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Organizing for material possibility in a community-led science program

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ABSTRACT

This case study examined how Mexican-American community educators developed material repertoires of practice to support a just and environmentally conscious afterschool program. Based on historical, environmental, economic, and sociopolitical circumstances, educators designed imaginative learning opportunities for predominantly working-class youth through the thoughtful cultivation of discarded, donated, and natural materials. Through these designs, educators offered young people new pathways for learning in their community. The author traced the constitutive relationships between the afterschool program, young people, educators, community, and the material environment to understand how these practices supported justice-oriented STEAM (Science, Technology, Engineering, Art, Math) education. The community educators created new "material possibilities" through practices of repurposing and developing material-rich projects to support youth. Simultaneously, they critiqued material consumption with youth in order to push back on an extractive economy that did not support a thriving community and environment. This work builds on the notion of material possibility in order to extend our pedagogical imaginations.

Introduction

At 3:30 pm during the school year and all day long in the summers, the door of the Harveston Science Studio[1] *is propped open and young people wander in ready to fix bikes, tend plants in the garden, build cars, design a house for fairies, and more. The room is brimming with made and found treasures from the composition of everyday life in Harveston. The tables and walls are filled with fish tanks, microscopes, skulls and pelts from animals found in the surrounding habitat, musical instruments made from recycled parts, a sewing machine, reusable wood, hand tools, power tools, tape measures, bins of recycled bottles, batteries, and wires, old CDs, and projects built from every imaginable found object. Each area of the room has signs written in Spanish, with English subtitles beneath. The materials are placed on low tables and arranged for young people to touch, manipulate, break, fix, or repurpose.*

This is a description of the Harveston Science Studio (hereafter referred to as HSS or the Studio), an afterschool science program organized with the goal to transform the science education experiences of young people traditionally underrepresented in Science, Technology, Engineering, Art, Math (STEAM). Since 1997, HSS has been a place designed for predominantly working-class youth and families, many of whom have ties to Mexico and/or Central America. The stated aim of the Studio is to "inspire and engage youth in the everyday wonder of science in the world around them" (HSS website). During the early years of HSS, parents in the community were recruited to become community science educators. Since then, the team of community educators has cultivated a historically informed pedagogical expertise that attends to the economic, political, and cultural lives of young people in Harveston (Shea & Sandoval, 2020). In what follows, I focus on the two senior community educators, Eva and Eduardo, who shape the material-rich pedagogy at HSS. Both

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educators initially learned of HSS by bringing their children to the Studio, and grew into roles as community educators over time. Eva, a Mexican mother of three, began attending HSS when her eldest child was an infant in 2006. For several years, she contributed to the Studio as a community participant making projects with her family and helping neighborhood children with their projects. Eventually, the director offered her a paid educator position. Since then she has become the social hub of the Studio: developing longstanding relationships with young people and families in the neighborhood. Eduardo, a Mexican father of three, was introduced to HSS in 2004 through his wife and daughter. As Eduardo puts it, he paid a visit to the Studio and "found his calling." Eduardo has now designed many of the projects that make up the curriculum. Between them, Eva and Eduardo shape the pedagogical practices of the Studio and serve as mentors for newer educators.

One dimension of their pedagogical practice involves utilizing deep knowledge of the local community to find and collect objects that aid young people in their investigations of the natural and built world. This emphasis on repurposing materials and the intention behind this practice is essential for a future of making in a world of diminishing resources. Over the course of a seven-year ethnography, I have returned to dwelling on the significance of a pedagogy that utilizes local knowledge of community spaces and events, recycled materials, and the natural ecology surrounding Harveston. In what follows, I explore what historical, spatial, and embodied community teaching looks like. To this end, I ask:

(1) How did Harveston educators cultivate material practices that built on and extended community histories to imagine and enact new futures with young people?
(2) What is the function of material possibility in this program, how is it enacted, and toward what ends?

