, in the wake of pandemic school closings, my students and I developed our own urban forest school, and how two significant landmarks on Randall's Island—Dream Tree and the Beach—became driving forces in our learning about the world, ourselves, and our community.

IN SEARCH OF CONNECTION

As I sat to write this article, I was COVID-19 positive. After two years of hiding from it, COVID-19 had found me. It quarantined me from my students. It canceled my birthday plans. The world went on outside my bedroom door. My children went to school. Dinners were made. Shoes were tied. Coffee was brewed. It had nothing to do with me. When we went into lockdown, our voluntary isolation was to protect ourselves and each other from this ultimate isolation scenario of being alone in a room with COVID-19. It did not feel good to be there, interacting with everyone through screens, being away from the people who make me whole. Even when I spoke to people on the phone or took small walks to the dog run, I felt disconnected from the flow of life.

COVID-19 forced me to think about the connections I forge and value. The loneliest, most disconnected days of the pandemic were in its first few weeks, when it was too cold to be outdoors. As the weather warmed, I found connection outdoors, in the here and now of our neighborhood. Every afternoon my daughter, Mona, and I took long, rambling walks through Prospect Park and our neighborhood. Sometimes, my daughter brought her notebook and surveyed our neighbors (from six feet away). She asked our neighbors what song they sang while washing their hands, how they were feeling, and what they were good at. Every Monday, Mona tallied the businesses that were closed and compared the numbers over weeks. In the park, Mona found a rock on the shore of a pond that she liked to sit on for the better part of an hour, just staring at the water. She proclaimed this spot as her peaceful place.

Things that were unremarkable before became landmarks to Mona and me. We noticed and loved things we had not noticed before. By that first COVID-19 summer, when we passed the sunflowers in a planter

on the sidewalk, Mona exclaimed, "These were just up to my head in the spring! They grew so much." And when, in the late summer, those same sunflowers were wilting and losing their color, Mona knew it was a harbinger of fall and cold.

Just as Mona and I reinvented what mattered in our daily lives through the first months of the pandemic, so did administrators and teachers at my Manhattan elementary school. Priorities were upended. Suddenly connection was all that mattered and all other standards fell away. Our quality of teaching was measured in how much we interacted with the students. Our administrators pushed us to report how many times we were seeing students' faces, how often they came to morning meeting, how often we were able to ask, one-on-one, how they were doing.

When we returned to the building and in-person teaching in the fall of 2020, this emphasis on connection continued. Now we had to think of ways to make our carefully measured and isolated desks, face masks, and forbidden contact with students in other classrooms feel not scary but welcoming. We had to understand that kids were coming from wildly different experiences of the past several months and were in different places emotionally and academically. We had to keep everyone safe. We had to make everyone feel comfortable.

For me, these new priorities provided an opening to move my fourth/fifth grade classroom outdoors. It was obvious to administrators that my proposal to take the children outside provided a way for students to stretch and move and connect while being safer than in a poorly ventilated classroom. This mattered to me, but even more, it was a chance to pursue a dream I had long been coveting: to have forest school.

For several years prior to COVID-19 I had been reading about forest schools and about the different ways educators were implementing this pedagogy across the world. Put most simply, forest schools take children into forest settings on a regular basis and encourage an emergent curriculum based on the children's explorations of that environment. In her book *Forest School in Practice for All Ages* (2016), Sarah Knight uses the metaphor of a tree to describe the pedagogy of forest school. Knight asks us to envision that the ground or soil that provides the conditions for forest school to grow is play and outdoor education. The "trunk" that holds up this tree is the children constructing knowledge through interacting with the world around them. The "branches of knowledge" that are then able to grow are pedagogies of place, time, mindfulness, biophilia (the loving of living things), bushcraft, and sustainability (2016). As a method, it is grounded in the belief that our organic connections to the earth foster the most important kind of learning. The curriculum is not pre-planned, but educators are there to ask questions and facilitate children's explorations.

Administrative permission secured, my students, co-teacher, and I undertook the construction of a forest curriculum, one that was firmly rooted in Randall's Island. The students and I took the 15-minute walk to the island every Thursday afternoon for two years. Sitting at the intersection of three different boroughs, in between large bridges and the East River, a part of the marvel of this experience was the dramatic shift from the constant activity of the city to an oasis of nature. To get to Randall's Island, we walked one short block to the river. From there, we accessed the pedestrian bridge that wraps around the corner of 103rd Street and stretches across the water.



Figures 1, 2, and 3. Walking to Randall's Island

Once we arrived, we were greeted with large sports fields, trees, hills, and rocks. To our left, paths ran along the coastline, dotted with sprays of wildflowers. On one of the paths, painted in yellow, were the words, "Black Lives Matter." Ducks and geese grazed by the water, picking at the grass, eyeing picnics for dropped morsels of food. A horse stable sat facing the water, and in the spring, two horses swayed their tails and ate grass through the chain link fence. My students plucked grass that was out of the horses' reach and passed it to them through the fence.

Figure 4. The students feeding the horses

Sometimes we walked to the shoreline that revealed itself—the muddy banks, the weathered sea glass (old bottles smoothed out by the waves), various rocks and sediments, and abandoned junk chipped and broken just enough that its existence appeared a mystery, its history coveted. There was a little grove where someone had set up logs in a circle, with half of a tree trunk in the middle to serve as a table.

Farther on, there was a marsh with a plethora of wildlife, including oysters and Great Blue Herons. When we looked across the river, we saw our city, its skyline of behemoth buildings and its highway jam-packed with cars, and the various bridges and landmarks that marked the sky like giants. We could hear the clatter of city life, the horns honking, the boom and crash of construction, the wail of sirens, but they did not hold the same weight here. The urban din was just as loud as the caws of the Peregrine Falcons that perched in the branches. On Randall's Island, we turned our attention to the trees and the birds.

Figure 5. The Manhattan skyline from Randall's Island

THE PEDAGOGY OF PLACE AND TIME AT THE DREAM TREE

One of the most important things that emerged as we explored the spaces of Randall's Island was a sense that a part of the park was "our space," a place the children returned to again and again. Our space turned out to be on the southern side of the island, to the right of the foot bridge, where trees dotted a sloping hill leading to the water. The defining feature of this space was a massive tree with branches that seemed to stretch in every direction, a place where we would gather and place our things. The trunk was big enough to hide behind during games of tag. In the late summer and early fall, the tree's leaves provided us with shade. In the winter, we were able to spot a hawk perching on the bare branches. After weeks of visiting this same spot, and always meeting at this tree, my students began to call it "Dream Tree." It became another member of our community. "Race you to Dream Tree!" the kids yelled as we approached it. Dream Tree was often greeted with hugs.

Figures 6 and 7. The Dream Tree

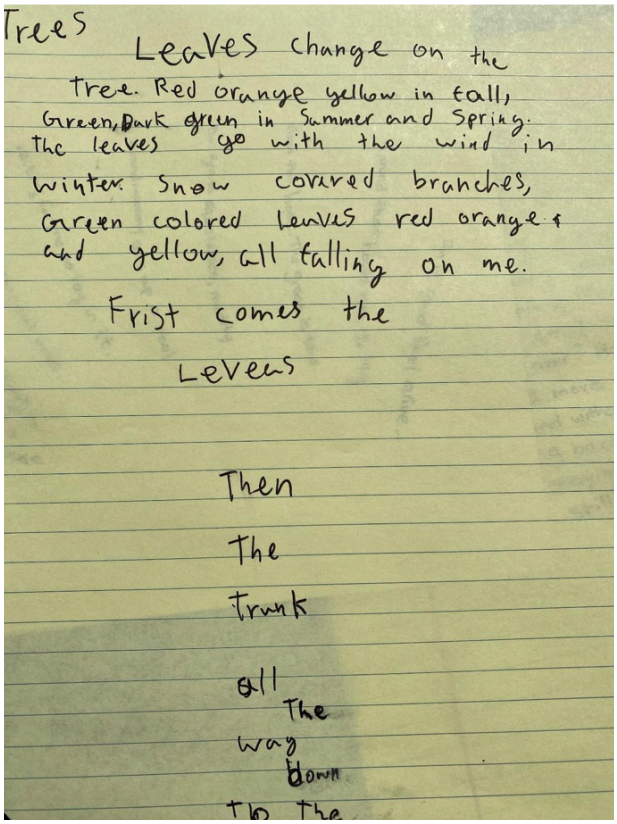
Knight (2016) discusses the pedagogy of place and time as essential in forest school teaching. "When participants engage with a wooded space over a number of weeks, then that space becomes another key to the learning experience. The minute changes that occur from week to week as the seasons progress, as the space becomes used and as the users' perceptions sharpen, link the learner to the space as if it were another facilitator" (p. 100). Knight argues that returning to the same space allows that space to take on the role of teacher, providing lessons simply through the changes over time and the relationships that students make with the space.

Our visits to Randall's Island were regular and predictable so that we could notice the small changes that occurred over time. Sometimes, this attention to time and place appeared explicitly, such as when we had students write and draw observations of a particular living thing on the island over months. Because we dedicated regular and frequent visits to the same place, questions, ideas, and observations of change and transformation on the island also happened spontaneously in free-form discussions among students and teachers.

In particular, curriculum emerged through my students' sense of connection to the Dream Tree. They observed it closely. They noticed the changes in the Dream Tree, changes in color, loss of leaves, subtle changes in the texture of its bark. They detected changes in the environs of the tree, the comings and goings of cicadas or changes in the quality of sunlight—changes that unfolded over longer periods of time and that were perceptible because we went there for two years. They observed how it felt to be there among the leaves, warm breeze, and sunshine, or on cloudy and blustery or snowy days. They saw what was the same about and different from all the days we had been there before. When they found the ground surrounding Dream Tree littered with trash, my students asked to bring trash bags and gloves to clean up.

Figures 8 and 9. Students make snow people with twigs from the tree in the winter and find cicadas in its shade the late summer

In the spring, when we wrote nature poems, the Dream Tree figured heavily.



Trees

Leaves change on the tree. Red orange yellow in fall, Green, Dark green in Summer and Spring. The leaves go with the wind in winter. Snow covered branches, Green colored leaves red orange and yellow, all falling on me.

Frist comes the

Leves

Then

The

trunk

all

The

way

down

to the

Figure 10. A tree poem

EMERGENT CURRICULUM AT THE BEACH

In the fall of 2021, the beginning of our second COVID-19 school year, we were meant to return to normal, though we still wore masks, we still got tested for COVID-19, and we still filled out paperwork to enter the building. But now all the students were in the classroom every day. We could sit three feet apart instead of six, and children could sit across from each other if there was enough distance. We got our rug back, the place we gathered in a community circle. Students could search for books from the same book bins.

In the first few days of school, students shared questions and wishes for the year. There was much talk of Randall's Island: when we would be going back, how frequently we would go, and whether we could start going immediately. This was our second year with our now fifth graders. Some of the students were in our physical classroom for the first time; in the previous spring, many students had attended in-person school only two of the five days while others had stayed remote all spring. It was clear in those first few days that the magic and lore that had grown around trips to Randall's Island were powerful for students who had been there the previous year and others who had only heard about it. Randall's Island was already driving the students' hopes for the coming year and it held the early promise of connection. In her essay exploring the importance of fostering ecological identity in students, Ann Pelo (2014) argues that "love for a specific place makes love for other places possible. An ecological identity allows us to experience the Earth as our home ground and leaves us determined to live in an honorable relationship with our planet" (p. 42). Our passionate ecological identity lived not only on Randall's Island but came with us into the classroom.

Even with these strong feelings of connection to Randall's Island, my co-teacher and I struggled with how these trips and their emergent curriculum fit into the new academic year. Now the expectations were for students to "catch up," as though there was some race that we were all participating in when we returned to learning in school. We still tried to go once a week, or to do something around the neighborhood. Sometimes it did not fit into the plans and so we did not go.

The students continued to ask to go to Randall's Island. I missed it, too. And so, despite the expectations, all the ways in which we were meant to *catch up,* after a month of school we made the commitment to go every Thursday. We dedicated the last hour of the day to Randall's Island—or as my co-teacher called it, the Isle of Randall—with the objective of just being there.

"I'm going to take a walk," I announced on one of these Thursday afternoons on the island. The weather was unseasonably warm, the last whisper of summer. Coats had been left in the classroom, which made it easier to move around and examine things: that plant that could be lavender or rosemary, a suspicious-looking insect.

Only a few of the children, mostly those who did not want to play frisbee, took me up on the walk. We moved slowly and I stayed back with a couple of kids lingering next to a plant. So I did not see the moment they discovered the beach. But I heard them. There were cries of astonishment and excitement. As I climbed over the rocks leading to the sandy shore, they were soon surrounding me and holding out their discoveries: a hermit crab shell, what looked like a crystal, sea glass (See Figure 4).

"This is quicksand!" one student cried, letting her fresh sneakers sink deep into the watery mud.

"Is quicksand even real?" another student asked as she tried to balance on a rock peeking out of the surf.

"It's not quicksand! It's just wet because of the water!" another student called out, crouched in front of a drainage pipe but still listening to the conversations happening a few feet away.

Immediately my teacher brain emerged. "An opportunity to teach about the tides!" I thought to myself, and then asked if they could think why the sand here might be more squishy than the sand close to the path. The children had no time for my agenda: "Look at that stick! Is that a piece of pottery?"

That afternoon, the kids brought back pocketfuls of what was essentially garbage—the chipped remnants of flatware, jagged pieces of weather-worn glass, hunks of rock and cement. They treated them as if they were treasure. They were objects of mystery and evoked many questions. On the walk back from Randall's Island that afternoon, curriculum began to emerge; the children voiced questions and hypotheses about what these treasures were and where they came from.

When we got back to the classroom, my students' shoes were caked with mud. Their leggings were wet and dirt and sand collected underneath their fingernails. They did not mind. My students were forming a sensual relationship with the beach, which is integral to developing one's ecological identity. Many students began to draw from their prior knowledge to classify the rocks and sediment they took back to the classroom to clean, sort, and organize. Other students identified distinctive markings on the flatware—a particular design, a collection of numbers that looked like a possible year, words that suggested a brand name or builder—and researched online the possible origins of these broken remnants of the past. Pelo argues, "Intellectual and critical knowledge needs a foundation of sensual awareness" (p. 44). When my students squished their feet in the "quicksand," this sensual act inspired them to hypothesize about what this liquidy sand could be.

Figures 11 and 12. Students discovering the beach on Randall's Island

The next week, more students joined the walk. I brought gloves and sandwich bags for collecting. This time, there was no possibility of an aimless walk; the call of the beach was too strong. Again, some kids ran ahead of me, so I was not there for the moment when they found that the beach had disappeared. By the time I reached the rocks, now teaming with water, the students were flustered.

"Where did the beach go?" the students cried. The shore's disappearing act was high drama for my students. Immediately, there was intense discussion and speculation about what had happened to the beach. Many students, remembering what they had been learning about Miami's shrinking coastline in social studies, suspected it had to do with climate change. The images and stories of the flooded beaches and encroaching sea in Florida reminded them of the disappearing shoreline here on Randall's Island. However, when we returned the following week, my students discovered the shoreline was once again visible. The re-emergence of their beach forced my students to rethink their hypothesis that the shore had disappeared due to rising sea levels, as climate change caused sea levels only to increase over time, not increase and decrease from week to week.

Other hypotheses were considered. One student offered the belief that when it rains, the river's level naturally rises and floods the shores. However, students soon debunked that theory as they began to keep track of whether or not it had rained in the immediate days before going to Randall's Island. The visibility and invisibility of the beach did not correlate with rainy or dry days. Plus, rain tended to be more unpredictable and random than the appearance or disappearance of the beach.

The question of what caused the beach to appear and disappear became a typical conversation among the students on Randall's Island and back in the classroom. This collective inquiry was practical: if students wanted to collect treasures on the beach, the beach had to be there to collect those treasures. It directly affected them to know about this river and how it behaved.

During one of these discussions, one student questioned whether or not the disappearing shoreline had something to do with ocean tides. Other students agreed that tides could cause the beach to appear and disappear. They recalled trips to the Atlantic Ocean beaches when adults around them spoke of "high tide" and "low tide." They knew it was related to how far up the sand the water reached.

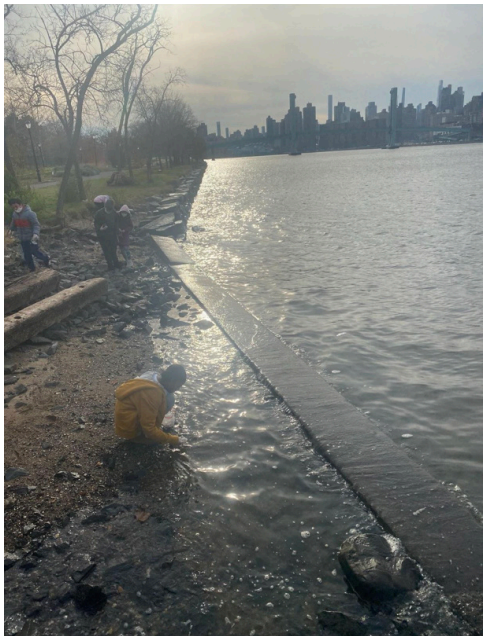
The following week, I used an app to track the tides. "It says it's going to be low tide today. So what do you predict? Will the beach be there or not?" With most not knowing the difference between low tide and high tide, students predicted using context clues. Walking over the bridge to Randall's Island, we stopped midway to gaze at the shoreline of the island. Together, we discussed where our beach would be and if it was there. We used landmarks from our previous visits: there are the benches where we dumped our gloves, that is the tree that Leela climbed. We found it, saw the flash of beige sand that revealed our beach. "So low tide, the beach is there."

It became a habit over the rest of the school year to check the tide level. When it was high tide, we would explore other parts of the island. When it was low tide, we went back to the beach and collected. The students noticed a pattern with this ritual: every other week, it would be low tide. A question bloomed from these discussions, always there but never needing to be uttered, since we were so intent on finding the answer: What does that say about how tides work?

Adrienne maree brown (2017) emphasizes the importance of attending to the emergent as a way to connect our understanding with the "sacred systems of life all around us" (p. 2). The knowledge that emerged out of our beach discovery and subsequent exploration came from experiencing and coming to know a sacred system—the tides. My students participated in this sacred system because they were drawn to its changing nature. They were engaged by what was revealed and what was hidden by the tides (see Figure 8). Brown goes on to explain that when we forge relationships with these sacred systems, we find our humanity in them (p. 2). We understand that we are part of the same sacred

systems and subject to the same changes, transformations, and mysteries that the natural world goes through. In this way, my students were impelled to think about the nature of the differences in their own lives, the ebbs and flows of their challenges and experiences, and find their own identities as living beings in nature.

The day my students found the sand covered with water, they felt they had witnessed magic. And nature is magic. When we speak of magic in stories, it is a reflection of the magic we witness every day in our own lives: the appearance and disappearance of things, strange-looking creatures with powers all their own, plants that heal.



Figures 13 and 14. Students return to the beach to collect objects and witness the changes in the tides

Hooven, Kissling, and Woods (2021) call this kind of curriculum "emergent earthen curriculum (p. 20), an act of "ecological citizenship," in which, they argue, borrowing from Aldo Leopold, children join '"the land-community,' which expands beyond humans 'to include soils, waters, plants, and animals, or collectively: the land.'" This expanded perspective on the place of humans as only one piece of a larger, more vibrant world is vital, Hooven and colleagues (2021) say, for facing our global ecological crisis.

FINDING PEACE ON RANDALL'S ISLAND

At the beginning of the second year, when we returned to Randall's Island, Leela and Suhri perched by the banks of the river, side by side. "What are you up to?" I asked. "Just feeling peaceful," they said. They told me that here, on Randall's Island, it felt like nothing bad could reach them.

When we make meaningful relationships with a place, we allow ourselves to find joy and meaning in the world. Perhaps my students found peace on Randall's Island because they needed peace as they reconstructed a world changed by the pandemic. When the world seemed out of their control, frightening and lacking connection, Randall's Island was a place where they experienced some

predictability, control over their learning, and often, they were able to engage with longer time frames of natural change. By being mindful and present, they could focus on loving, positive relationships with the land and each other, temporarily setting aside some of the stress and fear.

Many people believe that in the wake of the pandemic, children "lost a year." I would argue that they did not misplace a year of their lives. The time of learning during COVID-19 was very much in their possession, because they experienced it and are still experiencing it. Many parts of it have been difficult and scary. There has been a lot of disruption and change. But at the same time, there have been opportunities for new interests and new priorities.

Still, others claim that the children lost out on learning during the pandemic. While some of what is typically measured on standardized testing may be lagging or missing (Goldstein, 2022), it is also important to acknowledge that children have experienced remarkable contexts for learning throughout the pandemic. They have had to make sense of a frightening situation that impacted them directly. They had to learn new rules and protocols about the ways we spread disease, about the nature of medicine, and doctors, and isolating. They have had to learn personal responsibility as they obediently pull up masks they would have refused to wear just a couple of years ago. They have had to find resilience with every passing change, every interaction taken from them, every experience morphed into something new. They had to spend time with themselves and learn about who they were—how they managed their own learning in their bedrooms, how they managed their fear, boredom, and sadness. Learning, as always, was in abundance.

Perhaps something that was lost or at least challenged during the pandemic was a feeling of connection. This was certainly true for my students and me, as we struggled to connect over online schooling, locked down in our homes. But the feeling of connection was not lost in the sense that it was completely gone; rather, it was lost in that we did not have a map to find it because nobody had made one yet. We had to make our own maps.

My daughter Mona knew how to get to her rock in Prospect Park and she knew why she needed it. She understood, when climbing onto that rock, when peeling off her mask for a moment, breathing in the spring air, that she needed to find peace because the world around her was chaos. She learned that watching living animals; water moving with the wind; swaying grass; stoic, giant trees, calmed her.