Theoretical framework

Material possibility and just pedagogy

To understand materiality as a critical dimension of just pedagogy, one must first examine the local densities of race and class that inform ongoing injustices in young people's learning environments and in their lives (Ladson-Billings, 2006). Due to a political economy built upon the colonization of indigenous peoples and white supremacy, injustice is connected to stolen lands, racism, and the erasure of material ways of knowing and becoming (Smith, 2013, p. 27). Specifically, within the local context of a farming town on the West Coast of the United States, the political economy of agriculture informs the unjust material conditions that youth of color face (Quesada, 2011). Many parents are paid less than a living wage to work in the agricultural fields (Bardacke, 2012). Their children experience an uneven school funding system where the distribution of resources in schools varies widely based on race and class (Kozol, 1991). This uneven geography of development is part of the injustice that informs STEAM education and the subsequent need to reorganize for justice (Erickson, 1998; Harvey & Harvey, 2000). To this end, McDermott (2010) and Rose (2013) have both called for learning theories that recognize how those living in "tight circumstances" operate with inventiveness as they face the challenges of teaching and learning within these constraints.

Educators in working-class communities with limited material resources are often compelled to reach beyond their expected duties to support material dimensions of learning. Duncan-Andrade (2009) discussed how underpaid educators, "literally generate material resources" in order to provide, "laptops, housing, food, supplies, car rides, and links to legal and medical services" (p. 187). By studying community educators in Harveston, there is an opportunity to understand material pedagogies as more than brokering finished goods and services. To be sure, HSS educators connected young people and families to translators and access to laptops and the Internet, served free lunches in

the park all summer, and supported young people in finding jobs. However, the educators' thoughtful practice with discarded materials demands a reexamination of materiality and pedagogy. Material possibility, as I will argue in this paper, invites imagination, honors local knowledge, and offers new ways of perceiving and transforming discarded materials in order to act on and respond to the world around us.

Community educators in Harveston have much to teach the field of education about material possibility. Take, for example, Eva's work with Millie, a six-year-old girl who visited the Studio, to build a desk out of salvaged wood. After two days of collaboration, Millie had her own permanent workspace at home. And how Eduardo discussed their work with young people experimenting and building with discarded materials as an offering to "house kid's futures'." This future was imagined and realized within a system that Eduardo described as deeply hostile to Mexican and Central American immigrants (Shea & Sandoval, 2020). His conjuring of material possibility was to create a space for young people to "fight for what they want," and in that process, "offer [them] a new path" (Fieldnote, August 25, 2015). These words and deeds inspire further consideration of how material-rich pedagogy can offer new ways of seeing and acting in the world. Despite these hopeful sentiments, material possibility should not be confused with optimism, which West (2004) defines as the notion that things will get better or more just through time. Instead, there exists possibility in "actively struggl[ing] against the evidence [unregulated global capitalism, racial balkanization, social breakdown, and individual depression] in order to change the deadly tides of wealth inequality, group xenophobia, and personal despair" (p. 296). In addition to the list that West constructs, the environmental crisis looms large. In the face of such challenges, the contours of material possibility are not positioned to create justice or stem the deadly tides of systemic injustice, but can offer an outlet for young people to actively work against these global struggles.

Disinheritance and material possibility

The meaning of objects and the affordances they offer for thinking in economically "strained" environments are less theorized (Kabayadondo, 2016). Building on Kabayadondo's (2016) work in Zimbabwe, I consider the particulars of disinheritance in the process of making meaning with materials as a dimension of designing for justice-oriented learning. Kabayadondo (2016) theorizes disinheritance as a consequence of colonization and global capitalism, which informs how families, communities, and young people perceive materials. Colonizers have stripped Zimbabweans of their material wealth and left in its place an economy that was not intended to support them. This disinheritance caused an economic circumstance where Zimbabweans needed to use materials in "always opportunistic" and "unintended" ways to orchestrate their lives. Specifically, Kabayadondo explains that disinheritance forced "an attention to materials – a way of looking at materials that allows the beholder to recognize transience, mutability, intermediateness – that allows Zimbabweans to employ novel and unexpected ways to act within and around the constraints of their material conditions" (p. 156). Thus the beholders who are managing their lives in an economically strained system may see potential uses for objects that the original designers did not intend or perhaps could not perceive. For example, I have seen a discarded and broken record player be reimagined as a roulette wheel; and a broken broom handle be reimagined as an axle for a wagon. Objects in this context are used to create "clever workarounds" that are "constituted in both the limitations and freedoms that failing institutions, broken infrastructure, and distorted norms permit" (p. 155). By pointing out the separate cognitive practice associated with seeing through disinheritance, her analysis of cognition draws attention to the political dimension of learning through material construction.

Without glamorizing poverty or separating creativity from the political dimensions of life, I follow Kabayadondo's (2016) lead in considering how long-term disinheritance shapes material ideations and uses of materials in a different economically constrained environment. Although this practice is

historically and culturally specific to Zimbabwe, it offers insight into how histories of dispossession and colonization may change how communities view materials used for designing interventions. Participants in Kabayadondo's study were very accustomed to using unconventional materials to solve small household problems but questioned how inventions may (or more likely may not) lead to liberation. This attention to how participants questioned invention as a means to "extricate Zimbabwe from its economic quandary" underscores the need to see designing with materials as part of a web in social space that does not in itself solve underlying systemic inequities. Thus, materiality in learning environments must be contextualized within the historical and political rhythms of community life.

Material repertoires of practice

Learning to see discarded materials for their potential unintended uses is a practice honed through activity in communities that experience(d) disinheritance. Material practice refers to the way in which people use materials to literally construct newly imagined objects or to inquire *with materials* about the world around them in order to act upon it or shape it in some way. Materials used by participants are not assumed to have been modified over the history of their use into a particular intended goal-directed human action, as Cole (1998) suggests. Rather the agency of materials and humans are co-constructed and cannot be assumed to have one goal-directed use. Instead, there are multiple and emerging possibilities with any given object or material (Coole, 2013; Coole & Frost, 2010). There is not one "ideal" form to primary artifacts within a political economy built from disinheritance. Thus, we must ask: whose goals have shaped the historically constructed uses of materials? And what might be gained by seeing the emergent, transient, and opportunistic possibilities of materials as they accumulate and get reimagined by those experiencing economically "strained" conditions (Kabayadondo, 2016)?

Building from the work of Gutiérrez and Rogoff (2003) repertoires of practice are "ways of engaging in activities stemming from observing and otherwise participating in cultural practices" (p. 22). Moreover, these repertoires or proclivities involve understanding an individual's "familiarity with engaging in particular practices on the basis of what is known about their own and their community's history" (p. 22). As people pursue their interests within the multiple contexts and circumstances of their lives, they develop repertoires of practice based on these histories of participation. Material repertoires of practice, then, involves familiarity with materials and tools in order to construct new objects and experiences. Recognizing material repertoires of practice within a learning environment involves attention to the historical practices and sociopolitical circumstances that shape an individual's or a community's everyday encounters with materials while leaving the possible use of and ideation about materials open to interpretation and improvisation (Erickson, 2004). As individuals use materials in everyday activities, part of their cognitive work may be re-mixing repertoires of practices based on experience, interest, the materials at hand, and membership in multiple communities (Alim et al., 2020; Gutiérrez & Jurow, 2016).

Material practices are deeply tied to the cultural repertoires of a community as well as the changing political, economic, and environmental circumstances within which an activity takes place (Kabayadondo, 2016; Rogoff, 2003). Taking a sociopolitical lens on how communities and individuals develop, maintain, and revise repertoires of practice requires an attention to how contexts also shape activity and what is made to become consequential within a community (Jurow & Shea, 2015). Thus as we attend to educators' designs of learning environments we must also attend to the political, economic, and environmental conditions and the values that shape their practices (Tzou et al., 2019). Only after we account for these contextual and political elements is it possible to see and fully appreciate the creative intellectual work of calling upon material repertoires of practice as one dimension of building more just and equitable conditions for learning.

Methods

Research design

This study examined the way in which educators cultivated material practices that supported STEAM learning in Harveston. Using the traditions of critical and interpretive ethnography, I studied the meaning of actions that occurred in face-to-face interaction, and their relationship to the wider web of social and historical meanings of activity (Erickson, 1986). The unit of analysis was the activity system of community science educators and their work in and across settings as they supported material-rich learning. The research design drew heavily on interpretive participant observations that privileged the "immediate and local meanings of actions" (Erickson, 1986, p. 119). In what follows, I examine a subset of data collected over a 7-year period (2014–2020) to examine how educators designed and taught with materials from the community. This research design foregrounds how educators supported valued activity distributed across people, place, and technologies (Hall & Jurow, 2015).