In the same way my students found that every other week, our river was at low tide, and revealed a glittering shoreline with hermit crabs, sea glass, rocks and sediment, and the shattered remains of their neighbors. In just a few short weeks, they could predict when the tides would be high, and when they would be low. They inspected the landmarks that they adopted—those rocks, that cement barrier—to see how far in or out the tide had gone from the last time. Many did not remember all their times tables, but they did remember just where the water and the land met three weeks ago.

Looking back, I wonder why it took me so long to implement this sort of pedagogy. In my first few months of forest school, it was difficult for me to walk to Randall's Island without some sort of plan. Even in my second year of going there, there was still a voice in my head that kept nagging me. If I do not have a plan, are they really learning anything?

The answer: of course they are. Everyone is learning all the time. Being alive is learning, because experiences are learning. Learning is happening on the walk home from school. Learning is happening

while watching TV. Learning is happening while sleeping. Learning is happening in the bath. Learning is happening at the dinner table. When we are freed from some of the constraints of what we are told or imagine we must do, what else might we do? We can run. We can examine things. We can follow our questions. We can let our attention wander and see where it leads. We can have conversations. All of this is learning. Learning is always in abundance. What is missing from our students' formal education is the opportunity to connect their learning and their lives with the world outside classroom walls.

I had to fight the impulse not to go to Randall's Island because we had too much work to do or it was too cold or there was not enough time. Because no matter what, the students kept asking to go. Eventually, I became comfortable with venturing to Randall's Island without any agenda. We did yoga there, read, ate lunch, played games, set off paper rockets, sat by the river. We spent a month writing nature poems. My students snatched my phone out of my hands to take close-up photos of flowers blooming. They acted out a game they had invented from a book series about warrior cats (Cary & Baldrey, 2003-2022). They spent hours gathering "herbs" and setting up territories.

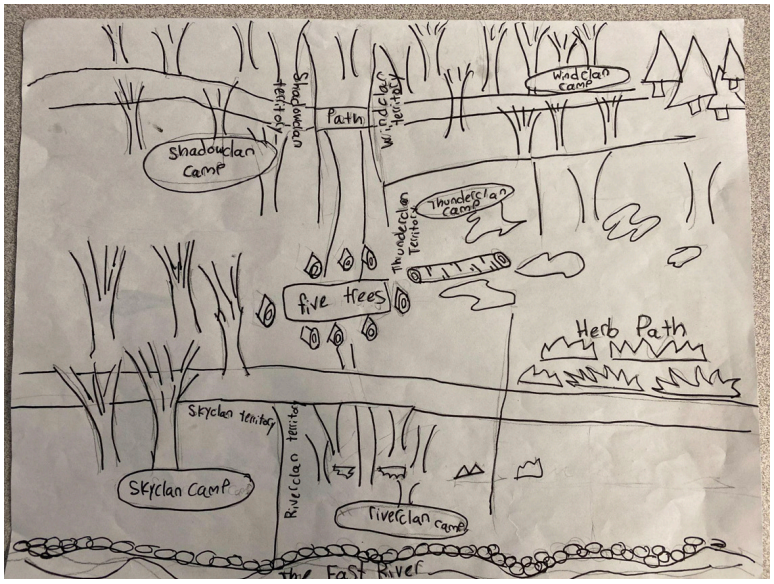


Figure 15. Students make a map of Warrior Cats territories on Randall's Island

Outside of our schools and homes and offices, the world exists. During the pandemic, the outside was the one thing that we did not have to distance ourselves from. Being outside was how I found connection to the world around me when connection seemed to be in desperately short supply. When I was quarantined with COVID-19, I missed that connection even more. I yearned to breathe in the air and sit in the grass and listen to what my students had to say about their world. I wanted to hear Leela and Suhri's thoughts about finding peace by the water's edge. I wanted to find myself again amidst our collective community, at the foot of the large, strong Dream Tree and standing at the ever-changing coastline, the Beach.

Living, teaching, learning, and connecting since COVID-19 have felt somewhat like a dream, or like a world of shifting sand, not that everything used to be perfect or ideal but that our worlds were rearranged. Because, with our worlds jumbled and dream-like, some of the demands and norms of standardized living were loosened and we realized we could do things we previously did not believe we could do.

When we took the time to experience the world around us, to form connections—with a tree, with the shore of a river, with one another—we created our own worlds in the here and now. They became woven into the inner fabric of who we are, and they led us to learning, to the natural world, to ourselves, and most importantly, back to one another.

Figure 16. Finding connections with one another on Randall's Island

REFERENCES

brown, a.m. (2017). *Emergent strategy: Shaping change, changing worlds.* AK Press.

Cary, K. & Baldry, C. (2002-2022). *Warriors* (Vols. 1-43). Harper Collins.

Goldstein, D. (2022, March 8). It's 'alarming': Children are severely behind in reading. *The New York Times.* nytimes.com/2022/03/08/us/pandemic-schools-reading-crisis.html

Hooven, J., Kissling, M., & Woods, M. (2021). Teaching ecological citizenship through an earthen early-childhood curriculum. *Social Studies and the Young Learner, 34*(2), 19-26.

Knight, S. (2016). *Forest school in practice for all ages.* Sage Publications Ltd.

Pelo, A. (2014). A pedagogy for ecology. In B. Bigelow & T. Swinehart (Eds.), *A people's curriculum for the earth* (pp. 42-47). Rethinking Schools.

ABOUT THE AUTHOR

Margaret Nell Becker graduated from Teachers College, Columbia University in 2010 with a master's degree in inclusive elementary education. After teaching in a variety of New York City schools, Becker has spent the past decade as a 4th/5th grade teacher at Central Park East 2 in East Harlem, NY. In her teaching practice, Becker prioritizes bringing the world into her classroom through experiential learning that is authentic and meaningful to her students. She lives in Harlem with her partner and two children.

Children as Design Visionaries, Learners, and Socio-Political Wayfinders: Mapping the Layers, Hierarchies, and Rhythms of a School Community

Natalie R. Davis and Roni Barsoum

The child in each of us
Knows paradise.
Paradise is home.
Home as it was
Or home as it should have been.

Paradise is one's own place,
One's own people,
One's own world,
Knowing and known,
Perhaps even
Loving and loved.

Yet every child
Is cast from paradise-
Into growth and new community,
Into vast, ongoing
Change.

Octavia Butler (2001), *Parable of the Talents*, p. 197

Tracy Jackson (2016). *Everything is going to be alright* [Mixed Media Collage on Canvas]

Figure 1. Excerpt from *Parable of the Talents* and artwork

INTRODUCTION

Despite the seemingly intractable problems of public schooling, we (as researchers and dreamers) remain encouraged by the persistent efforts to reconfigure and reimagine the socio-political landscape of schools. We begin this essay by recognizing the work of individuals bravely and imperfectly expanding notions of what schools could and should be. We stand in solidarity with the innovators sowing, designing, and reaching toward more just social futures, dreaming of schools for children that are not so distant from the paradise Butler (2001) describes (Figure 1). This liberatory dreamwork coincides with long histories of communal ingenuity (Vossoughi et al., 2016), resistance against normative models of schooling, and practical efforts to enact humanizing education while facing diminished resources and opposition on all fronts (e.g., King, 2006; Rickford, 2016; Tejeda et al., 2003). It is good, worthy work that we hope to contribute to in our own research and practice while asking the important questions: *Are the children alright? What can they teach us about designing transformative schools?*

The perspectives of the children who intimately understand what it means to be learners in schools often get overshadowed by adults' pedagogical imaginations, experiences, and ambitions (Erickson et

al., 2008). Children's processes of *knowing, owning,* and *loving* are seldom foregrounded, though they offer vital insight into what schools are and what they could one day be (Butler, 2001). The exploratory analysis presented in this paper is an exercise in seeing the design of schools through the eyes of children. Black students featured here were learners enrolled in an innovative city school with an articulated commitment to empowering elementary-aged children as intellectuals and critical civic actors (Davis, 2017; Davis & Schaeffer, 2019). The school, here referred to as Mission City School (MCS),[1] was also developed with a place-based, communal mission. Children were encouraged to consider the needs of the collective and seek out ways to serve and deepen connections to their socio-political and physical landscape.

As an investigation into children's sensemaking within this context, our study involved asking Black students to respond to a simple prompt, "What is it like here in school?" Obliging our request, participating children produced a range of artful and complex illustrations that served as a window into the "here and now" (Mitchell, 1953). While we expected variation in their drawings, we were struck by children's interpretations of the prompt and the corresponding representations of the design of the school. Children keenly amplified aspects of design and daily practice that were unnamed but nonetheless alive in the schooling environment. The rhythms and relationships in their visual maps sometimes centered patterns, tensions, and dynamics (by-products of design) that might differ from adult perspectives of the space. Most notably, we noticed the creative ways that MCS students represented conceptions and learnings around the meaning(s) of community. We see great value in their representations as portals that might help adults and educators reconcile pedagogical ambitions with moment-to-moment activity in everyday life (Davis et al., 2020). As we show, though children are not the original architects, they are visionaries, learners, and wayfinders, capable of seeing and making sense of nuanced community dynamics (Erickson et al., 2008). What opens up when we consider how children sketch the layers, hierarchies, and rhythms of their schooling experiences?

(RE)IMAGINING SCHOOLS AND LEARNING FOR BLACK CHILDREN THROUGH PLACE-BASED EDUCATION

Largely in spite of unjust and violent systems of oppression, there is a long history of efforts to leverage schools as sites of resistance, communality, and joy. Accordingly, many have treated schools as potential spaces to "act out" visions of liberation (Givens, 2021; Grant et al., 2020; Rickford, 2016) and to pedagogically convey that more humanizing socio-political realities are possible. For Black Americans, the struggle to define and establish "good," dignity-conferring (Espinoza & Vossoughi, 2014) schools for Black children has been especially fraught. In 1865, 230 years after the first public school was established on the Massachusee native lands now known as Boston, Massachusetts, a group of Black American "freedpeople" bravely assembled in Charleston to petition the state of South Carolina to support the establishment of quality public schools for Black children. The assembly's appeal conveyed a long-standing communal commitment to education as a means of self-determination, despite such ambitions being contested or (for a time) punishable by death:

> Whereas, knowledge is power, and an educated and intelligent people can neither be held in, nor reduced to slavery... we will insist upon the establishment of good schools for the thorough education of our children. ("Proceedings of the Colored People's Convention," 1865)

In line with this history, contemporary scholars and practitioners have advanced innovative schooling models that in addition to supporting robust forms of disciplinary learning are also designed to support

1 The school and students have been assigned pseudonyms.

the socio-political and socioemotional development of Black children. Though these schools have taken many forms, they are united in the goal of building solidarity to disrupt cycles of educational inequality. The hope is that with nurturing and transformative school practices, children might also begin to see themselves as individuals who can lead the charge in solving the problems affecting their communities.

As a specific and important example of innovative design that seeks to reorient Black children to their socio-political landscape(s), we foreground place-based approaches to schooling.[2] This approach is premised on the idea that youth need access to schools that affirm them as social and political actors, deepen community connections, and take into account students' immediate circumstances(s) (Ginwright, 2004). Place-based approaches allow for this "intensified focus" on people in context and provide a "sense of direction and identity that might power individuals to struggle and to endure" (Kincheloe & Pinar, 1991, p. 21). Critical place-based models prompt Black youth to think about how their actions can impact their community and the future world. The place-based model advances a communal orientation rooted in love, appreciation, and commitment to changing one's neighborhood for the better (Haymes, 1995; Tedla, 1995).

CENTERING CHILDHOOD THROUGH DESIGN, ART, AND ARCHITECTURAL PRINCIPLES

Place-based schooling models for children require synergistic ways of seeing and evaluating design. In Design Justice, Costanza-Chock (2020) offers several principles as guidance to shape communal design efforts. We note parallels between Costanza-Chock's conception of communal design and the goals of liberatory education. To illustrate these parallels, we developed a visual representation of three principles that are closely tied to the aims of place-based schooling (see Figure 2).

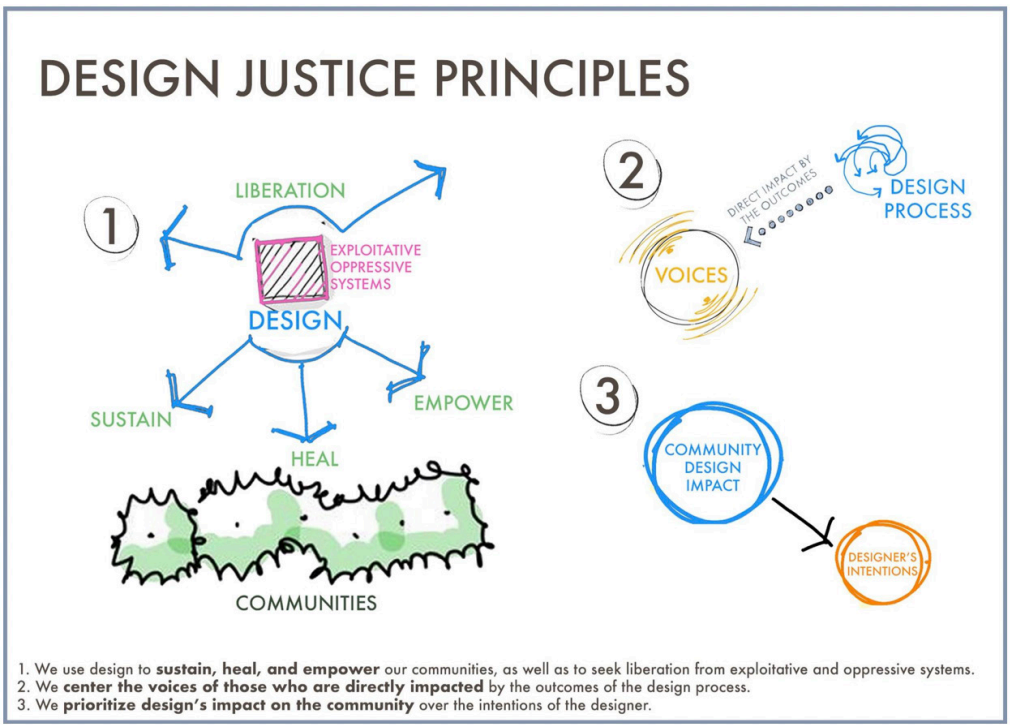


Figure 2. Design justice principles. Text from Costanza-Chock (2022, p. 6), emphasis in the original

2 We recognize that place-based approaches have been employed in a number of important contexts (e.g., Indigenous education) and with learners of all ages. Here we focus on the case of Black children and childhood.

Accordingly, elevating and engaging with the voices of children (as those most impacted by the outcomes) should be a core facet of innovative and just schooling models. However, empirical studies of justice-centered schools that foreground Black children's perceptions remain limited. We worry that even in our best intentions to affirm children, we might be falling short in practicing rich forms of intergenerational learning and research that position children as wise and dynamic in their own right (Akom et al., 2008; Davis et al., 2020; Dumas & Nelson, 2016). This paper is an exercise in exploring what it could look like to engage with Black children's visions of schooling and design on their own terms.

Arts-based methods, including drawing/illustration, have been offered as a tool for capturing learning that aligns with children's ways of knowing and doing (Causey, 2017). Koh (2010) and others found the "write and draw" strategy to be particularly useful in helping young students articulate abstract ideas. Similarly, Grover (2004) described the use of drawings in research as a means of allowing children (and adults) to tell their own stories. As a tool for understanding how children make sense of schooling and school design, drawing prompts afford opportunities for children to map the physical space, aesthetics, and normed practices of their school. To borrow language from architecture, a drawing of school can make visible the physical design structures that interact with other factors to arrange socio-political relationships and shape possibilities (Scheeren, 2015). Children's illustrations can represent school—as buildings and so much more—in form and function and through everyday stories (Charitonidou, 2020) that characterize their learning and experiences.

We are interested in how Black children attending one place-based school understand it as characterized by dynamic hierarchies, rhythms, and relationships. We will treat their drawings as windows into their knowledge and sensemaking. In architecture and design renderings, hierarchy can be implied through size, shape, or strategic placement relative to other forms within a space (Ching, 2007). For a form or space to be articulated as being important or significant, it must be made uniquely visible. In a visual drawing or map of school, we would expect more significant elements to be larger than others in size, unique in shape, and/or situated as a central point of focus. Rhythm is also an ordering principle that can be communicated visually. In design and architecture, rhythm is movement characterized by patterned repetition of formal elements or motifs in the same form or a variation of that form. The movement may be of our eyes as we follow recurring elements in a composition or of our bodies as we advance through spaces. A rhythmic pattern may be continuous and flowing or staccato and abrupt in its pace or cadence. In schools, multiple rhythms may be in play that work together harmoniously or in discord. In schools that are intentional in curating safe, nourishing spaces for Black children, we might wonder if/how students' illustrations reflect rhythmic attunement.

POSITIONALITY-RESEARCHER CONTEXT

Before describing the research study and children's drawings in greater detail, we pause to offer abbreviated insight into our own identities and experiences. We write together as a university faculty member (Natalie) and doctoral student (Roni) who have spent the last three years engaging in informal conversation about children's thinking and learning. We also write as co-thinkers who collaborate within a graduate program focused on innovation and co-developed a podcast focused on childhood.

I (Natalie) am a Black woman educator and critical scholar who has taught Black children in a variety of settings. In addition to teaching third grade in an African-centered school, I served as a volunteer teacher in MCS, the school that is the focus of this analysis. MCS is situated in the urban district where

I grew up and attended public schools. The children whose drawings are at the heart of this study are also near and dear to my heart. I position my scholarship as an exercise in demonstrating reverence and care (Davis & Neal-Jackson, 2022) for young people. I am also deeply motivated by my own personal and professional interests in positioning children as savvy social and political actors who are already *actively* making sense of complex systems and environments.

I (Roni) grew up as a multitalented artist enjoying design and various forms of visual and performing arts. As a child born in Egypt, a lower- to middle-income country, I struggled with the limitations of an education system that did not acknowledge or encourage my broad set of interpersonal and artistic skills. After securing an architectural design degree, I founded an art and culture center specializing in visual and creative arts training programs for children. In collaboration with a team of professional artists and art educators, I designed this space with careful consideration of children's needs. However, dealing with hundreds of children and their families, I saw too many children's creativity stifled and dreams deferred as they struggled to thrive within a conformist, neoliberal, and poorly designed education system.

This project melds together our collective histories of participation as an elementary school teacher and an architect and as researchers, creatives, space designers, and once-children (Ransom, 2017) who often felt misunderstood, stifled, or undervalued in school.

STUDY CONTEXT

MCS was designed as an act of resistance. Its founders and administrators, a team of three women, hold intersectional identities as teachers and local activists. Each was inspired by the work of elders who took part in the Civil Rights and Black Power movements. The team's top priorities were to create a place-based, solution-driven, humanizing school and to challenge unjust educational norms. Brightly colored murals featuring children collaborating and dreaming adorned the school walls. On any given day, members of the MCS community could be found convening in meetings to discuss recent happenings and determine together the next course of action.

Kisha, a fifth-grader, explained that at MCS, "they teach us different things… they teach us about life too… Like not just math and science and social studies. They teach us life tools like you have to show integrity." Iris, another student, also explained the mission in a manner consistent with the communal emphases of the school. According to Iris, the MCS mission is "to raise children [at this school] who can look at something and say, 'This is not right; I'm going to strive to change this… and I'm going to get my friends together and we're going to brainstorm and change this….'" A thorough analysis of the school design model can be found in Davis (2017). We emphasize that MCS was a school that very explicitly, in its design commitments, included a concern for supporting Black children as critical and communally oriented citizens.

The first author of this paper spent 18 months as a researcher-volunteer at MCS. The nature and structure of her participation varied, an ebb and flow of taking on formal responsibilities and "just being" in the space (Davis & Neal-Jackson, 2022). In this paper, we focus on a drawing task conducted with MCS children as part of the research study. Children were asked, "What is it like here in school?" and provided with a handout, prompt, and blank sheet of paper to sketch on. Children had a charcoal pencil and a full set of color pencils at their disposal. After they completed the illustration, they were asked to describe the composition. Natalie took notes on their explanations. Our analysis of MCS

students' drawings of school was conducted in response to the following questions: *How do Black children map the socio-political learning landscape in a place-based communal school? What do their drawings communicate about the experience, learning, and possibilities/tensions within this environment?*

EXPLORATORY ANALYSIS—SITUATING CHILDREN AS LEARNERS AND DESIGNERS

In this project, we presumed that Black children's illustrations reflected a level of nuance and sophistication shaped by their experience. Our commitments to elevating children's voices and questioning power asymmetries in this study are resonant with Mitchell's (1934/1991, 1953) arguments for seeing children as capable of complex sensemaking. Children can demonstrate sensitivity and savvy with respect to socio-political dynamics in school and more broadly (Davis, 2017; Davis & Schaeffer, 2019; Lee, 2017). Like Mitchell (1934/1991), we reject the notion that "[t]he world is too complicated for them to understand" (p.7) and have structured our analysis accordingly.

Our decision to engage with principles of architecture and design was driven by a few important factors. To begin, the drawing exercise was conceptualized as a tool to aid researchers in better understanding the school culture, mission, and normed/valued practices. Participating children were asked to create visual representations of school design, akin to those that architects or designers might draft to show the intended form and function of a space. Architectural principles also helped to make visible the relationship between spatial and aesthetic features and content that is indicative of the valued forms of learning in the space. Next, Roni has extensive professional training in architecture and design. His scholarly interest in elevating children's voices and understanding them on their own terms (Davis et al., 2020) provided motivation for "seeing" outside of the boundaries dictated by traditional theories of child development. In analyzing students' drawings, Roni could not help but notice the particulars of design elements and consider the significance of scale, lines, and spatial planes as a window into children's understandings.

Finally, for reasons we spell out above, we sought out alternative modalities for analyzing Black children's learning and socio-political meaning-making that could surface the "marginalized or erased stories of the places encountered with young children" (Nxumalo, 2021, p. 1193). In our analysis, we were open to the possibility that architectural principles might create openings for a shift in our thinking about what mattered to the children of MCS about the place-based design of school (Nxumalo, 2021). We are aware of the possible tensions in leveraging the adult-dominant lens of architecture to make meaning of children's ideas. Thus, we consulted research focused on child-adult participatory design in architecture. Drawing from models such as "design with children" and "children's voice" (Lozanovska & Xu, 2013) helped us explore language and mechanisms for centering the perspectives that children were conveying in their illustrations.

We engaged in an iterative process of analyzing 17 illustrations by MCS students alongside any notes summarizing children's explanations. We developed a spreadsheet that contained a scanned copy of each drawing, a caption with context for the image, and related excerpts from children's interviews. Each of us reviewed the illustrations independently and documented our noticings in regard to the following design categories: rhythm(s), hierarchy, social relationship networks, and time/space. From an architectural design standpoint, the expression of various elements, including lines, shapes, colors, perspective view, alignment, signs, and symbols, in the composition were understood as intentional and reflective of children's understanding(s) as experts in their own schooling experiences. We also analyzed each drawing with the intent of discerning patterns of similarity and dissimilarity (Maxwell &

Miller, 2008) in relation to signs/symbols, affective or socio-political dimensions, and the valued forms of learning and interaction represented. Each component of children's drawings was assumed to carry meaning unless otherwise indicated by the child (i.e., by scratching out a drawing and starting over). We then discussed and synthesized our preliminary findings, refining the initial categories and revisiting individual drawings as needed.

In the next stage of analysis, we explored ways to reconfigure children's conceptions of school that emphasized our understanding of the complexity of their ideas. Consider the original drawing below on the upper left in Figure 3, where fifth-grader Jeff depicted his participation in his favorite class, art. (Jeff is seated with the trio of students at the bottom.) Rather than exclusively focusing on art class, Jeff also depicted an understanding of what his primary classroom teacher was doing while the class was engaged in art in another area of the building. Hence, at the top we see the teacher preparing the board for math instruction. In our analysis, we noticed that many children at MCS depicted simultaneous activities and showed awareness not just of their immediate context, but also of the broader happenings within and outside of the school. We also noted the large scale of the math board relative to the one modeling the flower for art. The board was positioned in a central focal location within the parameters of the illustration, suggesting its significance and hierarchical elevation as a core content area of instruction.

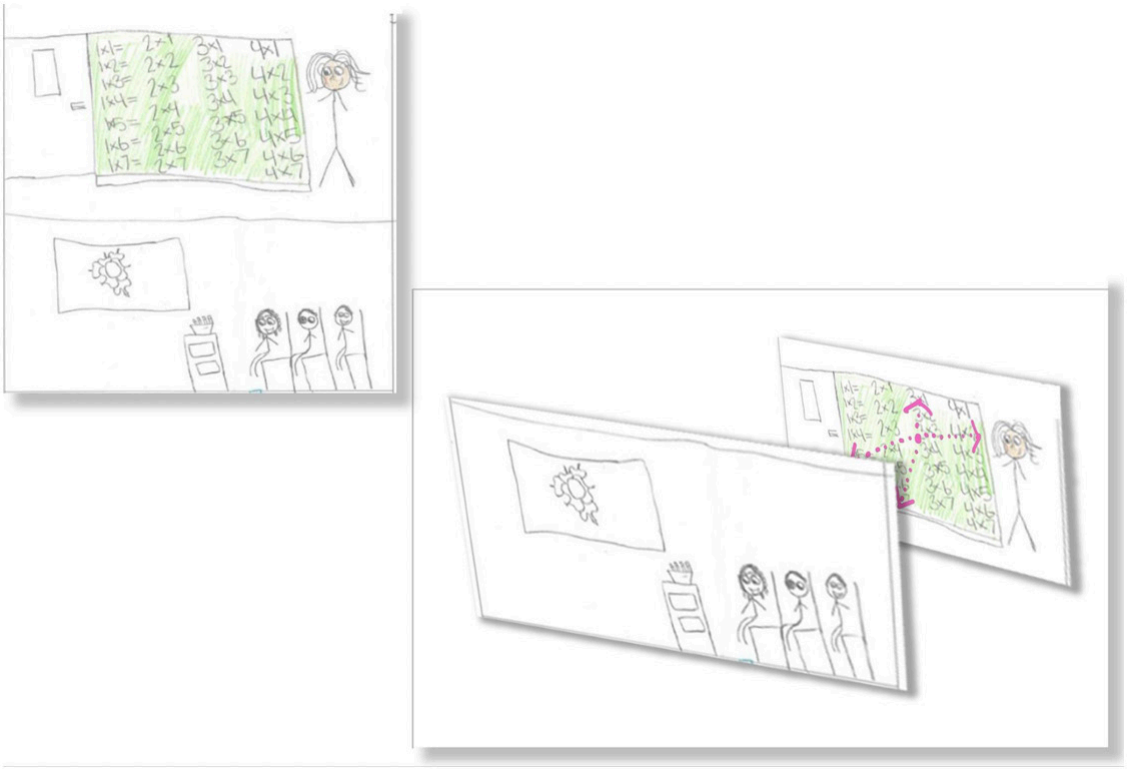


Figure 3. Art class

The rendering on the right in Figure 3 is representative of our analytical process. We used Adobe Photoshop to reconfigure, annotate, and/or deconstruct children's illustrations. As a tool for graphic design, Photoshop's functionality varies but includes the capacity to create layers on 2D images that

can be manipulated or removed. To underscore the concept of simultaneity and parallel space in Jeff's composition above, we detached the scenes and aligned them to appear to be 3D. The final 3D rendering developed in Photoshop is also annotated with symbols. A summary of the symbols utilized in our analysis is reflected in the table below (Figure 4).

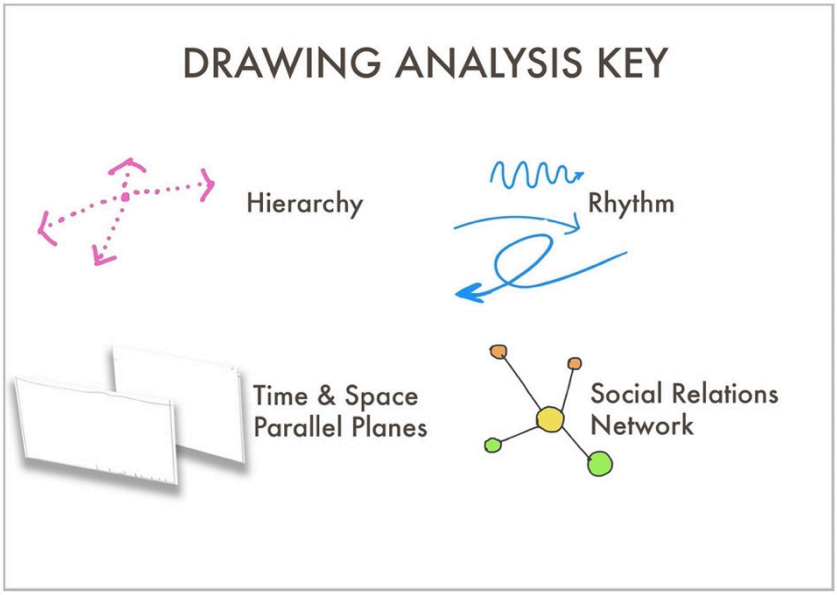
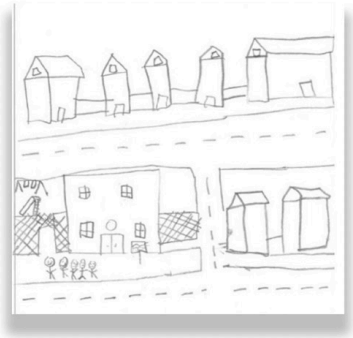


Figure 4. Drawing analysis key

In summary, our preliminary findings were that participating children at MCS created illustrations that reflected the schools' strengths and strivings. While the place-based communal focus was represented on a number of levels and included an accounting of broader context and multiple (harmonious) experiences, children also devoted time/space in their drawings to portraying community discord. We also noticed that children were concerned with the subjective experience of school and offered creative representations of how various people were positioned and were feeling as they navigated the socio-political dimensions of the space. We offer a few illustrative examples in the subsequent sections, followed by a brief discussion. Our goal here is not to be comprehensive, but rather to offer a window into our efforts to make sense of children's sensemaking relative to this particular school design.

WHAT IS IN A SCHOOL COMMUNITY? CHILDREN REPRESENTING HOLISTIC AND HARMONIOUS CONCEPTIONS OF COMMUNITY

By design, MCS advanced the values of communalism and connection. "We include people," is how Craig, a student, summarized the school's approach. The founders' theory of change was premised on the idea that by deepening connections of place and practicing inclusion in school, Black children would develop a sense of efficacy, belonging, and responsibility. Our analysis suggests that in some important ways, MCS was succeeding in its attempts to cultivate community. Below we share select drawings that evidence this assertion and that are representative of the larger corpus of data. In the first set of illustrations, Jalen and Darui each depicted a scene with the school building as a prominent element (Figure 5). Instead of a static drawing, children situated the school within the context of a communal environment. In both cases, the young artists represented gathering and greeting other members of the school community at the start of the school day.



"I drew houses [and] the school...in the streets"
(Jalen)

"I drew a picture in the morning time... there is usually people talking in front of the school and the grown-up comes out and says it's 'breakfast time' or time for school like school's open. And then yeah I see a lot of my friends walking into the school...."
(Darui)

Figure 5. School and community

Viewing the first image with an architectural eye, we note the representation of school relative to the broader neighborhood setting (Figure 6). The school is situated harmoniously within the city, flowing with the lines and rhythms of the broader environment. Houses in the backdrop are scaled up such that they are not dwarfed by the distinct presence of the school. Through this lens, school is characterized as connected and contextually grounded, enlivened through robust activities and meaningful interactions between people.

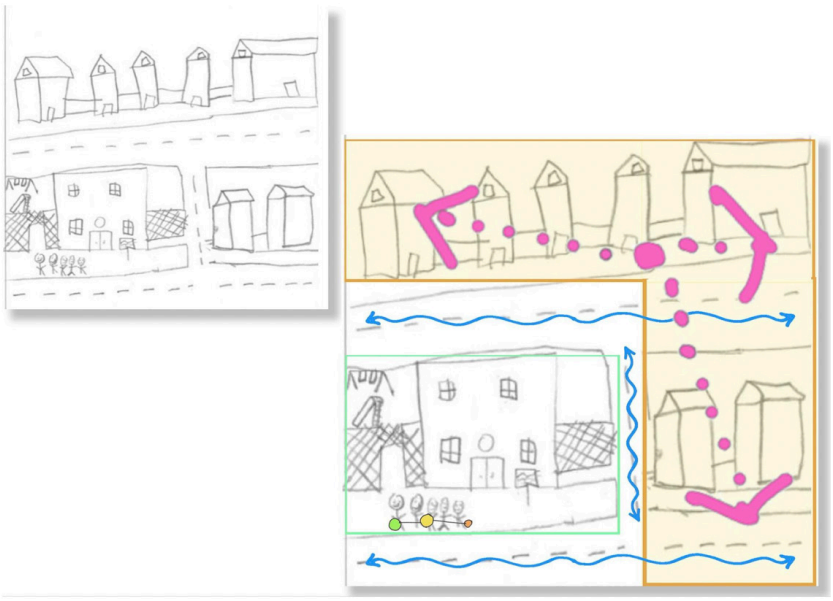


Figure 6. School and neighborhood

Sometimes children opted to represent the school design and community through multiple happenings, or vignettes. In those drawings, children could be seen convening in various spaces within and outside of the school building. The use of vignettes helped to convey a conception of school that was relational, dynamic, and eclectic. No single, static image was sufficient in describing the space. Below, students are depicted socializing with friends, playing during recess, attending class, and even singing the school song (Figures 7 and 8). The positive and comprehensive representation of school activities is consistent with MCS founders' communal design ambitions. By and large, children seem to be content and connected, in sync with the rhythms of school.

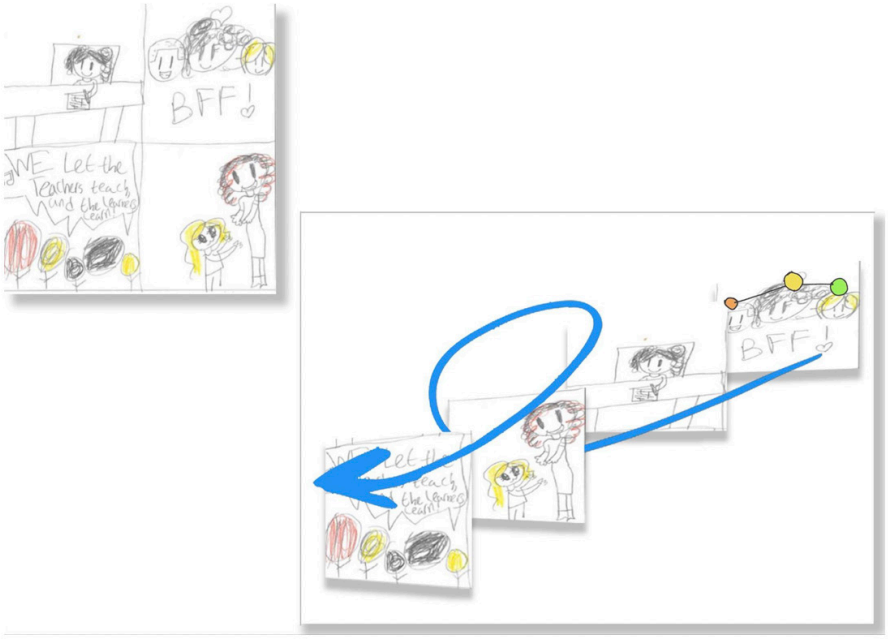


Figure 7. Vignettes A

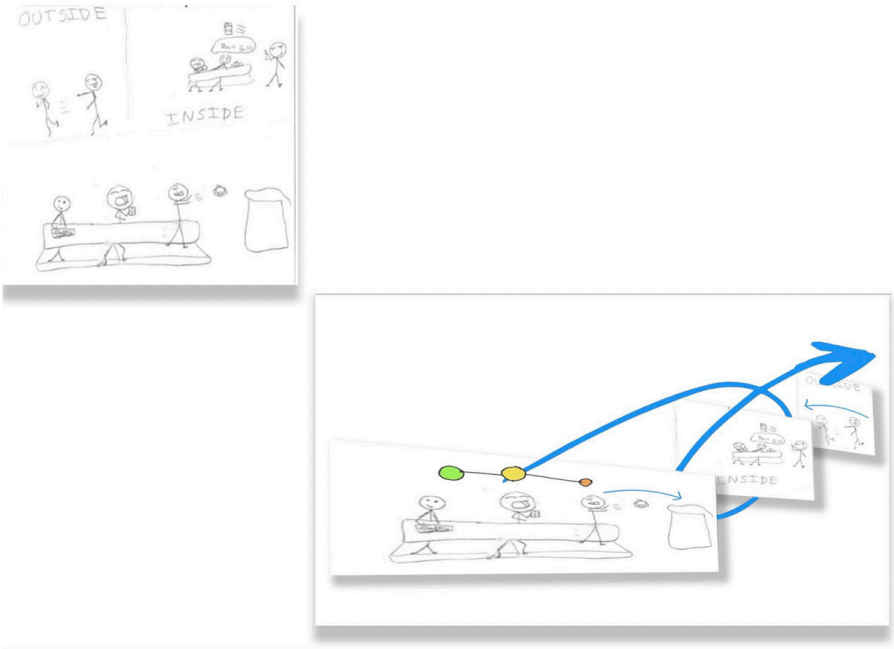


Figure 8. Vignettes B

CHILDREN'S REPRESENTATIONS OF COMMUNITY DISCORD AND POWER DYNAMICS

In this section, we account for the fact that children's schooling experiences at MCS were not always presented as harmonious. We found that although MCS children were very aware of the ethos of community and freedom advanced by the school, they also did not always experience school in this way. There was a pattern in children representing and amplifying sources of communal discord as a by-product of the school design. Their drawings demonstrated a recognition of disruptions stemming from children taking too many individual liberties and deviating from adults' behavioral expectations. There was also evidence of students being attuned to and navigating social hierarchies within the MCS context.

Take for example Starr's beautiful and complex rendering of the experience of attending MCS, which we have annotated below (Figure 9).

Figure 9. School experience

Starr illustrated school as the accumulation of having "good days and bad days" and represented these discordant rhythms as weather/environmental patterns. According to our analysis of the drawing, most (90 percent) of the days felt like sunshine and clear skies, some like thunderstorms (9 percent), and a few (1 percent) somewhere in the middle. We note that, with regard to design, the hierarchies in the composition are more balanced than the numbers suggest. In fact, more circles (used to represent classmates) are situated on the left side with inclement weather and Starr herself (the fully drawn stick person) is standing in the middle. Starr's drawing does not attempt to portray physical or aesthetic school features. Instead, her illustration is more expressionist in nature—a representation of awareness of the variation in students' subjective experiences.

Relatedly, there were many instances where children drew social peer groups, each with their own rhythm and positioning within the school. An example of this is reflected in Mackenzie's map of daily outdoor recess time (Figure 10). Each pod illustrated represented a group with particular characteristics and behavioral tendencies. For example, the "fancy" group occupied the center of the drawing and accordingly, held an elevated status. Sometimes the groups interacted peacefully and other times contentiously (e.g., by being "bossy,"mean, or judgmental toward others). According to Mackenzie (although it is not obvious from the drawing), some MCS students traversed across social groups and occupied membership in both. Using design symbols, we emphasize the complexity of the relational dynamics outlined in the drawing, including the presence of social discord within the school community.

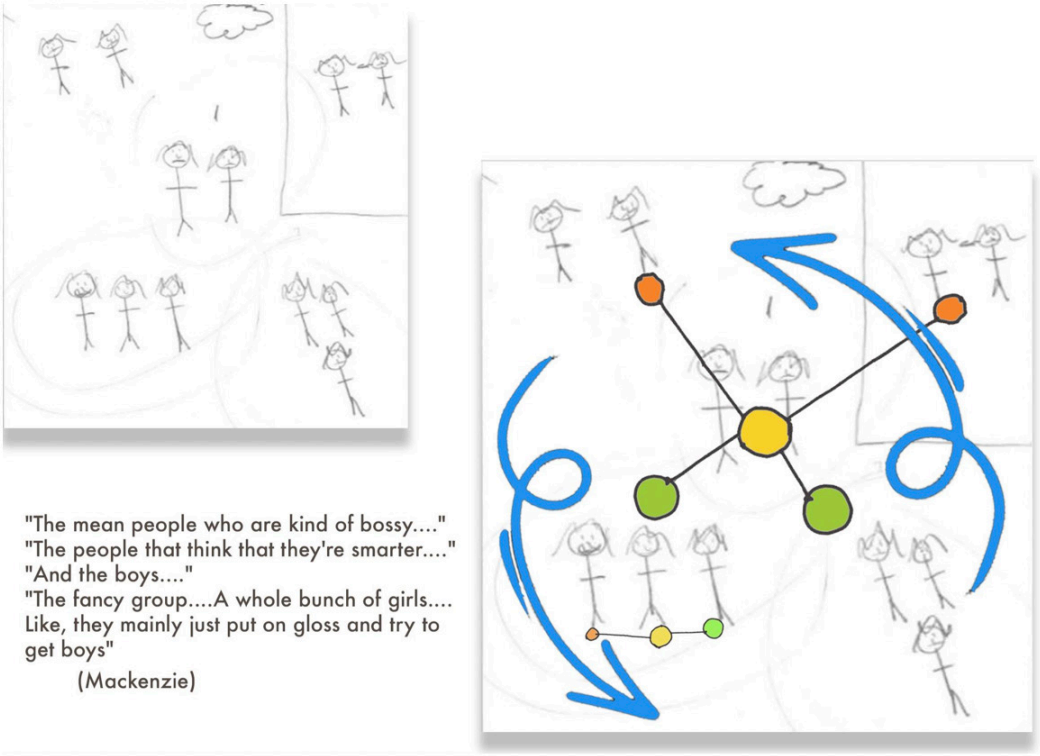


Figure 10. Social map during recess time

Our point here is not that these dynamics are unique to MCS (see, for example, Gholson & Martin, 2014). However, these examples indicate that even within the context of a school that prided itself on cultivating community, social discord and power asymmetries were still a salient aspect of children's everyday experience of "doing school." Finally, we offer Kam's illustration of multiple and conflicting activities occurring during class time (Figure 11).