Setting & participants

The Harveston Science Studio (HSS) is a free, drop-in afterschool STEAM program designed for young people (4–14 years old), with older participants (age, 15–19 years) taking part as educators-in-training. Two bilingual lead educators, Eva and Eduardo, are the focus of this study. They mentored 7 other educators, who also appear in the study as part of a material-rich activity system. The group of 9 educators worked in multiple afterschool locations around Harveston, and interacted with approximately 600 young people per week. The main drop-in location was located near downtown and easily accessible by foot or bus to the surrounding neighborhoods in Harveston. The building is situated within a community park where parents and guardians often bring young children to play. The park is in a low-income neighborhood and adjacent to multiple agricultural fields. Eva and Eduardo both live in the neighborhood and connect with a larger network of Science Studios located along the West Coast of the United States. Their long-standing leadership drives much of the direction of the Harveston program. Between them, they possess a range of skills in electronics, woodworking, tailoring, wielding, cooking, and gardening, which come from longer histories of making, crafting, and inventing in both Mexico and the United States. The study centrally focuses on their activities within a community network that has developed material-rich STEAM and art explorations out of discarded materials.

Data collection

The primary record of data collection was a field journal with approximately 215 hours of participant observations with 52 sets of observations. The methodology of participant observation allows for researchers' insights into how processes of human existence unfold through relationships among people, materials, and events over time (Jorgensen, 1989, p. 12). The focus of this analysis explores approximately 20 observations of educators and youth across locations including following educators as they: procure supplies, attend professional development sessions, work with young people in the Studio, and design and participate in community events. Ethnographic interviews from each educator in May of 2018 and January of 2020 played an important role in understanding the meaning educators were making of material use at HHS. The initial interviews were conducted in Spanish or with a translator present for clarification. These interviews served as an initial inquiry into pedagogical practices after spending a year getting to know the space and the educators. Subsequent interviews in 2018 and 2020 were conversations conducted predominantly in English and some Spanish (without translators) as we had grown comfortable with our movement in and out of languages with google translator available for clarification. The latter interviews built from initial analysis of material

practices but were focused on Eduardo and Eva's personal histories together with recollections from moments from our work together over several years. I also captured video recordings of educators procuring materials, working with materials with young people, and sharing material creations during Harveston community events. Video data were collected only 15 times during 2015 and 2018 with content logs taken for each. Transcriptions of video data were produced based on the relevance of the interactions for analyzing materiality within the practice of equity-oriented STEAM teaching. Artifacts were also captured in photographs and videos for future analysis. Finally, the HSS director and I developed a series of seven focus group sessions that offered a localized method for supporting joint knowledge production across the research and educator team (Watts & Ebbutt, 1987). We jointly designed the sessions to work with all nine educators to define the values of the program, discuss the role of educators, confirm and develop new codes within the research, and jointly analyze pedagogical interactions. These sessions were, in part, designed to support transparency within the research project. Eva noted that part of building trust within the partnership included my "honesty" about the research project where I shared fieldnotes and we jointly developed codes and preliminary analysis. These efforts were part of a practice to re-center educator knowledge, disrupt my white researcher gaze, and develop a more nuanced understanding of the epistemological rationale of the educators' pedagogy in the Studio (Esmonde & Booker, 2016; Taylor & Shea, 2021).

Approach to analysis

Throughout the analysis, I drew on interpretive participant observations and video data of moment-to-moment interactions to investigate how material practices built on and extended community histories to imagine and enact new futures. Specifically, I began to turn information into data as I speculated within fieldnotes about the types of materials that educators valued, where they found materials, how they talked about and used materials, and the ways in which they connected material-rich projects to community events. I created categories of codes inductively and deductively as I worked through rounds of data analysis throughout the life of the study. For example, during my first observation in the Studio (3/25/2014) I noted how Andrés, a college student, and HSS facilitator, dropped off a cache of recycled goods for Eva to inspect, dissemble, and arrange for reuse:

> At 4:45 Andrés brought a box of recycled supplies to the table (e.g., CDs, toilet paper rolls, cereal boxes, bottles) where the little girl was working on making an apple napkin holder with Eva. Andrés dropped off a stack of supplies that Eva began to disassemble and sort. She explained that many people from the community donated used supplies to them. As she explained this, she was taking apart a donated broken sander in order to fix and reassemble it.