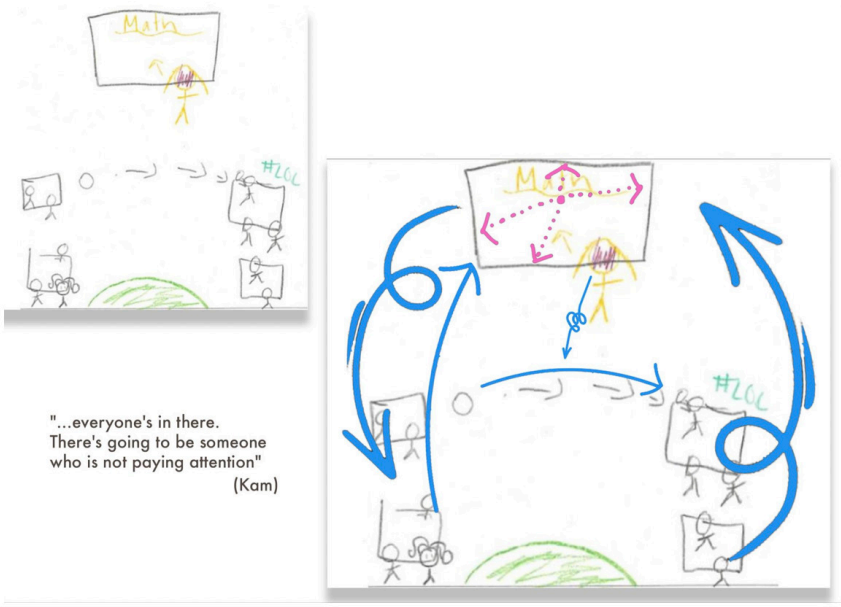


Figure 11. Conflicting activities during class time

Despite a clear understanding that the teacher and whiteboard should be a point of focus, Kam offered a bird's-eye view of both on-task and off-script behavior. As the teacher attempted to teach, much to her chagrin, a paper ball was being tossed across the room. This prompted laughter from some of the children in the classroom. We were struck by the composition, rhythms, and scale in this image. The inclusion of the board was a recognition of it as a symbol of the valued adult forms of learning, and yet the focus of the scene and bulk of the drawing was devoted to depicting the children and what they likely noticed as participants in the classroom environment. There was an obvious tension between the adult and student experience. The distorted facial expression of teacher was intended to convey adult frustration while students are laughing, indicated by "#LOL" in the drawing. Seen through this lens, navigating school is about much more than falling in line with adult expectations. MCS children were navigating a complex community where formal academic learning was not always the primary point of focus.

CONCLUDING THOUGHTS

Our goal in this paper was to explore an approach to seeing schools through the eyes of Black children. Rather than impose adult boundaries of childhood and children's worlds (Dumas & Nelson, 2016; Orellana, 1999), our intent was to center Black children's imaginings as key indices of a school's strengths and strivings. MCS, with its innovative design focus on community, socio-political learning, and youth agency, served as an ideal space to practice this experimental method of analysis. The beautiful illustrations created by students remind us that schools cannot be characterized by a single story. While school mission statements are typically succinct and declarative, children frequently remind us that pedagogical ambitions are just that—aspirations that adults design for and hope will come to fruition. Design intention may not always align with students' noticings or everyday subjective experience. Close engagement and kinship with children can create openings to dig deeper into the form and function of innovative schooling.

In the case of MCS, children's drawings helped us attune to their multi-level conceptions of what it meant to be in community with one another. From their visual maps, we learn that dynamic relationships and an awareness of the collective was what resonated with them about their school. They recognized the ways that actors may be differently positioned in the school environment. They saw connections between people, places, and simultaneous experiences. They understood what held value and for whom. There was a powerful duality reflected in their drawings where harmony/solidarity and discord/acts of resistance lived in the school environment together. As adults and researchers, we could see how children were already engaging in complex sensemaking and wayfinding. Their illustrations challenge flat, deficit constructions of Black childhood (Dumas & Nelson, 2016), melding artfulness and imagination with sharp insight.

As we look across the drawings from this project, we continue to wonder about how schools help children make sense of discord and oppression, even when it may come from within their community. MCS did a phenomenal job of explicitly teaching children about the role of civil disobedience/resistance in society as a valued practice. Perhaps children's drawings serve as a call to design for increased opportunities for children to describe and analyze the dynamics of their own community as they experience it, not as it is in an aspirational sense or as seen through the eyes of adults. School drawings might serve as resources for helping students make sense of higher order concepts (e.g., community, resistance, justice, agency) in the "here and now" and in deeply meaningful ways. Illustrations and multimodal feedback from children then become tools in assessing where design and intention may be falling short. They also serve as a window into what may be possible.

Principles from architecture and design helped us become more sensitized to the layers, hierarchies, and rhythms communicated through children's illustrations. This was a fruitful exploratory exercise that allowed us to engage directly with children's thinking. At the same time, our process raised questions for us about the politics and ethics of annotating, deconstructing, and/or reconstructing children's creations. In our efforts to elevate their voices and ideas, we worried that we might be distracting from the full impact of their compositions as finished works. We also do not mean to imply that their drawings hold value *because of* their alignment with architectural principles or adults' viewpoints. The tensions we were recognizing are not unique. Even in the field of architecture, scholars have noted that adults in general—politicians, planners, and city managers—often ignore children's perspectives and their contribution to the design process (Lozanovska & Xu, 2013). Or worse, adults filter and morph the perspectives of children as a means of legitimizing their own agendas (Yoon & Templeton, 2019).

We maintain that the goal of this exercise was to explore how adults might interpret and use children's illustrations as resources for understanding the "here and now" of a school community. It is also an exercise in lifting up children's renderings and seeing them as having the potential to revolutionize how we think about school design in general (Jobb, 2019), including giving attention to the shapes, patterns of movement, and relational practices that characterize Black children's experiences. As we continue with this thinking, we plan to revisit our drawing analysis key. We also hope to elicit feedback from children to determine how they interpret our analytical approach and what amendments they would suggest for the analysis moving forward. We invite other educators to facilitate similar drawing exercises with their students at various points throughout the academic year as a window into school design. After the illustrations are compiled, the content of the drawings (alongside children's explanations of them) can be shared and discussed with members of the school community. Our stance is that discussions should be accompanied with a concrete plan for intentional use of the feedback that children provide. This is one of many ways that adults demonstrate intellectual respect (Vossoughi et al., 2021) for children and the expertise they embody.

REFERENCES

Akom, A. A., Cammarota, J., & Ginwright, S. (2008). Youthtopias: Towards a new paradigm of critical youth studies. *Youth Media Reporter, 2(*4), 1–30.

Butler, O. E. (2001). *Parable of the talents: A novel.* Aspect Press.

Causey, A. (2017). *Drawn to see: Drawing as an ethnographic method.* University of Toronto Press.

Charitonidou, M. (2020). Simultaneously space and event: Bernard Tschumi's conception of architecture. *ARENA Journal of Architectural Research, 5*(1), 5. doi.org/10.5334/ajar.250

Ching, F. D. K. (2007). *Architecture: Form, space, & order.* John Wiley & Sons.

Costanza-Chock, S. (2020). *Design justice: Community-led practices to build the worlds we need.* MIT Press.

Davis, N. R. (2017). *Hope in those places of struggle: A critical exploration of Black students' agency in one place-based and one African-centered elementary schoo*l [Doctoral dissertation, University of Michigan-Ann Arbor]. ProQuest

Davis, N. R., & Neal-Jackson, A. (2022) *All or nothing:* Demystifying the "what," "when," and "how" of participant observation in school-based research with Black youth. In V. Vasudevan, N. Gross, P. Nagarajan, & K. Clonan-Roy (Eds.), *Care-based methodologies: Reimagining qualitative research with youth in US schools* (pp. 9–13). Bloomsbury Press

Davis, N. R., & Schaeffer, J. (2019). Troubling troubled waters in elementary science education: Politics, ethics & Black children's conceptions of water [justice] in the era of Flint. *Cognition and Instruction, 37*(3), 367–389.

Davis, N. R., Vossoughi, S., & Smith, J. F. (2020). Learning from below: A micro-ethnographic account of children's self-determination as sociopolitical and intellectual action. *Learning, Culture and Social Interaction, 24,* 100373.

Dumas, M. J., & Nelson, J. D. (2016). (Re) Imagining Black boyhood: Toward a critical framework for educational research. *Harvard Educational Review, 86*(1), 27-47.

Erickson, F., Bagrodia, R., Cook-Sather, A., Espinoza, M., Jurow, S., Shultz, J. J., Spencer, J., Boostrom, R., & Noguera, P. (2008). Students' experience of school curriculum: The everyday circumstances of granting and withholding assent to learn. In F. M. Connelly, H. F. He, & J. Phillion (Eds.), *The SAGE handbook of curriculum and instruction* (pp. 198–218). SAGE Publications.

Espinoza, M. L., & Vossoughi, S. (2014). Perceiving learning anew: Social interaction, dignity, and educational rights. *Harvard Educational Review, 84*(3), 285–313.

Gholson, M., & Martin, D. B. (2014). Smart girls, Black girls, mean girls, and bullies: At the intersection of identities and the mediating role of young girls' social network in mathematical communities of practice. *Journal of Education, 194*(1), 19-33.

Ginwright, S. A. (2004). *Black in school: Afrocentric reform, urban youth & the promise of hip-hop culture.* Teachers College Press.

Givens, J. R. (2021). *Fugitive pedagogy: Carter G. Woodson and the art of Black teaching.* Harvard University Press.

Grant, C. A., Woodson, A. N., & Dumas, M. J. (Eds.). (2020). *The future is Black: Afropessimism, fugitivity, and radical hope in education.* Routledge.

Grover, S. (2004). Why won't they listen to us? On giving power and voice to children participating in social research. *Childhood, 11*(1), 81–93.

Haymes, S. N. (1995). *Race, culture, and the city: A pedagogy for Black urban struggle.* SUNY Press.

Jobb, C. (2019). Power, space, and place in early childhood education. *Canadian Journal of Sociology, 44*(3), 211–232.

Kincheloe, J. L., & Pinar, W. (Eds.). (1991). Curriculum as social psychoanalysis: The significance of place. SUNY Press.

King, J. E. (Ed.). (2006). Black education: A transformative research and action agenda for the new century. Routledge.

Koh, S. S. (2010). *National identity and young children: A comparative study of 4th and 5th graders in Singapore and the United States* [Unpublished doctoral dissertation]. University of Michigan.

Lee, C. D. (2017). Forward: Critical learning opportunities for the learning sciences. In I. Esmonde & A. N. Booker (Eds.), *Power and privilege in the learning sciences* (pp. vii–xii). Routledge.

Lozanovska, M., & Xu, L. (2013). Children and university architecture students working together: A pedagogical model of children's participation in architectural design. *CoDesign, 9*(4), 209–229. dx.doi.org/10.1080/15710882.2012.693187

Maxwell, J. A., & Miller, B. A. (2008). Categorizing and connecting strategies in qualitative data analysis. In S. N. Hesse-Biber & P. Leavy (Eds.), *Handbook of emergent method*s (pp. 461–478). Guilford Press.

Mitchell, L. S. (1953). *Here and now story book.* E. P. Dutton & Company.

Mitchell, L. S. (1991). *Young geographers: How they explore the world and how they map the world* (4th ed.) Bank Street College of Education. (Original work published 1934)

Nxumalo, F. (2021). Disrupting anti-Blackness in early childhood qualitative inquiry: Thinking with Black refusal and Black futurity. *Qualitative Inquiry, 27*(10), 1191–1199.

Orellana, M. F. (1999). Space and place in an urban landscape: Learning from children's views of their social worlds. *Visual Studies, 14*(1), 73–89.

Proceedings of the Colored People's Convention of the State of South Carolina, held in Zion Church, Charleston, November, 1865. Together with the declaration of rights and wrongs; an address to the people; a petition to the legislature, and a memorial to Congress. (1865). omeka.coloredconventions.org/items/show/570

Ransom, K. C. (2017). A conceptual falsetto: Re-imagining Black childhood via one girl's exploration of Prince. *Journal of African American Studies, 21*(3), 461–499.

Rickford, R. (2016). *We are an African people: Independent education, Black power, and the radical imagination.* Oxford University Press.

Scheeren, O. (2015, September). *Why great architecture should tell a story* [Video]. TED Conferences www.ted.com/talks/ole_scheeren_why_great_architecture_should_tell_a_story

Tedla, E. (1995). *Sankofa: African thought and education.* Peter Lang.

Tejeda, C., Espinoza, M., & Gutierrez, K. (2003). Toward a decolonizing pedagogy: Social justice reconsidered. In P. P. Trifonas (Ed.), *Pedagogies of difference: Rethinking education for social change* (pp. 10–40). Routledge Falmer.

Vossoughi, S., Davis, N. R., Jackson, A., Echevarria, R., Muñoz, A., & Escudé, M. (2021). Beyond the binary of adult versus child centered learning: Pedagogies of joint activity in the context of making. *Cognition and Instruction, 39*(3), 211–241.

Vossoughi, S., Hooper, P. K., & Escudé, M. (2016). Making through the lens of culture and power: Toward transformative visions for educational equity. *Harvard Educational Review, 86*(2), 206–232.

Yoon, H. S., & Templeton, T. N. (2019). The practice of listening to children: The challenges of hearing children out in an adult-regulated world. *Harvard Educational Review, 89*(1), 55–173.

ABOUT THE AUTHORS

Natalie R. Davis is an assistant professor in elementary education and the Program in Creative & Innovative Education at Georgia State University. She is also a 2021-2023 NAEd/Spencer Postdoctoral Research Fellow. As an educational ethnographer and learning scientist, her scholarship focuses on children's socio-political development within the context of justice-oriented learning environments. Her work also considers if/how the study and enactment of political education shows regard for children as playful and imaginative. Prior to graduate school, Davis taught 3rd grade in an African-centered school.

Roni Barsoum is an architect, designer, visual, and performing artist. He is a College of Education and Human Development Dean's Research Doctoral Fellow studying his PhD in Early Childhood and Elementary Education at Georgia State University. As a Fulbright Scholar, he also received his master's degree in Creative & Innovative Education. His research focuses on designing creative and innovative learning spaces that foster joy and motivation for children. Barsoum has past experience as a certified trainer in the fields of hospitality industry and education. He also founded LifeUP Egypt, an arts and culture center specializing in creative arts training programs for children and families.

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

Emily Reigh, Meg Escudé, Michael Bakal, Edward Rivero, Xinyu Wei, Collette Roberto, Damaris Hernández, Amber Yada, Kris Gutiérrez, and Michelle Hoda Wilkerson

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 ocus 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 Latine[1] 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 o 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 o schooling in Oakland, and we advertised scholarships or youth afiliated with this group to attend ree o charge. However, or reasons that remain unclear to us, the recruitment efforts resulted in the enrollment of 12 fee-paying participants. Most lived in afluent suburbs o 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 sel-reflections o Emily and Meg, who were the workshop's two primary acilitators. 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 "racespace" 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 Solózano (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.

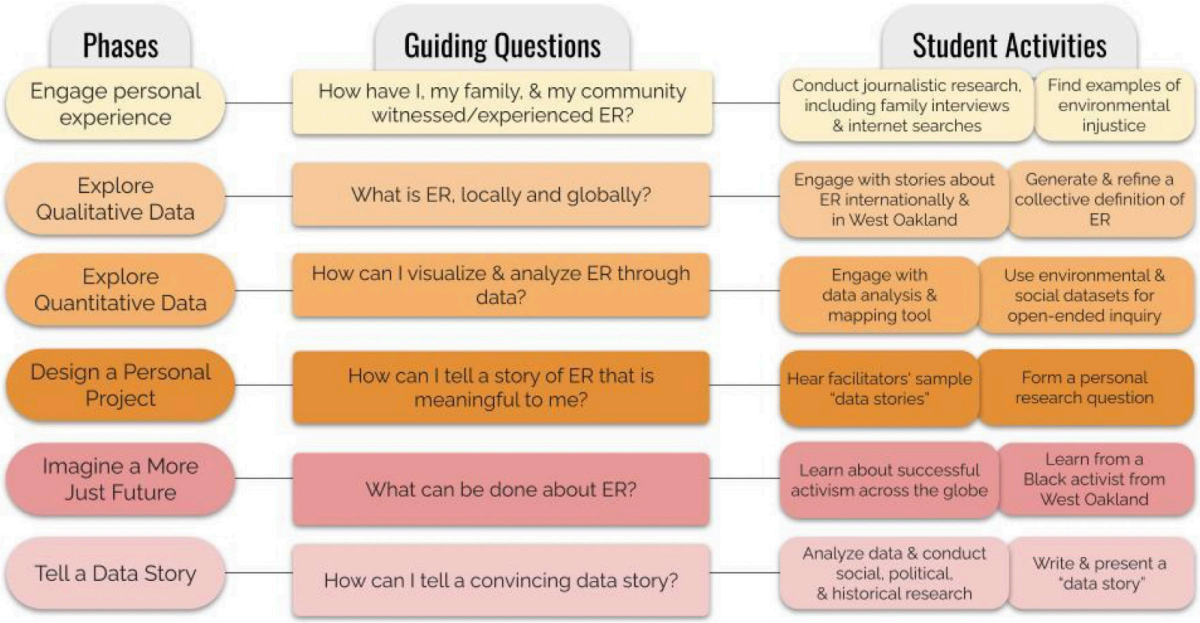


Figure 1. Curricular design

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.

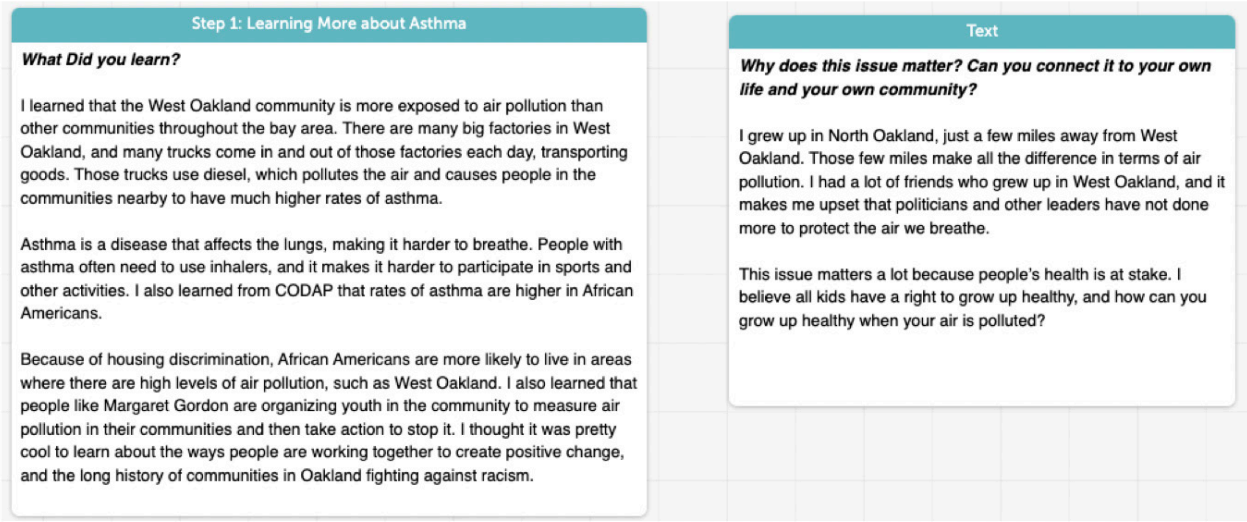


Figure 2. Model data story from a facilitator on asthma

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.

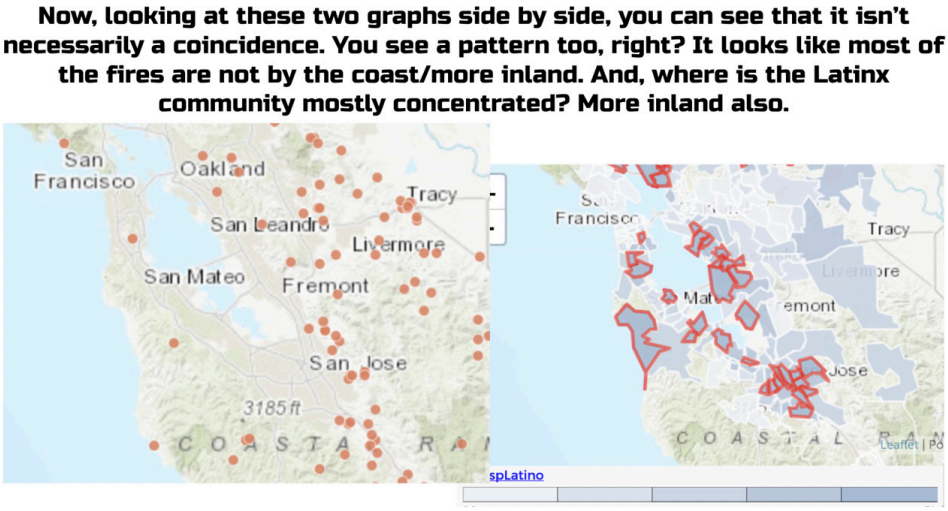


Figure 4. Maps in Nala's data story

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.

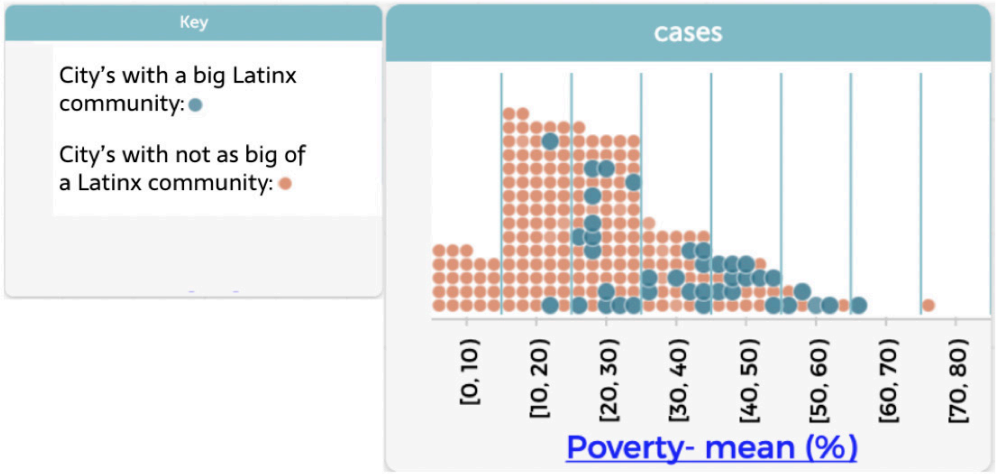


Figure 5. Graph in Nala's data story

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.