This observation was notated with jottings about potential important meanings. The eventual codes pertaining to this excerpt included: *Materials flowing into the Studio; Knowledge of/Practice with Materials; Community Donation; Sorting Materials*; and *Reuse of Materials*. This transformation of information into data categories emerged over time as patterns of material uses became apparent and important for making sense of activity in the Studio (Glaser & Strauss; 1967; Merriam, 1998). Gradually codes about the retrieval, design with, and use of newly constructed objects became part of understanding the unique pedagogy in the Studio. These interpretations of data about valued materials grew into analysis and findings. For example, I coded for *Valued Materials*, which were types of materials that seemed particularly generative in the Studio: *Wood, Bones, Plastic Bottles, Bike Parts, etc*. I also noticed how educators used their knowledge of natural resources and caches of discarded materials to organize their pedagogy and work with young people. These conversations once coded led to the creation of more interpretive codes that included ways in which study participants critiqued material use in the community and ways in which participants used materials to make critiques about the current conditions within their community and beyond.

Analysis was also developed deductively by seeking out examples of cultural repertoires of practice within the corpus of data (Goodwin & Goodwin, 2012; Gutiérrez & Rogoff, 2003). I coded for *translingual or multilingual practices in activity; references to school, family, and larger community events; projects built for use in home, school, or community life*; and *storytelling related to experiences with science outside of Studio* (Shea & Sandoval, 2020). These codes explored what Gutiérrez and Rogoff (2003) called the "dynamic patterns of individuals' participation in building on historical constellations of community practices, continuing and transforming across generations" (p. 23), but were also slightly narrowed to focus on those repertoires of practice that developed alongside material use. Speculations about material practices led to a more detailed analysis of fieldnotes and shaped interview topics. The final semi-structured interviews built from an analysis of educators' histories of making, the origin of project ideas, and how thinking with available resources sustained existing practices or helped to imagine new practices (Alim et al., 2020; Goetz & LeCompte, 1984). For example, I asked Eva about the origin of her ideas about designing dresses from woven recycled newspaper, because I suspected there was a history to her practice beyond what could be witnessed through observation. The subsequent findings present excerpts of data in the language of the utterance, which was most often English. When the participants spoke in Spanish, it was indicated by presenting the Spanish utterance first and the English translation immediately after.

Positionality

As a white cis-gender female with limited conversational Spanish language skills, my work in a predominantly Mexican-American community began by invitation based on HSS's roughly fifteen year affiliation with the museum where I worked. To address my language limitations, white gaze, and position of power as the researcher (to the extent that that is possible) over the course of our partnership (2014-present), we conducted joint research (see, Shea & Sandoval, 2020), developed ongoing member checks, and held focus groups for joint data analysis (Taylor & Shea, Under review). Additionally, I became a learner in the space taking cues from Eva and Eduardo as I worked with young people on projects, organized and cleaned the Studio with them, and discussed the nuances of Spanish words and phrases I was working to understand during interaction with young people. For example, after Eva and David discussed, in Spanish, the skulls he had seen in Mexico, I approached Eva to see if I had understood his story and her response. In this case, I had, but on other occasions, I did not understand the nuance of the Spanish even after it was translated into English. For example, Eduardo discussed the use of "dichos" when young people named the boats they made. I asked for more explanation of "dichos" but never fully grasped the nature of the jokes he described. Although our racial and linguistic differences were not insignificant to my subjective interpretation of social life in Harveston, we shared working-class upbringings and histories of repairing and repurposing materials (England, 1994). My family history included family gifts that, out of necessity, came from the fabrics of old clothes sewn into bags, wood sculpted into treasures, and recycled cardboard fashioned into office furniture. Other points of connection were spending time in nature as a form of science practice and seeing learning as taking place across multiple settings. Attending to the limitations and points of connections made for an imperfect, but substantive co-construction of learning at HSS.

Findings

This analysis focuses on how community educators worked with repurposed materials to create new possibilities for learning and imagining in Harveston. Educators leveraged their histories of work with materials and knowledge of the local community to create an environment where young people could create, build, and develop different avenues of participation in community life. These efforts became central to offering young people meaningful opportunities to sustain and extend material-rich practices that could enrich their daily lives and, at times, help them address injustices in society.

Building on personal histories of making

Educators at HSS developed a space of possibility built from a history of creating imaginative designs from within strained economic circumstances. Seeing discarded materials as objects-to-think-with, for Eva and Eduardo, was part of a cultural and historical practice that developed during childhood. They began their practices of creating and designing early in life with family members. In Eduardo's case, he began making and inventing things from discarded materials with his cousin in Mexico and referred to those memories as the genesis of his own practice. In an interview in 2018, I asked Eduardo when he first started building or making things. He responded:

> Eduardo – [In Mexico, my cousin and I] used to take care of the cows and the goats. And in order for me to go with him, he would have to bribe me. We were actually very poor. We did not have a lot of resources. But everything you see around could be a resource. It was something that stuck with me because he used to make airplanes and cars with propellers out of a cornhusk. Yes, the stem and the leaves. And that is where I learned to make propellers and all kinds of stuff.