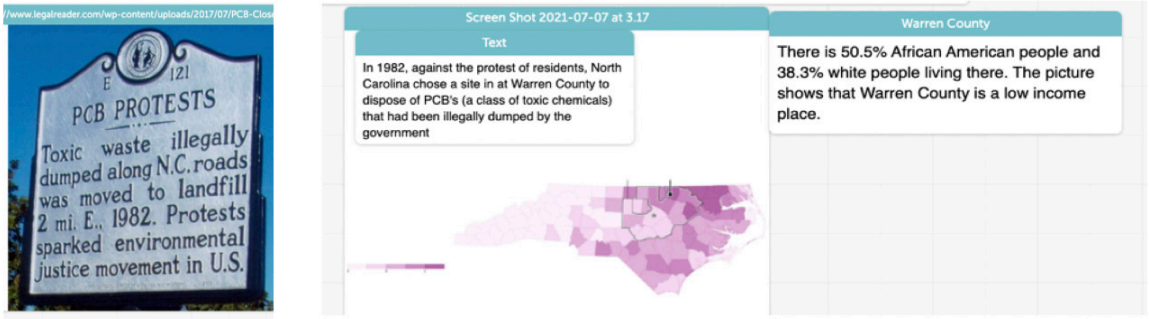


Figure 6. Pictures, explanations, and maps in Eva's data story

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.

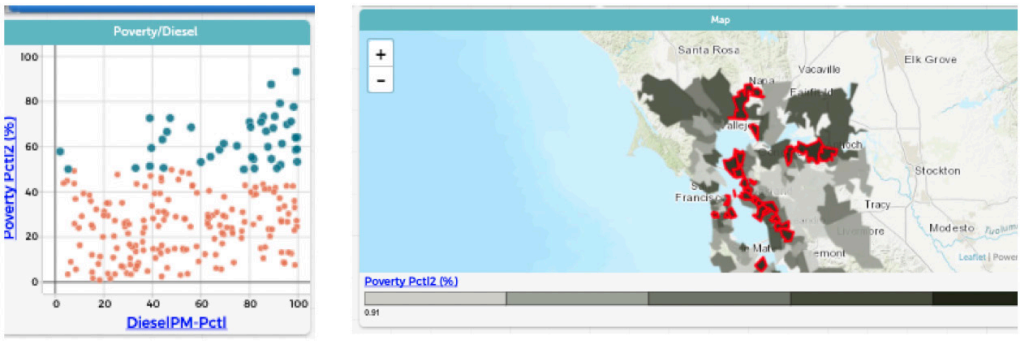


Figure 7. Plots and maps in Narun's data story

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.

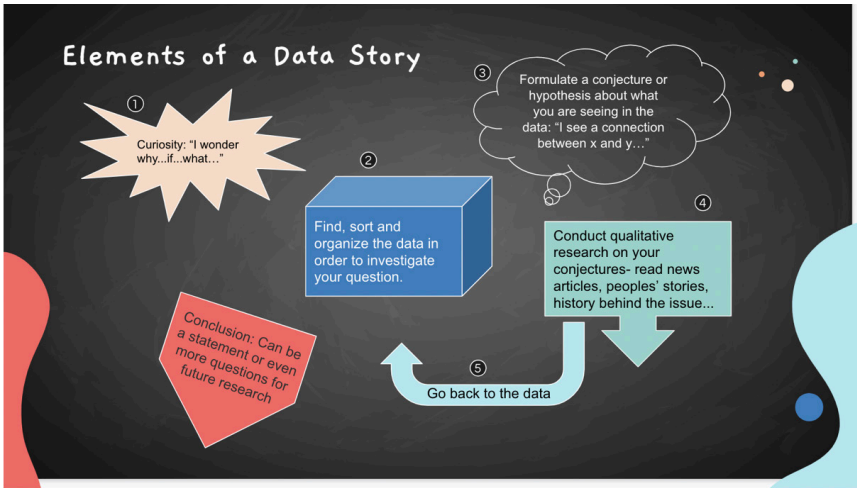


Figure 8. Model for developing a data story

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 *racespace* 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.

REFERENCES

Abbott, D. (2006). Disrupting the "whiteness" of fieldwork in geography. *Singapore Journal of Tropical Geography, 27*(3), 326-341.

Beyers, M., & Brown, J. (2008). *Life and death from unnatural causes: Health and social inequality in Alameda County.* Alameda County Public Health Department.

Cole, L. W., & Foster, S. R. (2001). *From the ground up: Environmental racism and the rise of the environmental justice movement*. NYU Press.

Du Bois, W. E. B. (1899). *The Philadelphia Negro: A social study.* University of Pennsylvania Press.

Gillborn, D., Warmington, P., & Demack, S. (2018). QuantCrit: Education, policy,'Big Data'and principles for a critical race theory of statistics. *Race Ethnicity and Education, 21*(2), 158-179.

Gonzalez, P. A., Minkler, M., Garcia, A. P., Gordon, M., Garzón, C., Palaniappan, M., & Beveridge, B. (2011). Community-based participatory research and policy advocacy to reduce diesel exposure in West Oakland, California. *American Journal of Public Health, 101*(S1), S166-S175.

Gutiérrez, K. D. (2014). Integrative research review: Syncretic approaches to literacy learning. *Leveraging horizontal knowledge and expertise. 63rd Literacy Research Association Yearbook, 48-61*.

Gutiérrez, K. D., Becker, B. L., Espinoza, M. L., Cortes, K. L., Cortez, A., Lizárraga, J. R., & Yin, P. (2019). Youth as historical actors in the production of possible futures. *Mind, Culture, and Activity, 26*(4), 291-308.

Hoops, J. F. (2020). Ethnographic mapping discourses of whiteness. *Communication Studies, 71*(1), 112-127.

Jones, S. T., & Melo, N. (2020). "Anti-blackness is no glitch": The need for critical conversations within computer science education. *XRDS: Crossroads, The ACM Magazine for Students, 27*(2), 42-46.

Kahn, J. (2020). Learning at the intersection of self and society: The family geobiography as a context for data science education. *Journal of the Learning Sciences, 29*(1), 57-80.

Ladson-Billings, G. (1998). Just what is critical race theory, and what's it doing in a nice field like education? *International Journal of Qualitative Studies in Education, 11*(1), 7-24. doi: 10.1080/095183998236863

Lee, C. H., & Soep, E. (2016). None but ourselves can free our minds: Critical computational literacy as a pedagogy of resistance. *Equity & Excellence in Education, 49*(4), 480-492.

Lee, V. R., Wilkerson, M. H., & Lanouette, K. (2021). A call for a humanistic stance toward K–12 data science education. *Educational Researcher, 50*(9), 664-672.

Lipsitz, G. (2007). The racialization of space and the spatialization of race: Theorizing the hidden architecture of landscape. *Landscape Journal, 26*(1), 10-23.

Martinez, A., & Broussard, W. (2018). Storytelling as #Resistance. *Diverse Issues in Higher Education, 35*(1), 32-32.

Murch, D. J. (2010). *Living for the city: Migration, education, and the rise of the Black Panther Party in Oakland, California*. University of North Carolina Press.

Neely, B., & Samura, M. (2011). Social geographies of race: Connecting race and space. *Ethnic and racial studies, 34*(11), 1933-1952.

Omi, M., & Winant, H. (2014). *Racial formation in the United States*. Routledge.

Philip, T. M., Olivares, M. C., & Rocha, J. (2016). Becoming racially literate about data and data-literate about race: Data visualizations in the classroom as a site of racial-ideological micro-contestations. *Cognition and Instruction, 34*(4), 361-388.

Philoxene, D. (2021). *"Can you feel me…" The sociospatial logics and ghost-map of Black and urban youth navigating urban violence*. [Unpublished doctoral dissertation]. University of California, Berkeley.

Pulido, L. (2015). Geographies of race and ethnicity: White supremacy vs white privilege in environmental racism research. *Progress in Human Geography, 39*(6), 809-817.

Solórzano, D. G., & Yosso, T. J. (2002). Critical race methodology: Counter-storytelling as an analytical framework for education research. *Qualitative Inquiry, 8*(1), 23-44.

Vélez, V. N., & Solórzano, D. G. (2018). Critical race cartographies: Exploring map-making as anti-racist praxis. In J. T. DeCuir-Gunby, T. K. Chapman, & P. A. Schutz (Eds.), *Understanding critical race research methods and methodologies* (pp. 150-165). Routledge.

Wilkerson, M., Finzer, W., Erickson, T., & Hernandez, D. (2021). Reflective data storytelling for youth: The CODAP Story Builder. *In Proceedings of the 20th ACM SIGCHI Interaction Design and Children Conference* (pp. 503-507).

ABOUT THE AUTHORS

Emily Reigh is a postdoctoral researcher on the Writing Data Stories project at the University of California, Berkeley and an instructor in the Berkeley Teacher Education Program. Her research focuses on designing science learning environments that engage and sustain the cultural and linguistic practices of students from minoritized communities. Before embarking on her graduate studies, she spent a decade teaching science in a public high school in Oklahoma and an international high school in Cairo, Egypt.

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.

Edward Rivero is a research associate at the John Gardner Center for Youth and Their Communities at Stanford University. Eddie's dissertation examined youth of Color's play as a critical site of inquiry for understanding how digital technologies can be leveraged to design for relational equity. As a postdoctoral fellow at the Learning Policy Institute, Eddie continued his studies on the role that relationships play in the learning and development of young people through his research on the Relationship-Centered School campaign in California. Eddie's research employs critical approaches to co-designing equitable learning ecologies with students, teachers, and community organizations.

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.

Kris Gutiérrez is associate dean of the School of Education and the Carol Liu Professor of Education at the University of California, Berkeley. She holds expertise in the learning sciences, literacy, educational policy, and qualitative and design-based approaches to inquiry. Gutiérrez's research employs a critical approach to the Learning Sciences and to Cultural Historical Activity Theory, examining the cultural dimensions of learning in designed learning environments with attention to students and families from non-dominant and translingual communities.

Michelle Hoda Wilkerson is an associate professor in the School of Education at the University of California, Berkeley. Her research focuses on the teaching and learning of computational literacies. This includes studying how youth learn about, use, and create computational artifacts including simulations, data visualizations, and other digital scienti ic media; and, exploring how teachers and students understand the role(s) these artifacts play in science, personal expression, and society.

Stories From Islita Libre: Digital Spatial Storytelling as an Expression of Transnational and Immigrant Identities

Jennifer Kahn, Daryl Axelrod, Matthew R. Deroo, and Svetlana Radojcic

> I learned some more about the demographics and origins of [my community] especially through story maps because I was experimenting with it … I'd say I got to know more about my community. (Miguel)
>
> On my drive to school, I opened my eyes a little bit more than I have before. I'm like, oh, I never noticed that before. I didn't see that before. (Jaylen)

These quotations are from high school students sharing their experiences in a semester-long storytelling project where transnational youth used digital media tools and practices to tell stories important to them and their communities. Leveraging interactive digital media is critical for compelling and impactful storytelling in the digital age. For transnational adolescent youth, who engage their lived experiences across two or more nation-states (Skerrett, 2015), digital storytelling (i.e., combining narrative with digital media, such as visuals, sounds, and videos to tell a story; Robin, 2008) creates opportunities to amplify their voices across global contexts and help maintain connections with friends, peers, and family members in other countries (Skerrett, 2015). Digital storytelling can transcend typical time and place boundaries that shape identities, relationships, and worldviews and strengthen connections to global culture and flows of information (Suarez-Orozco & Qin-Hillard, 2004).

In this essay, we (a team of university researchers) share our learning from the Stories from Islita Libre,[1] a project that provided a high school class of racially, ethnically, linguistically, and economically diverse first- and second-generation immigrant students access to digital tools to support digital, spatial storytelling around narratives of personal and community migration. Over four months, we led a series of instructional activities in an eleventh grade introduction to research course. Students learned about various qualitative and quantitative data sources for community-based inquiry, from demographic datasets to photographs, oral histories, and cultural artifacts, culminating in their creation of digital, layered map-based stories (subsequently called story maps) about their local communities. The project drew on digital spatial storytelling practices as methods for conducting community-based research and as means for youth to express their transnational identities.

We aimed to provide a creative space where transnational and immigrant youth could explore and express themselves. Like Mitchell's (1934/2010) view of children as real-time geographers who experientially learn through the exploration of their worlds (what she called the "here and now," p. 11, of children's environments), our project prompted students "to hunt for sources and study the relationships… [to] explore their environment… [to] analyze the culture of which they are a part, see what part of it is geographic, what part historic" (Mitchell, 1934/2010, p. 63). We prompted youth to actively examine their neighborhoods and to talk with family and community members to deepen their own understandings of migration and social relationships within their communities. We positioned

1 All school, place, and people names are self-selected or research team-designated pseudonyms.

youth as agentive and able to draw upon their existing creative digital practices (Ito et al., 2013) and introduced an array of digital tools and media for spatial storytelling. Finally, we hoped that our intervention would deepen students' existing cultural and linguistic knowledge and extend their complex spatial literacies, or their understandings and representations of spaces (Comber et al., 2006), to support greater community engagement and the sharing of stories to preserve culture and identity.

We examine the relationship between students' spatial literacies of their neighborhoods and their transnational identities in our designed learning activities, and how students used the digital spatial storytelling tools in our project for exploring and expressing that relationship and their voices more generally. We offer two illustrations that speak to how students' spatial literacies of the Islita Libre neighborhood, where the school is located, included their self-positioning within the *local* socio-political landscape, and how the signs and symbols they chose in their story maps reflected *broader* socio-political forces. We discuss the extent to which students explicitly attended to power relations and structures that produce inequity and conclude with questions to broaden and deepen transnational and immigrant adolescent youth engagement in digital spatial storytelling.

DIGITAL SPATIAL STORYTELLING ABOUT OUR COMMUNITIES

Multimodal composition is a common feature of youth culture within and beyond school due to the ubiquity of digital devices like cell phones and tablets (Smith et al., 2021). A series of studies in education research has shown how digital spatial storytelling with multimedia can create opportunities for disciplinary learning and personal inquiry as well as for leveraging and expanding student knowledge of local neighborhoods and cities (e.g., Gordon et al., 2006; Hall et al., 2020; Headrick Taylor, 2017; Kahn, 2020; Rubel et al., 2016). New technologies allow for layering of data or media, through geotagging or overlaying inscriptions on a digital map base, which affords the quick assembly and sharing of rich, multimodal stories. In one such study by Hall and colleagues (2020), a group of pre-service social studies teachers created *digital spatial storylines* to make tours that told historical stories of their city, using software to layer geotagged videos and pictures that could be accessed through a mobile device. Importantly, the assembly and consumption of digital artifacts provided learners with new opportunities for telling and learning different spatial stories.

This growing body of scholarship focusing on digital spatial storytelling speaks to youth creativity and interest in digital media more broadly (Ito et al., 2013; Lambert & Hessler, 2018). The composition and sharing of digital multimodal identity texts (Cummins et al., 2015)—texts that affirm self-identity, acknowledge social power dynamics, and influence literacy engagement—can promote academic literacy (Vu et al., 2019) and create opportunities for expressing youth voices and identities, particularly for multilingual and minoritized populations. Transnational youths' multiple literacies (New London Group, 1996) and language practices often reflect how mobility impacts their identities (de los Ríos, 2019; Deroo & Mohamud, 2022; Lam & Warriner, 2012; Skerrett, 2015). In our work, we take a transnational lens that challenges assumptions about the ways that nation-state boundaries constrain mobility and personal identity (Ali & Hartman, 2015; Thakurta, 2021).

Our project and its focus on digital spatial storytelling extends the work of studies that investigated the relationship between digital storytelling mediums and community inquiry generally (e.g., Ito et al., 2015; Jenkins et al., 2016; Mihailidis, 2014) as well as research examining transnational and immigrant youth multimodal storytelling more specifically (e.g., Honeyford, 2014; Kim, 2018; Nogueròn-Liu & Hogan, 2017; Vasudevan et al., 2010). This latter work collectively shows how multimodality better fits the

complexity of linguistic and cultural identities. In our study, students' final digital storytelling projects were multilayered story maps where youth could select and express, through multiple modes, their understandings of community-based cultural signs and symbols. We also applied a social-semiotic lens to better understand how sociocultural elements and power dynamics influenced meaning-making across the various modes of communication students used in their projects (Jewitt, 2016; Kress, 2009; Scollon, 1998). Together, these two perspectives (transnational and social semiotics lenses) shaped our project design and analysis of how multilingual, transnational, and immigrant youth utilized a suite of digital tools and practices to engage in multimodal, spatial storytelling about their families and local community.

THE STORIES FROM ISLITA LIBRE PROJECT

Stories from Islita Libre was a design-based research project (Cobb et al., 2003) that engaged transnational youth in learning about digital media for community-based inquiry and storytelling. The goal was to develop high-quality, innovative curriculum centered on spatial tools for inquiry with transnational and immigrant populations. From September to December 2021, we co-instructed an eleventh grade Advanced Placement research elective course at Global High School (GHS), a Title I charter high school that serves a multilingual, multicultural student population in the urban neighborhood of Islita Libre. GHS students live in Islita Libre and other neighborhoods across the city.

Our team, who works at the two major research universities in our city, is composed of two US-born scholars who identify as White, are bilingual, and hold transnational connections through time living overseas or through family members. Another team member is a US-born scholar who identifies as White and was a teacher at GHS from 2010-2017 before entering academia and building an ongoing research partnership, and the fourth member is an international bi/multilingual graduate student. A GHS faculty member we had worked with previously recommended Mr. Morales' class as an ideal setting for developing the curriculum for the study. Mr. Morales self-identifies as Cuban-Egyptian American.

GHS's administration, faculty, and students gave us a large degree of freedom to design curriculum and implement activities. This was due to several factors. First, our universities have positive relationships with the Islita Libre community. In addition, Mr. Morales highlighted to students and their parents that our collaboration was an opportunity to connect with university faculty, engage in college-level activities, and visit one of the universities. Students noted that the team's university affiliations played a significant role in gaining their and their parents' interest and trust because it reinforced students' college-going identities. All students in the class consented to the study. We led approximately 28 hours of instruction over 14 weeks to 30 students, all of whom self-identified as bi/multilingual and as an immigrant or the child of immigrants. Their classroom community included familial connections to 17 countries outside of the US and linguistic flows across seven languages, including 10 distinct Spanish dialects. While seven students identified themselves as solely American, none of the students identified their family country of origin as the United States.

DESIGNED ACTIVITIES

During the semester, we introduced various research methods involving a range of digital storytelling tools (Table 1) to give students opportunities to expand their notions of research and tell stories about their local or school communities. Each activity, lasting one or two class periods, was first modeled by the research team and then completed by students in self-selected small groups or individually in and outside of class. We also organized a field trip for students to a Cuban cultural heritage archive located at one of universities, where students explored primary source cultural artifacts from Islita Libre and participated in a digital mapping activity with historical artifacts (using the web-based application Historypin).

Research Method	Digital Storytelling Tool(s)	Learning Activity Description
Writing Fieldnotes	Livestream video of pedestrians and car traffic on Abbey Road in London, England	Students individually watched a livestream of Abbey Road and took ethnographic notes based on their observations and identified how their positionalities might impact what they observed.
Oral History Interviewing	Personal smartphones for audio and video recording of conversations with parents	Students recorded a 10-minute StoryCorps—style oral history with a family member (in any language) about their immigration experience. Students transcribed part of the interview and wrote a memo about the interview.
Large-Scale Data Comparisons	Social Explorer, a map-based data visualization tool for displaying open US census data and creating comparisons over time	Students constructed three data comparisons with accompanying story text that focused on the Islita Libre neighborhood.
Photovoice	Personal smartphones for taking pictures of their neighborhoods	Students took three to five pictures in the school or home neighborhood and wrote a narrative of how the pictures represented a social issue in the community they wanted to address.
Semiotic Analysis of Archival Materials	Google Docs for shared analysis and writing	Focusing on social semiotics, students in groups analyzed images and artifacts available through a university's Cuban heritage center's digital archives.
Transmediation (changing the form of media)	TikTok and Snapchat for creating still images and videos for the comic; Microsoft PowerPoint for constructing the comic	Students analyzed the poem "Yoke and Star" by Cuban poet and activist Jose Marti and transmediated the poem into a multimodal digital comic construction.
Primary Artifact Analysis	Historypin, a mapping tool in which users can freely "pin" or locate content (historical photos, videos, audio recordings and stories) with metadata (e.g., dates, descriptions) to an open Google Map base; Instagram and Twitter for taking pictures of artifacts and adding personal observations	Students visited the Cuban cultural heritage center to learn about archival research. They conducted analyses of primary source artifacts and posted those to a shared Historypin map and composed social media posts that incorporated the artifacts.
Story Mapping	Padlet, a virtual "bulletin board" that supports creating points (pins) with text, images, video, online links, or documents on a digital map-base	Students in groups assembled story maps for the Islita Libre neighborhood.

Table 1. Research methods taught to students

The final project began with student groups brainstorming, workshopping, and refining multimedia stories about the Islita Libre neighborhood in the form of a digital community map using Padlet, a free, web-based mapping software that enables users to embed media (uploaded or linked from online sources) to locations they pinpoint on the map. We prompted students to frame their story as addressing a research question and include at least three "data layers" drawing on the research methods introduced during the semester. The data layers students could use in their projects included: (a) audio recordings, such as from interviews with family or community members; (b) photos or (c) videos of city neighborhoods; (d) demographic data accessed via the software Social Explorer; and (e) historical artifacts from a university library archive we provided access to. (Figure 1 shows an example of students' selected data layers in their Padlet.)

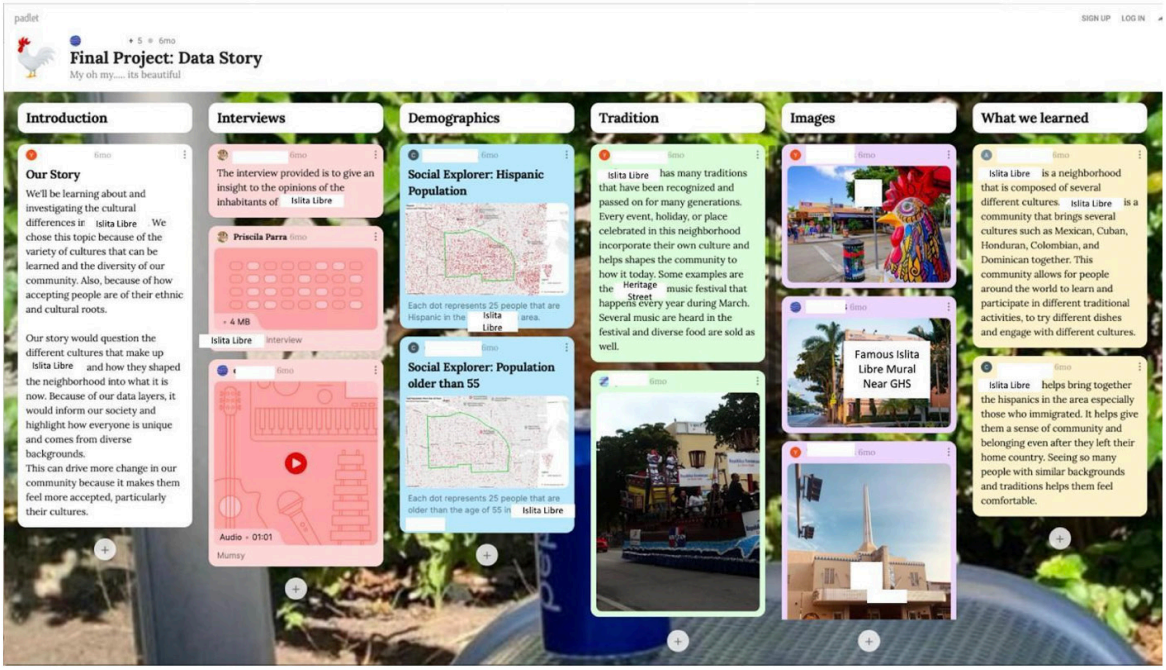


Figure 1. Example of data layers in Padlet

Note: Group 4 used a variety of data layers, including interviews, data maps, and photographs, assembled in Padlet, using the grid format

We provided students with a graphic organizer (Figure 2) to structure content and align their story goals with the perspectives they were highlighting, their choices of media and representations, and how the project could inform social change. This final aspect built upon our discussions of criticality at varying points across the project, which we defined for students as a perspective that considers power relations and human experiences. After completing the organizer, students constructed story maps using the digital mapping tool Padlet (Figure 3). In our final class meeting, groups gave 15-minute presentations of their projects, followed by a five-minute Q&A session with the class. (Table 2 describes the students' stories.)

What story about the Islita Libre neighborhood are you going to tell?	Whose perspective(s) will the story share?	What will be your 3 data layers? (audio or videos [e.g. interviews], demographic data, photos, historical artifacts, art, signs/ symbols)	Multimodality: Will you *transmediate* anything? If so, what and why those media?	Critical perspective: How could your story challenge and inform, inspire, and support political action or change?
The story about the Islita Libre neighborhood that we are going to tell is the Cuban influence. For example, the restaurants, small businesses, music, art, and street life.	With this story, we will be sharing our own group's perspective since we all come from different backgrounds in which we can share our own personal experiences with the influence of Cuban culture on Islita Libre. We have all lived in the city most of our lives and have been exposed to many cultural aspects regarding Cuba.	1. Photos/Videos 2. Art 3. Business research of Islita Libre	We can collage pictures and videos to exhibit Islita Libre. We can also research past videos made on Islita Libre and include it as well. These medias all demonstrate Cuban culture clearly as it allows us to visualize it.	Our story has a good chance of being informative to those who live or wish to live in Islita Libre since they see how you are influenced or the impact of living there. It can either inspire others to do so if they appreciate or like the influence and wish to experience it.

Figure 2. Group 2's graphic organizer for their Padlet story map project

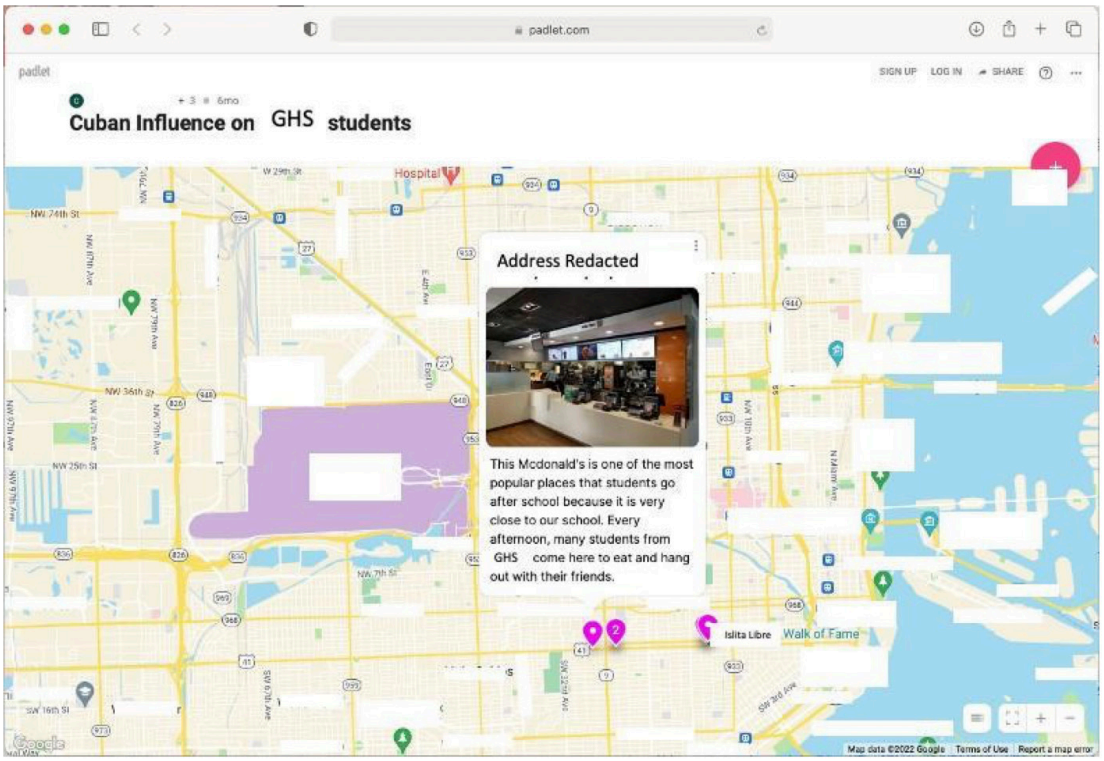


Figure 3. Group 2's Padlet story map with one datapoint highlighted

Note: The pink markers indicate locations the students pinned as important, such as the McDonald's highlighted in the figure

Group	Project Topic	Text Source
1	"How the Cuban influence on the community has attracted Uruguayan and other sub-Latino cultures [from the] perspective of Uruguayan immigrants to our neighborhood."	Graphic organizer
2	"The Cuban influence. For example, the restaurants, small businesses, music, art, and street life [from] our own group's perspective since we all come from different backgrounds in which we can share our own personal experiences with the influence of Cuban culture on Islita Libre."	Graphic organizer
3	"How the specific views GHS students have on the Islita Libre neighborhood, those being seeing the neighborhood as the center of Cuban culture in The City, differs from and/or impacts the general views of the Islita Libre neighborhood."	Graphic organizer
4	"The cultural differences in Islita Libre [from] the Latin-American perspective of our older community. We chose this topic because of the several cultures that can be learned and because of how diverse our community is."	Graphic organizer
5	"Comparing two popular tourist attractions, Heritage Street and Fame Coast, to see what makes Heritage Street unique [from the perspectives of] tourists and locals."	Presentation transcript

Table 2. Final project topics

During the project, we video recorded all classroom activities (14 days of instruction, each class was approximately 90 minutes), collected student work, and interviewed student groups at the end of the semester about their final projects as well as the teacher. Here we focused on video recordings of student group final presentations of story maps and the post-presentation Q&A sessions as well as their produced work for the assignment (e.g., presentation Padlets or slides, graphic organizers).

We present two narrative vignettes that illustrate two themes that emerged from our qualitative analysis that we think are useful for educators who want to design opportunities for transnational and immigrant youth to compose digital spatial stories. We draw from two groups' final project presentations and the subsequent conversations that took place as classmates responded to their peers. We chose these two groups because they consisted of students who live in the Islita Libre neighborhood (most of Group 1, all of Group 2) and because the class conversations that took place during their presentations explicitly referenced systems of power (i.e., race, economics), giving us an opportunity to examine how students situated their spatial literacies of their neighborhood and their transnational identities within varied socio-political landscapes.

TRANSNATIONAL IDENTITIES IN THE LOCAL SOCIO-POLITICAL LANDSCAPE

In Group 1's presentation, students revealed their recognition of power hierarchies within the broader Latin influence of migration in the city and operating in the local neighborhood, as well as their positions within those hierarchies. However, students did not explicitly examine these power dynamics in their constructed projects. Group 1 consisted of Emmy, Carlos, and Asta, who all identify as Cuban and Cuban-American; and Ignacio and Diego, who identify as Uruguayan and Uruguayan–Italian–

Armenian respectively. Their story map sought to explore the diversity of Latin cultures in the Islita Libre neighborhood by highlighting the nondominant Uruguayan cultural community in the neighborhood. They presented their Padlet, accompanied by text (Google) slides, with three data layers (Figure 4): a) family oral histories (as audio files) to give "a first [hand] account of what Uruguayans think and feel about the Cubans and interaction[s] with them;" b) a data map from Social Explorer to show "a demographic population;" and c) pictures of Uruguayan-owned businesses to show "Uruguayan food and culture here in Islita Libre."

What story about the Islita Libre neighborhood are you going to tell?	Whose perspective(s) will the story share?	What will be your 3 data layers? (audio or videos [e.g. interviews], demographic data, photos, historical artifacts, art, signs/ symbols)	Multimodality: Will you *transmediate* anything? If so, what and why those media?	Critical perspective: How could your story challenge and inform, inspire, and support political action or change?
The story we plan to tell is about how the Cuban influence on the community has attracted Uruguayan and other sub-Latino cultures.	The story will share the perspective of Uruguayan immigrants to our neighborhood,	1. Demographic data 2. Interview of that demographic 3. Uruguayan business	Mediating is sometimes a complicated thing to do, but like the TikTok we did it can turn into something really fun and enjoyable. So, we would transmediate into TikTok's or drawings because they're fun and we have people in the group that are capable of doing those things.	It could challenge and cause a change because if people see the importance and influence immigrants have put to production and employment in the US then there might not be so much discrimination and racism towards them.

Figure 4. Group 1's graphic organizer

Note: The red box shows the three data layers they planned to incorporate were demographic data, an interview with a member of that population, and a Uruguayan business

During the presentation, Carlos and Emmy showed two side-by-side population density maps in Social Explorer that displayed the Cuban and Uruguayan populations of Islita Libre. When a student asked the group to "explain the relation between Cuban people and people from Uruguay" Carlos responded:

Excerpt 1

Turn	Speaker	Transcription
1	Carlos	*[Shows Social Explorer on the board.] So here [points to a map of Islita Libre]* you see what is kinda like blank, that's cause there's no Uruguayans here *[points to the red dots on the Social Explorer map]* but on Heritage Street, like Islita Libre there's more dots that come up.
2	Emmy	Because Latinos attract Latinos.

Carlos points out how in Islita Libre, there are more Uruguayans (red dots) than in other parts of the city. Emmy suggests that the reason for this is that the existing Latin (Cuban) community in Islita Libre drew other Latin immigrants, like the Uruguayans. Her assertion was challenged in a student exchange during the Q&A (see Figure 5), when they discussed the majority-minority power hierarchies among immigrant populations within the Islita Libre neighborhood:

Excerpt 2

Turn	Speaker	Transcription
1	Lainez	Based on the map, how does it feel to be part of the majority as you see Cubans?
2	Carlos	What do you mean by that?
3	Emmy	*[Points at the map]* How does it feel that there's so many of us?
4	Carlos	Oh.
5	Emmy	Well, it feels nice.
6	Carlos	Yeah
7	Class	*[Laughter]*
8	Ignacio	It sounds, seems kinda racist, c'mon what do you mean by that? What do you mean by that? *[Carlos uses the touch screen Promethean board to slide the demographic data map interface back and forth, which changes the map display to reveal the larger Cuban presence in place of the smaller Uruguayan presence]*
9	Emmy	Because you go anywhere else and you don't see as many Cuban stores or restaurants—
10	Carlos	—*[Smiling]* You've got so many people to relate to [looks out at the class]
11	Emmy	Exactly. It's about the relation. It feels welcoming, comfortable.
12	Justin	What about them *[looks to Ignacio and Diego],* how does it feel to be a minority?
13	Ignacio	Feels kind of racist. *[Diego shakes his head and looks down. Carlos shakes his shoulders and head, smiles, and looks away. Emmy looks down and covers her face with her hand]*
14	Class	*[Laughter]*
15	Justin	*[Laughs and nods his head towards Ignacio]* You feel attacked.
16	Carlos	*[Speaking to Ignacio]* No, but you feel welcomed by the Latino culture. *[interweaves his fingers to indicate togetherness]*
17	Ignacio	Nah, I feel welcomed by you.

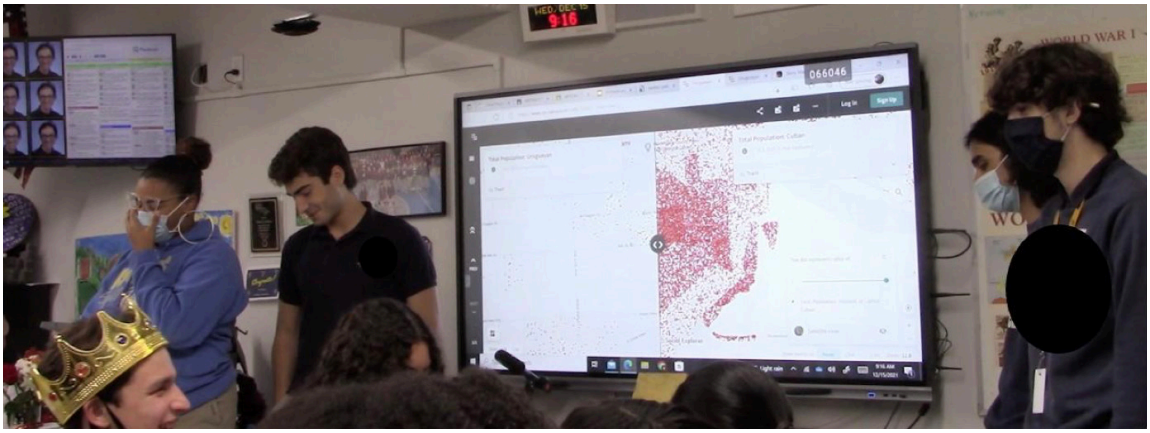


Figure 5. Reaction to Ignacio saying, "Feels Kinda Racist" during Group 1 presentation

Note: Members of Group 1 left to right are Abby, Carlos, Diego, and Ignacio. Justin from Group 5 is in the lower left corner. The social explorer map displays Islita Libre's Cuban population on the right and Uruguayan population on the left

In Excerpt 2, the notion of shared identity was complicated when a class member questions Emmy and Carlos's majority Cuban community perspective ("how does it feel to be part of the majority") and Ignacio and Diego's minority Uruguayan community perspective (Turn 12), a question anchored by their displayed Social Explorer data comparison. While Carlos and Emmy took the position that it was "nice," "welcoming, comfortable," (Turns 5 and 11), Ignacio countered that by calling those attitudes and statements racist (Turns 8 and 13). Carlos tried to salvage the notion of togetherness that Ignacio denied, but Ignacio continued to disagree (Turn 17), while at the same time nodding to their friendship as distinct from his statement of racism. Notably, these exchanges all had humorous overtones (e.g., students smiling, the class laughing) despite the confrontational undertones and content.

As in this vignette, students across groups offered contrasting perspectives of the local school community. On one hand, they presented a cohesive Latin community that was like "a big old family" and "home to everyone" (Group 1 presentation), in which Latinx immigrant attracted Latinx immigrants (Excerpt 1). On the other hand, student discourse and selections showed differences flowing from their varying national identities and Spanish as language(s) of power in the community and in the class. References to majority-minority membership and perceptions of racism suggests unequal power relations operating among local cultural populations in the community.

Students engaged in what Dervin (2016) calls *othering* forms of language (i.e., language that highlights inclusion and exclusion from cultural groups), such as when Emmy states, "How does it feel that there's so many of *us?"* and when Justin (also from a Cuban background), asks, "What about *them?"* These examples demonstrate that the students recognized themselves as belonging to varied national/ethnic/cultural groups within the community and saw the existing (perhaps unequal) relationships of power among those groups.

SIGNS AND SYMBOLS REFLECTING A BROADER SOCIO-POLITICAL LANDSCAPE

The signs and symbols youth chose in their final story maps expressed their transnational youth identities and spoke to a broader socio-political landscape shaping changes in the Islita Libre neighborhood. These socio-political forces include gentrification; the production and commodification of culture, in which culture is performed and (re)produced for economic development or consumption (e.g., heritage tourism and the de-valorization of some cultural minorities; Çağlar, 2021); and multinational corporations' inclusion in the community. Students' stories revealed tensions between places as representing a community's identity through cultural signs and symbols and their own understandings of what those signs and symbols mean in relation to their youth identities.

All five groups' story maps included performative, commodified cultural elements in the tourist district of the neighborhood as representing the authentic dominant cultural identity of the neighborhood. However, when groups composed of students from the GHS neighborhood deviated from this performative-culture-as-authenticity stance by adding additional places to the narrative, they were met with open resistance during the Q&A portion of the presentations.

These questions poked at the authenticity of the signs and symbols, typically in the form of places students included on their maps.

Group 2 was composed of six students—Alexis, Miguel, Isabella, Lya, Mateo, and Luna—all of whom identified as living in the GHS local neighborhood. Each member had a different family country of origin (Argentina, Venezuela, France, Colombia, Dominican Republic, and Cuba respectively). Their group

presentation highlighted a popular park, an ice cream parlor, a movie theater, and a "walk of fame" marking famous residents in the central tourist district of the neighborhood. They described these places as where "tourists and locals go." However, they also included a McDonald's on their map (Figure 3), located outside the tourist district, only a five-minute walk from GHS and was a place where they spent time after school to "experience Cuban culture" (Group 2 presentation transcript).

In the Q&A session following their presentation, members of Group 2 were tasked with defending their choice to include the McDonald's (Figure 6):

Excerpt 3

Turn	Speaker	Transcription
1	Maria	You mentioned McDonald's. What is the Cuban influence on that?
2	Luna	*[Laughs while covering her face with her hand]*
3	Isabella	So the influence there is that the employees there are actually mostly Hispanic, and when we ordered in Spanish, that's also Cuban and Hispanic influence. And mostly in our interactions with them, that's where we are influenced.
4	Maria	So you're saying that Cuban influence comes from the small interaction you get from ordering?
5	Isabella	*[Luna lowers her mask and is about to speak when Isabella begins to answer]* That's just a part of the Cuban diversity.
6	Class	*[Loud noises of disagreement and indecipherable talk]*
7	Luna	*[Hand gestures to speak]* Okay, okay, so you know how most of the workers at McDonald's are mainly Hispanic. I've noticed that most of them are Cuban. You know for a Cuban community in Islita Libre that don't have the ability to speak English that helps them out.
8	Justin	Where's the Dominican?
9	Maria	Cuba is not the only country that speaks Spanish, so how do you know?
10	Class	*[Loud noises of disagreement and indecipherable talk]*
11	Luna	Cause you can tell.
12	Mateo	You know by accent, you can tell where you're from.

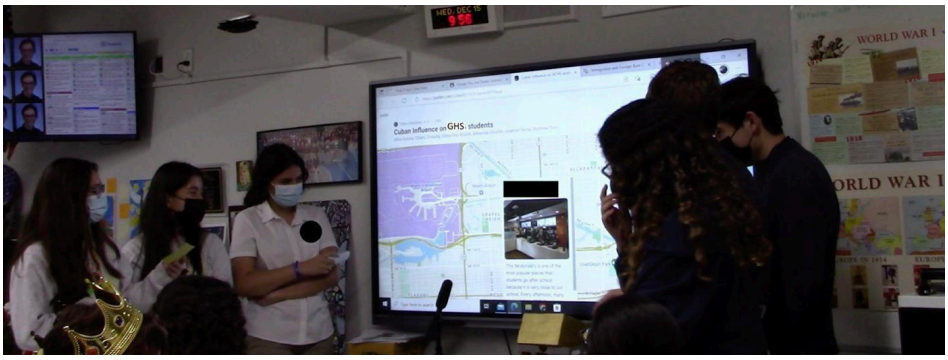


Figure 6. Defending use of McDonald's in their story map

Note: Group 2 is displaying their Padlet map with their preferred McDonald's location

Luna, when confronted about including McDonald's in their project, reacted by lowering her mask and interjecting that this McDonald's hires people from the community who might not be hired elsewhere because they do not speak English, which they know from her interactions at the McDonald's.

We chose this vignette to demonstrate students' expressed belief that lack of proficiency in English limits social mobility and opportunities for higher-paid jobs, which aligns with the dominant discourses present in today's US educational system. Their commending a company that hires non-English speaking immigrants to perform menial jobs and "helps them out," echoes the assimilationist narratives present in the current US political and educational landscape, where knowledge of English secures economic success and immigrants' native languages are regarded as having little value.

Luna and Mateo then draw from their own experiences in Islita Libre and their knowledge of linguistic variation through accented speech. Despite their initial defense of including McDonald's on their map, the class continued to critique them for it:

Excerpt 3 Continued

[Turns 13-17 transcript omitted]

Turn	Speaker	Transcription
18	Anabel	I don't understand the importance of McDonald's.
19	Isabella	It was just a part of our project because we go there often and since we have those interactions it's part of our project. We also included it because it's important to us, our group, we usually go there, but—
20	Justin	—A few blocks down from McDonald's there is a lot, I repeat a lot of Cuban restaurants including El Coche and Imperio. Why did you—
21	Class	*[Loud noises of disagreement and indecipherable talk]*
22	Justin	I'm not done, I'm not done—
23	Luna	—We're students on a budget.
24	Justin	[Increases his speaking volume] Okay, El Coche is cheap, Imperio is cheap.

Students again defended their choice to include McDonald's because it is a place that they visit regularly. When Justin confronts them over the inauthenticity of choosing a multinational corporation instead of a Cuban restaurant, Luna cites affordability as a consideration since "we're students on a budget." Justin suggests larger, waiter-serviced Cuban eateries that are affordable. However, they were still not viewed as affordable by Group 2.

These two vignettes illustrate how the students' transnational or immigrant, linguistic, and youth/student identities informed their digital spatial stories. The students' interactions and selections for their story maps also speak to the unique city and hyper-local context in which we did our fieldwork. Despite broader power dynamics in the United States privileging White, monolingual, and monocultural orientations, our city's multilingual, multicultural population and the Cuban-based heritage of Islita Libre shift and complicate cultural and linguistic power relations among students.

SENSE(S) OF PLACE IN LOCAL AND GLOBAL SOCIO-POLITICAL LANDSCAPES

Our project approached transnational youths' positionalities as boundary and border crossers (Skerrett, 2015) and asked them to draw on their lived experiences to highlight community issues. Students used digital multimedia to represent their identities as high school students, as local community

residents, and as immigrant and transnational youth. They particularly enjoyed reaching out to family members about their immigration experiences. As Lya put it, "most of us felt more connected to our family members… cause we learned about their history, their background" (group interview). However, explicit considerations of their engagement in transnational life worlds with families and communities across the globe had to be prompted by the instructional team. Perhaps because of the demographics of the neighborhood and city, for the youth in our project, holding a transnational identity was an unremarkable part of their experiences as they navigated their daily lives across homes, school, and community spaces.

Students' conversations suggested some socialized understandings of power hierarchies among various Latinx and immigrant populations in the city, in Islita Libre, and within the school. However, given that the whole class was bi/multilingual and from immigrant backgrounds, there was an opportunity for students to critically examine the assumptions they made (e.g., about being part of the majority, about accented speech). For example, while students' presentations and their classmates' critiques pointed to, explicitly and implicitly, socio-political power operating globally and in the GHS neighborhood, students did not reimagine the neighborhood to better achieve equity and social justice goals. Rather, students critiqued peers' choices of signs and symbols (e.g., the McDonald's) as representative of the local community.

In future work, making interrogations of systems of power a more explicit piece of the project's evaluation could motivate students to take up critical perspectives more seriously. In the case of McDonald's, this could have included a discussion of whether McDonald's counts as an authentic neighborhood restaurant or a corporate structure that diminishes differences among local cultures (for a discussion of "McDonaldisation," "Wal-Martisation," and "Disneyfication" processes, values, and impacts, see Matusitz & Palermo, 2014).

Conflicts arose for students between notions of culture that could be easily represented (and commercialized) and their more complex *senses of place* (Lim & Calabrese-Barton, 2006), as shaped by their transnational or immigrant, linguistic, and youth/student identities. Students situated themselves within the city's minority-majority demographic but recognized their distinct linguistic and cultural identities through references to countries of origin and variations in how they speak Spanish. This stood in contrast with many of the signs and symbols they selected in their story maps. Many of their choices expressed culture as performative, featuring food, flags, and festival-type representations that reflect superficial views of multicultural identifications (Banks, 1993).

The design of the final project artifact, including the technologies in use, and our decision to encourage students' social media storytelling *repertoires of practice* or cultural and linguistic ways of knowing, being, and learning (Córtez & Gutiérrez, 2019; Gutiérrez & Rogoff, 2003) may have supported choices of popular attractions or representations of community culture. At the same time, the technologies we used afforded multimedia layering of data on a map base and generated provocative questions and discussions. Furthermore, the encouragement to layer multimodal data deepened their understanding of what research is and how research can be used in service of community inquiry and storytelling.

While some students saw the complexity that these tools afforded as a challenge, most students appreciated the varied modes and viewpoints that could be explored. As Carlos said in Group 1's final presentation, "the multimodality, it just helps understand the data better, give like different perspectives and ways to visualize it." Similarly, Donald, a member of Group 3, said during his group interview that

"multimodal and research became just an overall thing that could be translated to different things like videos, media, photos, or even the same writing, but all of those come together just to make it a perfect kind of mix."

The vignettes we shared here demonstrate how multimedia digital storytelling can enhance research skills and build a bridge between school learning and students' families and communities. This is especially important for educators who seek ethical and equitable praxis and wish to recognize their students' varied funds of knowledge (González et al., 2005), which may be disregarded in today's classrooms. Digital spatial storytelling tools and practices are key for amplifying the voices of communities and populations that are not always heard, such as the transnational and immigrant youth in our project. Layering multimedia on a map-base to tell stories is an interdisciplinary spatial literacies practice that we hope educators will increasingly explore and incorporate into their curricula and learning designs. Access to digital spatial storytelling tools and practices can support college-seeking students' future aspirations by providing them with the tools, skills, and stances needed to engage in future research and extend their voices across social and professional networks about issues they care about.

We conclude by offering questions that we seek to answer as the next steps for our work and others in the field: How might educators support students to critically examine local and global socioeconomic issues from nuanced perspectives? How can teachers, typically a part of a monolingual, monocultural majority, have awareness of transnational youths' unique socio-spatial and linguistic repertoires of practice? Recognizing digital spatial storytelling as central to democratic participation and activism in global networks, how do we provide youth with greater access to digital spatial storytelling tools and practices? As local and global socio-political landscapes continue to shift, we ask educators to consider these questions and raise new ones to support continued community storytelling.

ACKNOWLEDGMENTS

This work was supported by the Andrew W. Mellon CREATE Grants Program. We also want to thank Ahmed Soliman, Martin Tsang, Amanda Moreno, and our local school partners for their support and contributions to this project.

REFERENCES

Ali, S., & Hartmann, D. (2015). *Migration, incorporation, and change in an interconnected world.* Routledge.

Banks, J. A. (1993). Multicultural education: Development, dimensions, and challenges. *The Phi Delta Kappan, 75*(1), 22-28.

Çağlar, A. (2021). Situating the "cultural reach" of cities in a multiscalar field. *International Journal of Politics, Culture, and Society, 34*(4), 437-453.

Cobb, P., Confrey, J., DiSessa, A., Lehrer, R., & Schauble, L. (2003). Design experiments in educational research. *Educational Researcher, 32*(1), 9-13.

Comber, B., Nixon, H., Ashmore, L., Loo, S., & Cook, J. (2006). Urban renewal from the inside out: Spatial and critical literacies in a low socioeconomic school community. *Mind, Culture, and Activity, 13*(3), 228-246.

Córtez, A., & Gutiérrez, K. D. (2019). Socio-spatial repertoires as tools for resistance and expansive literacies. In M. Pacheco, P. Zitlali Morales, & C. Hamilton (Eds.), *Transforming schooling for second language learners: Theoretical insights, policies, pedagogies, and practices* (pp. 123-142). Information Age Publishing, Inc.

Cummins, J., Hu, S., Markus, P., & Kristiina Montero, M. (2015). Identity texts and academic achievement: Connecting the dots in multilingual school contexts. *TESOL Quarterly, 49*(3), 555-581. doi:10.1002/tesq.241

de los Rios, C. V. (2019). "Los músicos": Mexican corridos, the aural border, and the evocative musical renderings of transnational youth. *Harvard Educational Review, 89*(2), 177-200.

Deroo, M.R., & Mohamud, I. (2022) "I would rather be informed than misinformed": Critical conversations supporting transnational identity across time and space. *English Teaching, Practice & Critique.*

Dervin, F. (2016). *Interculturality in education*. Palgrave Pivot.

González, N., Moll, L. C., & Amanti, C. (Eds.). (2005). *Funds of knowledge: Theorizing practices in households, communities, and classrooms*. Routledge.

Gordon, E., Elwood, S., & Mitchell, K. (2016). Critical spatial learning: Participatory mapping, spatial histories, and youth civic engagement. *Children's Geographies, 14*(5), 558-572.

Gutiérrez, K. D., & Rogoff, B. (2003). Cultural ways of learning: Individual traits or repertoires of practice. *Educational Researcher, 32*(5), 19-25.

Hall, R., Shapiro, B. R., Hostetler, A., Lubbock, H., Owens, D., Daw, C., & Fisher, D. (2020). Here-and-then: Learning by making places with digital spatial story lines. *Cognition and Instruction, 38*(3), 348-373.

Headrick Taylor, K. (2017). Learning along lines: Locative literacies for reading and writing the city. *Journal of the Learning Sciences, 26*(4), 533-574.

Honeyford, M. A. (2014). *From Aquí and Allá. Journal of Literacy Research, 46*(2), 194–233. doi.org/10.1177/1086296X14534180

Ito, M., Gutiérrez, K., Livingstone, S., Penuel, B., Rhodes, J., Salen, K.,...Watkins, S. C. (2013). *Connected learning: An agenda for research and design*. Digital Media and Learning Research Hub.

Ito, M., Soep, E., Kliger-Vilenchik, N., Shresthova, S., Gamber-Thompson, L., & Zimmerman, A. (2015). Learning connected civics: Narratives, practices, and infrastructures. *Curriculum Inquiry, 45*(1), 10–29. doi.org/10.1080/03626784.2014.995063

Jenkins, H., Shresthova, S., Gamber-Thompson, L., Kligler-Vilenchik, N., & Zimmerman, A. (2016). *By any media necessary: The new youth activism*. NYU Press.

Jewitt, C. (2016). Multimodal analysis. In A. Georgakopoulou & T. Spilioti (Eds.), *The Routledge handbook of language and digital communication* (pp. 69-84). Routledge.

Kahn, J. (2020). Learning at the intersection of self and society: The family geobiography as a context for data science education. *Journal of the Learning Sciences, 29*(1), 57-80.

Kim, S. (2018). "It was kind of a given that we were all multilingual": Transnational youth identity work in digital translanguaging. *Linguistics and Education, 43,* 39-52.

Kress, G. (2009). *Multimodality: A social semiotic approach to contemporary communication.* Routledge.

Lam, W. S. E., & Warriner, D. S. (2012). Transnationalism and literacy: Investigating the mobility of people, languages, texts, and practices in contexts of migration. *Reading Research Quarterly, 47*(2), 191-215.

Lambert, J., & Hessler, B. (2018). *Digital storytelling: Capturing lives, creating community* (5th ed.). Routledge. doi.org/10.4324/9781351266369

Lim, M., & Barton, A. C. (2006). Science learning and a sense of place in an urban middle school. *Cultural Studies of Science Education, 1*(1), 107-142.

Matusitz, J., & Palermo, L. (2014). The Disneyfication of the world: A grobalization perspective. *Journal of Organisational Transformation & Social Change, 11*(2), 91-107.

Mihailidis, P. (2014). *Media literacy and the emerging citizen: Youth engagement and participation in digital culture.* Peter Lang.

Mitchell, L. S. (1934/2010). Young geographers (1934). *Schools: Studies in Education, 7*(1), 56-63. doi.org/10.1086/651510

New London Group, (1996). A pedagogy of multiliteracies: Designing social futures. *Harvard Educational Review, 66*(1), 60-92.

Noguerón-Liu, S., & Hogan, J. (2017). Remembering Michoacán: Digital representations of the homeland by immigrant adults and adolescents. *Research in the Teaching of English, 51*(3), 267-289.

Robin, B. R. (2008). Digital storytelling: A powerful technology tool for the 21st century classroom. *Theory into practice, 47*(3), 220-228.

Rubel, L. H., Lim, V. Y., Hall-Wieckert, M., & Sullivan, M. (2016). Teaching mathematics for spatial justice: An investigation of the lottery. *Cognition and Instruction, 34*(1), 1-26.

Scollon. (1998). Reading as social interaction: The empirical grounding of reading. *Semiotica, 118*(3-4), 281-294. doi.org/10.1515/semi.1998.118.3-4.281

Skerrett. (2015). *Teaching transnational youth: Literacy and education in a changing world.* Teachers College Press.

Smith, B. E., Pacheco, M. B., & Khorosheva, M. (2021). Emergent bilingual students and digital multimodal composition: A systematic review of research in secondary classrooms. *Reading Research Quarterly, 56*(1), 33-52.

Suarez-Orozco, M., & Qin-Hillard, D. (2004). Introduction. In M. Suarez-Orozco & D. Qin-Hillard (Eds.), *Globalization: Culture and education in the new millennium* (pp. 1-33). University of California Press.

Thakurta, A. G. (2021). "The door was always there": Transnational youth leveraging their multiliteracies for civic justice. *Journal of Adolescent & Adult Literacy, 64*(6), 645-656.

Vasudevan, L., Schultz, K., & Bateman, J. (2010). Rethinking composing in a digital age: Authoring literate identities through multimodal storytelling. *Written Communication, 27*(4), 442–468. doi.org/10.1177/0741088310378217

Vu, V., Warschauer, M., & Yim, S. (2019). Digital storytelling: A district initiative for academic literacy improvement. *Journal of Adolescent & Adult Literacy, 63*(3), 257-267.

ABOUT THE AUTHORS

Jennifer Kahn, PhD, is an assistant professor of STEM education in the Department of Teaching and Learning and learning scientist at the University of Miami. Dr. Kahn studies how to broaden participation in interdisciplinary, technology-rich activities to support youth learning across community settings, from schools to libraries, museums, and cultural heritage archives. Her current research qualitatively explores how youth and families critically engage with large-scale data and data visualizations to connect personal, local experiences with global social-scientific issues.

Daryl Axelrod, PhD, received his PhD in education from the University of Miami in Coral Gables, FL and is currently a Research Assistant Professor in the FIU Embrace Center at Florida International University in Miami, FL. His collaborative learning with digital literacies research covers two primary areas of interest. One is emergent bi/multilingual students' multimodal composing practices, such as how adolescents use mobile devices to compose digital comics for literacy learning. He also examines youth and families' storytelling practices that incorporate data visualization tools, such as families telling migration stories while examining related census data maps.

Matthew R. Deroo is a former language teacher and teacher educator who spent 10 years in China before getting his PhD. He is an assistant professor at the University of Miami. His interdisciplinary research centers around three lines of inquiry: supporting immigrant youth from a translanguaging perspective, multimodal and semiotic theoretical framing in teacher learning, and community engaged scholarship. Dr. Deroo is a Mandarin speaker committed to supporting teachers and students to draw upon their full linguistic repertoires in support of their learning.

Svetlana Radojcic is a doctoral student in the Language and Literacy Learning in Multilingual Settings program at the University of Miami in Coral Gables, FL. Radojcic's research focuses on the use of multimodal literacies in TESOL classrooms for the purpose of teaching and learning English as a second language. She is also interested in examining how immigrant youth and adult ESL learners engage in digital literacy practices to express their linguistic and cultural identities.

Learning to See More Clearly: Extending Lucy Sprague Mitchell's Vision for Geography Teaching

Abigail Kerlin and Ellen McCrum

As former elementary school teachers, graduate level instructors, and researchers, we have engaged students of all ages in geography inquiry. In recent years, we have focused on developing mapping experiences that will both develop geographic thinking and shed light on the inner questions and experiences students have with their environments. These experiences can be quite revealing, offering insight into the surprising and varied geographic relationships that students pay attention to. In this paper, we share some of these experiences and ask you to consider what a more reflective engagement with maps can reveal about what students see and have yet to see in the world around them.

DEVELOPING AN UNDERSTANDING OF PERSPECTIVE: "DID WE ALL JUST TAKE THE SAME TRIP?"

We begin our graduate class on developing geographic thinking in a typical fashion: introductions, review of the syllabus, and initial conversations assessing students' experiences as both learners and teachers of geography. However, we are eager to get students involved. Before the first hour together is up, we inform the class that it is time to take a trip. We begin with succinct instructions:

> Make a map of the rectangular block, walk the rectangle from 112th Street to Broadway to 111th Street and then to Riverside Drive. Bring a pencil and clipboard. Take notes on a blank piece of paper. Walk around the block twice. Walk in silence during your first trip around the block. Use this time to engage your senses, using your eyes, ears, and nose.

No matter whether they are eight or 28, students appeal to us for clarification, asking, "How do you want it to look? What information should I include?" Some students leave for their trip slightly ill at ease, not sure how to meet the expectations of the task.

Our response is intentionally obtuse: "We want to see your map of the block, however you choose to represent it. Think of your trip as an opportunity for research.

As people trickle back into the classroom, there are fewer questions about doing it "right." Armed with their observations, there is a new eagerness to settle into their representations, and soon enough there is only the sound of scribbling.

Once finished, the group has a chance to walk around the classroom and see what their peers created. There are many commonalities: some have filled in the map with the names of businesses on Broadway; located our school, Bank Street, along 112th Street (Figure 1); and highlighted the curve of Riverside (Figure 2), a lovely deviation from New York's largely perpendicular, gridded streets. There is often an empty rectangle in the middle of their map. Details are included on the outer edge but the middle is an empty mystery.

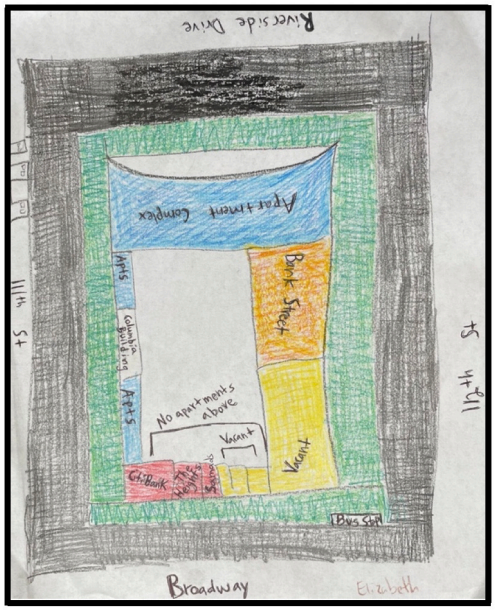


Figure 1

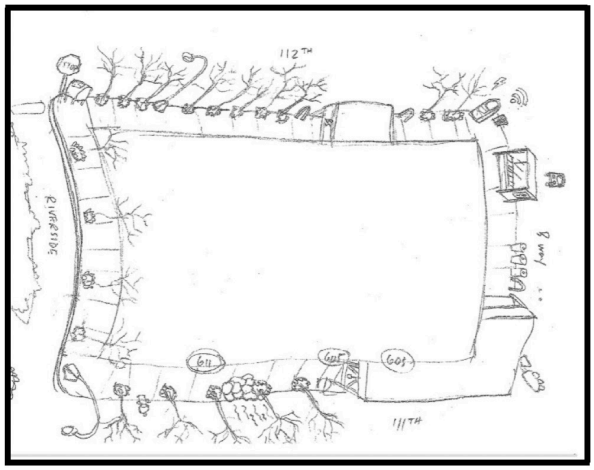


Figure 2

As the class takes in the variety of maps, it is clear that participants have very specific experiences of the block. Some mapmakers focused on the smells, making an odiferous statement by showing garbage piling up on Riverside.

Others captured the presence of people on the block and included snippets of conversation heard on Broadway, a contrast to the silence and lack of pedestrians on Riverside Drive. Climate and weather make an appearance, with the wind rushing up Riverside Drive, while 111th and 112th Streets remain protected and calm. A smaller handful filled in the mysterious middle of the block with buildings and green space they have observed from Bank Street windows.

The variety of maps raised an interesting question: We all just took the same trip, so why are our maps so different? For many of us, in-school mapping lessons focused on coloring regions and labeling landmarks, but fell short of offering insight into the people who made the maps we used. This conveyed the impression that maps were fixed tools with no particular voice or perspective. In our mapping classes, we encourage our students (young and not-so-young) to consider a new idea about geography: maps are stories with authors who come to a space with their own experiences, perspectives, and biases. While our students' feet covered the same ground, they did not all take the same trip.

Creating, sharing, and discussing the maps immediately highlights the variety of choices, but more importantly, presents the opportunity to develop the students' understanding of one another. The students soon realize that the pedagogical choice to keep the activity open-ended allows for each of them to bring their own perspective to their map. They learn that some peers commute long distances, drawing them to attend to parking rules, while others travel by subway. The choice to share the maps opens their eyes *both* to the physical and the human geography of the block, as well as to the experience and perspective of their peers.

Our work with graduate students parallels the work we do in elementary classrooms. While graduate students typically arrive more quickly at an understanding of how their perspectives shape their maps, the big ideas and the process are the same with young students. It is critical for teachers to have these experiences in order to construct ideas just as their students do. For many teachers, this is the first time

they have made and shared maps. The experience opens the door to an expanded definition of geographic thinking that will be incorporated into their work in classrooms. We see experiences like this one and others detailed in this paper as offering possibilities for the development of self-reflective insights and a curiosity about the geographic and social perspectives of others.

THEORETICAL GROUNDING

Lucy Sprague Mitchell, founder of Bank Street College, believed that young children naturally think in geographic terms. Mitchell viewed geography as any other scientific study, one based on observation and questions. To be a geographer, above all, is to ask how and why things are the way they are, an inclination that is hardwired into the minds of young children. In her seminal text from 1934, *Young Geographers: How They Explore the World and How They Map the World,* Mitchell pointed out that a laboratory approach to geography helps children make critical connections and allows them to see the effect of one fact upon another through a process of active inquiry. "Make Maps!" was Mitchell's rallying cry to teachers, recognizing that these experiences cultivate in young learners a practice of noticing, questioning, and seeking answers. It is a process that helps build a bridge between the child and the environment. In time, and with teachers providing the scaffolding, children begin to piece together the significance of these observations.

Nearly 100 years later, as Bank Street Graduate School instructors, we continue to use maps in this way and we strongly advocate for the practice. However, our decade of mapping experience with children and adults has helped us to see that the details each individual prioritizes often influence the way they perceive these relationships in the world around them. For example, we observed that how the students traveled to Bank Street impacted the details of their maps. A student who drove made a map of the block replete with parking information, while those who walked from the subway or from other places around the city, did not. Our modes of transportation influence the details in our environment that we attend to (Taylor, 2020) and therefore influence what we communicate to others in a map (Silvis et al., 2018). Indeed, mapping experiences help students to become keen observers and share their unique perspective. Mapping experiences also serve an additional purpose. They help students to understand that others may not see the world the same way they do. Maps can help us all to see one another more clearly.

Within the geographic domain of human-societal dynamics, a growing body of research has explored the ways we are conditioned to relate to the physical world around us. Just as our graduate students did not experience the block around Bank Street in the same way, research suggests that our experiences in space are subjective and informed by our lived experiences (Rediscovering Geography Committee & National Research Council, 1997). Current discourse on this topic has examined the importance of political and cultural factors, in particular. Overwhelmingly, this research indicates that the way we move through space is rooted in complex calculations about the way we feel and engage with the structures and relationships that inform our lives. Our perspectives emerge from myriad factors, such as our sensory preferences (Grahn & Stigsdotter, 2010), our disabilities (Jacobson ,2013) and our feelings of safety related to our race (Krivo et al, 2013; Day, 2006) or our gender (Day, 2001, Brownlow, 2005; Lampe et al., 2020)

New research suggests that our engagement with our local geography also impacts our health and sense of well-being. In a 2018 study, researchers at the University of Pennsylvania surveyed 342 participants living in communities adjacent to abandoned lots before and after these spaces underwent a clean-up initiative. After the greening of the vacant lots, researchers found that community member's self-reported feelings of depression and hopelessness decreased by 41.5 percent and poor mental health showed a

reduction of 62.8 percent. These remarkable mental health outcomes suggest a dramatic shift in the way some individuals in the community actually experienced the space around them (South et al., 2018).

Some research suggests that our relationship to the environment around us is also formed by what we perceive, based on our gender identification, for instance, rather than what we see. Two studies considered how one's gender can influence a person's relationship to their environment. In one study, researchers found that women's fear of male perpetrators in public spaces is so persistent that it "impacts their personal involvement in the public life of a city" (Tandogan & Ilhan, 2016). Regrettably, this outcome was remarkably similar to that of another study that asked men to share their experience of *being feared* in public spaces. This study concluded that men, particularly Black and Latino men, navigated spaces based on the level of fear they anticipate from others (Day, 2006). The reality is that men of Color are at considerably greater risk than women to be victims of violent crime in public spaces (Brownlow, 2005). Social scientist and geographer Doreen Massey writes of the "constitutive relationships between place and group" and the role that racial, gendered, and economic power structures play in defining our perceptions of space. These power dynamics, Massey suggests, "have created a geography of difference" (Christophers et. al., 2018).

Evolving technologies such as GPS tracking devices and wearable cameras have allowed researchers to observe mobility in real time. Data collected from this media has revealed the interactional structures (natural, human-made, historical, political) that inform the decisions that travelers make as they move through their environments. As a person's mobility changes (e.g., crawling to walking or walking to riding), so does their participation and interaction with the natural and human-made forces around them (Marin et al., 2020). New technologies have also provided reminders that mobility itself is shaped by inequitable legacies. Video and audio recording, GPS tracking, and interactive maps made by the African American teenage cyclist in one study provided researchers with insight into participants' feelings of safety and accessibility. Through counter-mapping experiences, the teenage cyclists were empowered to use the data they collected to develop urban planning solutions, including new forms of mobility (Taylor & Hall, 2013).

Why is this framing on space and place important for teachers and children? We believe that teachers can make use of the findings from this compelling research to highlight the myriad factors influencing our geographic perspectives. When children and adults have opportunities to map their world and reflect on the maps of their peers with the scaffolding of a thoughtful instructor, they can begin to explore deeper feelings about the world around them. Mapping experiences help students to ask:

- How do I perceive the world?
- What facts and details do I observe or prioritize?
- What forces, factors, and biases inform these observations?
- What can I learn by hearing about the unique geographic perspectives of my peers?

As students practice perspective-taking through mapping experiences, they also investigate the potential aims and motivations of other mapmakers. They begin to ask:

- What is included or not included in a map?
- What story is this map trying to tell?
- Who is centered in this story?

PEDAGOGICAL TOOLS

Lucy Sprague Mitchell ends *Young Geographers* with a plea for educators to make maps. Maps are not only a powerful tool for investigating relationships, they are also a gathering of our observations and perceptions of the environment. We agree that making maps is a critical piece in supporting the development of geographic thinking and that this work can be deepened even further. As students engage in geographic inquiry, teachers can think about three different ways of engaging with maps that move children from self-reflection to empathy and then to analysis: making maps, sharing maps, and juxtaposing maps.

MAKING PERSONAL MAPS: "WHAT DO YOU SEE?"

From the beginning, children are intrepid explorers of their environments, and typically their world grows and grows, expanding out from home to school, their neighborhood, and beyond. Kids develop their abilities to orient themselves, locate themselves in space, and use maps to represent relationships between places. By starting with their own perspective of familiar environments, very young children are able to capture and document their experience of the world in map form in ways that are unique and revealing.

Figure 3

By kindergarten, students are able to explain where they live and articulate where this is in relation to other places. We had some kindergarteners map a very familiar journey: the trip from home to school. Here is an example of a five-year-old describing his perspective of his route, shown on a map he has made (Figure 3). He represents these two critical landmarks in his life and discusses the different paths between them.

Interviewer: Alright, can you tell me about your map?
Child: Yes.
Interviewer: Tell me about how you get to school.
Child: So, I made it like this because, since I'm up here, there's different ways I can get to school.
Interviewer: When you say, "I'm up here" does that mean you live up on a hill? You live on an up-hill?
Child: Yeah, I live right at this [marks an x by his home].
Interviewer: And you have to walk down a hill to get to school?
Child: Yeah. This is my house right here.
Interviewer: Okay.
Child: If I go across, I can go down. I could go here, I have to turn, that's how I made my map.
Interviewer: Okay. So is this line showing that you walk downhill?
Child: Yes.
Interviewer: And then you have to turn to actually get to your school.

Making personal maps allows children to develop their abilities to orient themselves in space and, in this case, to localize or indicate where two places are in relation to one another. These are critical steps in developing the ability to understand your own perspective and represent it symbolically.

While this child lives on a hill and travels a short distance to school, another child in his class might have a different map that includes a walk up the hill, public transportation, or a stop along the way to drop off a sibling. The mapping stories give teachers insight into each of their student's perspectives and offer young mapmakers an opportunity to articulate their own way of seeing.

SHARING MAPS: "WHAT DOES YOUR NEIGHBOR NOTICE?"

When asked to map a familiar route from the school lobby to the cafeteria, William, a fifth-grade student at PS 130 in Brooklyn carefully illustrated the switchback of stairs (Figure 4). William made sure to draw attention to the flow of traffic by labeling his route down the staircases. Another student, Alima, showed the precise location of the elevator (Figure 5), a tool essential for her to use with her wheelchair, but not used, and thus not included, on the other student's map. Both representations did a wonderful job of highlighting the students' spatial reasoning abilities. Perhaps more significantly, they told us something about the perspective that each child brought to their geographic representations.

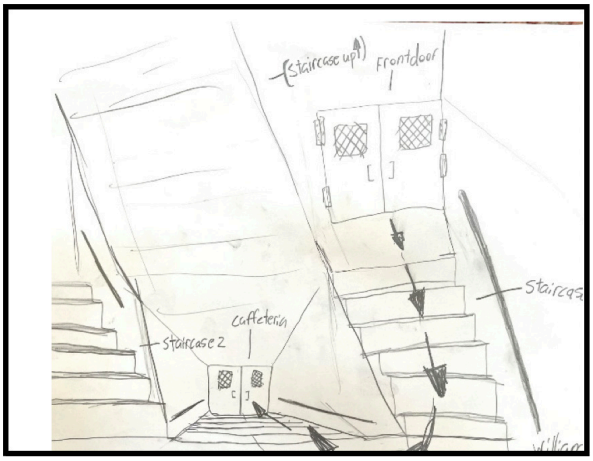


Figure 4

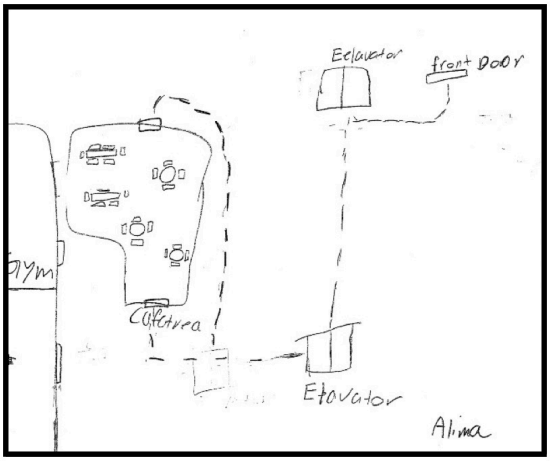


Figure 5

As they shared their maps, the students began to see their familiar shared space in a new way, from another's perspective. When asked about the experience of sharing their maps, Alima and William both spoke of the importance of seeing and being seen. Alima said, "The other kids didn't really take the elevator. I was unsure at first because I felt like they wouldn't understand my map. It was the way that I went, so that's what I showed in my map. I was glad I shared it."

William added, "I liked seeing all the different things that people included in their maps. I liked Alima's map especially, compared to the others that had the same-ish routes. I saw Alima go in the elevator [to the cafeteria], but I didn't think about her trip so much until her map made me think about it." The children's willingness to share their maps broadened their understanding of one another.

JUXTAPOSING MAPS: "WHOSE PERSPECTIVE IS THIS?"

Maps are not neutral, although they feel like fact-based representations of reality. While students can recognize that their perspective differs from a classmate's, we want them to see the same issues at play with all maps.

Over time, students come to understand maps in multiple ways. Among other things, maps can be seen as utilitarian objects that can guide you in different ways from one place to another, or as a snapshot of land that is dynamic, even though a map seems to have frozen it in time. Giving students the opportunity to juxtapose maps can expand their understanding of maps as stories. They come to see that maps give readers selective pieces of information. For example, topographic maps provide information about the shape of the land, while political maps highlight borders. Juxtaposing these two types of maps raises many interesting questions for students and supports them in making connections, such as noticing how a border aligns with a mountain range.

The pedagogical tool of juxtaposition is a powerful one for identifying similarities and differences and generating questions about those observations. When juxtaposing maps, we are looking for students to notice and begin to interrogate specific relationships between the maps. The teacher's work is to find the right maps to put next to each other.

The relationships between the maps could be between the physical and the political, as described above, but the maps could also be from different perspectives. We begin to engage with the perspective of mapmakers by starting with ourselves and our personal stories. Over time, we expand our perspective and branch out: exploring our neighborhoods and cities, then the wider world, in its current state and in the past. We want students to become critical observers of maps, asking, "Whose perspective is this?" Putting maps alongside each other draws attention to the fact they were created from different perspectives.

Maps have long been used to push a specific perspective. For example, they have been used by countries to claim territory that is in dispute or as propaganda to generate public support. This practice continues today (Carnegie Ethics Online, 2018). We wanted to explore this idea with fifth-grade students, using the juxtaposition of maps as our pedagogical strategy. Fifth-graders are ready to explore history in geography, something that is very apparent in maps over time. They are also curious about current events and are often not provided with the opportunity to contextualize these events in geographic terms. They are developmentally ready to engage with the idea that maps are stories that have authors and biases.

Gathering small groups of fifth-grade students both in and out of school settings, we presented maps that represented three different perspectives on the annexation of Crimea in 2014. Our role as teachers was minimal beyond the choice of maps. We entered these conversations with the faith that children would bring their observational abilities and curiosity to the task—trusting that our choice of maps would drive the conversation. We chose maps that minimize distraction, and often cropped out some information to allow specific relationships to emerge. Typically, because we had carefully chosen our maps, our prompts focused on noticing and wondering.

We presented the first map of Ukraine (Figure 6) and asked students what they noticed. The following is an amalgam of observations from the fifth-graders:

Figure 6

"We're in Ukraine. A bunch of different places in Ukraine."

"It shows the rivers, I think. And places around it like Russia, Poland…"

"What's the capital? Kyiv. The star."

Next to the first map we placed a second map of Ukraine (Figure 7), including Crimea as part of Russia. We asked, "What changed?"

Figure 7

The different groups had interesting observations. A summary of the responses demonstrates their observations of similarities and differences:

"This shows Ukraine in both maps."

"Here [pointing to the first map] it looks like Crimea is part of Ukraine. and here it looks like it's part of Russia. You can tell because of the color."

The last map (Figure 8) we introduced showed the area of Crimea represented in two colors. Again, we asked the students what they noticed as they looked across all three maps. The groups responded:

Figure 8

"This one says Crimea is both Russia and Ukraine's territory, which makes no sense!"

We followed up with, "Why doesn't it make sense?"

"It doesn't 'cause whose laws would they follow? Crimea is in between, there's orange and green, so it might be like… a mix. Pending maybe, like not sure which it's from. It's striped and it doesn't have a straight color. They are probably at war. War between Crimea and Russia. Russia wants that land."

One student decided to sequence the maps: "It looks like this is when it's part of Ukraine, this is when they're fighting, and this is at the end, it's part of Russia. It would be in this order."

We noted that students were beginning to move the maps as if to put them in chronological order. We told them that all of the maps were currently being used, so who did they think made each map?

They responded: "Russia made this [pointing at the second map], Ukraine made this [pointing at the first map], and some other country made this [pointing at the third]."

The juxtaposition and our line of questioning allowed the students to identify the different perspectives of the mapmakers and the different narratives. With multiple experiences, juxtaposition develops what we actually see. Two students' abilities to approach any map (current or historical) with a critical lens, consistently speculating about the perspective of its creator and how this perspective impacted their representation.

SEEING OUR WORLD MORE CLEARLY

If we simply see maps as static tools for navigation or blank pages to passively color and label, we miss important opportunities to deepen students' geographic thinking. We miss opportunities for them to consider the dynamic choices that inform the maps they read.

People often ask why we use such basic materials when easily accessible, computer-based mapping tools abound. The answer is that in our age of smartphones, we use maps often, but we do not actively engage with path-finding; we follow a route dictated to us. We find that when students come to a mapmaking

task using the most basic materials, we get more insight into what they see in the world around them, and their geographic voice emerges. They have to make more decisions—about such things as color, landmarks, scale, distance, and details to include or leave out.

Shifting our use of maps provides opportunities to raise students' awareness about the choices that they make as they move through the world. Finally, and perhaps most importantly, during these polarizing times, we can provide opportunities for students to consider other ways of seeing and being. William came to understand that his way of traveling to the cafeteria may have been more common, but it was not the only way. Alima's decision to share her map made space for her perspective to take center stage.

While there are many ways to use technology to engage with maps, we believe this process, which requires modest tools (paper, pencil, and clipboard), capitalizes on children's engagement with their lived environments. It is a process that can, and should, be used with students of all ages. Making, sharing, and juxtaposing maps appears to be a simple practice, yet with the support of a thoughtful teacher, these moves can help students develop understandings of how they, their peers, and other mapmakers experience space and why it matters. Nearly 100 years later, we repeat Lucy Sprague Mitchell's call to "Make Maps!" This time, we say it with an eye toward their potential for helping us to see our world *and* see one another more clearly.

ACKNOWLEDGMENTS

Student maps contributed by:

Elizabeth Schneider
Ian Dudley
Max Lieber
Alima Bangura
William Teplin

REFERENCES

Brownlow, A. (2005). A geography of men's fear. *Geoforum, 36*(5), 581-592. doi.org/10.1016/j.geoforum.2004.11.005

Carnegie Ethics Online. (2018, July 11). *Politics and cartography: The power of deception through distortion*. Carnegie Council for Ethics in International Affairs. (n.d.). www.carnegiecouncil.org/media/series/ethics-online/politics-and-cartography-the-power-of-deception-through-distortion

Christophers, B., Lave, R., Peck, J., & Werner, M. (2018). *The Doreen Massey Reader.* Agenda Publishing.

Day, K. (2001). Constructing masculinity and women's fear in public space in Irvine, California. *Gender, Place & Culture, 8*(2), 109–127. doi.org/10.1080/09663690120050742

Day, K. (2006). Being feared: Masculinity and race in public space. *Environment and Planning A: Economy and Space, 38*(3), 569-586. doi.org/10.1068/a37221

Encyclopædia Britannica, inc. (n.d.). *Ukraine: Facts & stats*. Encyclopædia Britannica. Retrieved September 5, 2022, from www.britannica.com/facts/Ukraine

Grahn, P., & Stigsdotter, U. K. (2010). The relation between perceived sensory dimensions of urban green space and stress restoration. *Landscape and Urban Planning, 94*(3-4), 264-275. doi.org/10.1016/j.landurbplan.2009.10.012

Jacobson, D. (2013). Geography of disability. *Oxford Bibliographies Online Datasets*. doi.org/10.1093/obo/9780199874002-0064

Karklis, L., & Mellen, R. (2022). *Four maps that explain the Russia-Ukraine conflict.* The Washington Post. February 26. www.washingtonpost.com/world/2022/01/21/ukraine-russia-explain-maps/

Krivo, L. J., Washington, H. M., Peterson, R. D., Browning, C. R., Calder, C. A., & Kwan, M. P. (2013). Social isolation of disadvantage and advantage: The reproduction of inequality in urban space. *Social Forces, 92*(1), 141–164. doi.org/10.1093/sf/sot043

Lampe, T. M., Reisner, S. L., Schrimshaw, E. W., Radix, A., Mallick, R., Harry-Hernandez, S., Dubin, S., Khan, A., & Duncan, D. T. (2020). Navigating stigma in neighborhoods and public spaces among transgender and nonbinary adults in New York City. *Stigma and Health, 5*(4), 477-487. doi.org/10.1037/sah0000219

Marin, A., Taylor, K., Shapiro, B., & Hall, R. (2020). Why learning on the move: Intersecting research pathways for mobility, learning and teaching. *Cognition and Instruction, 38,* 1-16.

Mitchell, L. S. (2001). *Young geographers: How they explore the world and how they map the world.* Bank Street College of Education.

Rediscovering Geography Committee, & National Research Council. (1997). *Rediscovering geography: New relevance for science and society.* National Academies Press.

Sandiredpath. (2022, January 26). *Statement on the Ukraine: Rachael Maskell MP.* Rachael Maskell - Labour and Co-operative MP for York Central. Retrieved September 5, 2022, from www.rachaelmaskell.com/news_page/2022/01/26/statement-on-the-ukraine/

Silvis, D., Taylor, K. H., & Stevens, R. (2018). Community technology mapping: Inscribing places when "everything is on the move." *International Journal of Computer-Supported Collaborative Learning, 13*(2), 137-166.

South, E. C., Hohl, B. C., Kondo, M. C., MacDonald, J. M., & Branas, C. C. (2018). Effect of greening vacant land on mental health of community-dwelling adults. *JAMA Network Open, 1*(3). doi.org/10.1001/jamanetworkopen.2018.0298

Tandogan, O., & Ilhan, B. (2016). Fear of crime in public spaces: From the view of women living in cities. *Procedia Engineering, 161,* 2011-2018. doi.org/10.1016/j.proeng.2016.08.795

Taylor, K. H. (2020). Resuscitating (and refusing) cartesian representations of daily life: When mobile and grid epistemologies of the city meet. *Cognition and Instruction, 38*(3), 407-426. doi: 10.1080/07370008.2020.1766463

Taylor, K. H., & Hall, R. (2013). Counter-mapping the neighborhood on bicycles: Mobilizing youth to reimagine the city. *Technology, Knowledge and Learning, 18*(1), 65-93.

ABOUT THE AUTHORS

Abigail Kerlin is a member of the Teaching and Learning faculty at Bank Street Graduate School of Education where she teaches courses in curriculum development and geography and serves as the Director of General Education programs. **Ellen McCrum** works as a coach/educational consultant and is an adjunct at Bank Street Graduate School where she advises in the Math Leadership program and teaches Geography. Kerlin and McCrum began their careers at the same public school, PS 234 in Manhattan. During their time at the school, they collaborated with colleagues to develop inquiry based social studies curricula, learned to harness students' curiosities about their world to drive learning, and help students see themselves as researchers of their own environments. McCrum and Kerlin have collaborated as geography instructors for over a decade, exploring the power of mapping experiences to support teachers and students in developing geographic thinking. They are continuing to research how pedagogical tools—like juxtaposition of maps—can deepen students' geographic understandings at all ages.

Contact
Kristin Freda, Director of Library Services,
kfreda@bankstreet.edu