In developing a practice of making, Eduardo immediately referenced family life in Mexico. The practice of making went back to not having "a lot of resources" and therefore seeing everything around them "as a resource." Materials from nature and discarded materials were resources. When made into a toy, the materials became something of value – a bribe to convince Eduardo to tend to the livestock together. His cousin had made something that captured Eduardo's imagination. In this story, the practice of making was not only tied to family life but offered Eduardo a lesson about how to "see" resources where he had not before. Learning to see cornhusks as materials to build airplanes or car propellers was part of using materials in unintended ways to create possibility to imagine anew. Eduardo's practice of inventing things from discarded materials came from a history of creating in his family that was related to their financially tight circumstances.

In Eva's case, she learned how to make things by watching her grandfather and her mother. Her grandfather built furniture and her mother created clothing. Much like Eduardo's story, these practices of making were not limited by having the ideal materials at hand. I asked Eva when she first started learning to build or make things. She also connected the practice back to family life in Mexico:

Eva – I think when I was a kid. My grandpa was a carpenter. Well he is still alive–he is 105 years old. The last thing he built was when he was 95 years old. He chopped off one of his fingers, and so my mom said we had to hide these tools because he wants to keep doing it, but he is old and it's more dangerous. My mom also taught me a lot of things because she is a seamstress. She made my wedding dress, my sister's dress, my sister-in-law's dress, and my Quinceañera dress. I learned a lot of things from her, too.

M – Can you tell me about the process (and how young you were) when your mom and your grandpa taught you?

Eva – Yeah because my grandpa was like "don't touch that because it's dangerous" but he always gave us little pieces [of wood] that he was not going to use anymore. He always said, "use only glue. I don't want you to chop your finger or get hurt . . . " And we only glued and made little things from those pieces . . . at 5 or 6 years old.

M – And now I see all the little kids doing that in here. The hot glue station is where everyone [starts].

Eva – Yeah Lucía [is young] and really into the glue. Yesterday she made like two little dolls out of wood . . . little ones like Lucía is when you need to start.

Eva began working with discarded materials and learned to make things from her grandfather and her mother in Mexico. In addition to learning to make from the resources available, Eva explained that the practice also included watching them make beautifully finished work for important occasions (dresses for weddings or Quinceañeras). Using a combination of new and used materials, depending on what they had, Eva now works with young people to imagine and create projects from their

imagination. For Eva, starting with gluing pieces of wood together grew over time and this is how she introduces the very young children in the Studio to the practice of imagining and making. Young people in the Studio could be seen creating desks for doing work at home (fieldnote, 6/12/14), building birdhouses to study birds in their backyard (fieldnote, 9/12/15), and designing dresses out of recycled paper for taking part in a community fashion show (fieldnote, 10/20/17). When I asked Eva about how her idea to hold a fashion show for the 20th anniversary of HSS first came about, where young people designed outfits from recycled materials, she explained in English:

> Maybe because my mom showed me how to make little dresses for my dolls, but my dolls were made out of cornhusk and we used small pieces of fabric, cardboard, paper—whatever we had. When we [recently] had this opportunity [to take part in the town parade] maybe everything came from the past . . . We just used newspapers [to make dresses] because we didn't have that much time and we didn't have the budget to buy more things. When the 20th anniversary came we had a little more budget and we could design a little bit more. Not just me but with the students. Maybe I always do the most perfect designs with the kids.

Like Eduardo, Eva discussed the idea that she and her family would make clothes or toys with "whatever we had." This notion of making from one's imagination with the materials that could be found came through in both educator interviews about their teaching practices. As Eva mentioned, even when the budget for the Studio was tight, she kept developing projects with what they had, which was largely recycled materials procured from the Harveston Recycle Center. This practice supported a way of seeing materials that was unintended, due to their economic circumstances, for use in their original "functional" form and creating something new from those same discarded materials.

The idea for the Fashion Show "came from the past" and informed how Eva created worlds of imagination with young people. Eva developed a practice of using the materials available, together with the tools in their Studio, to bring young people into a way of seeing new potential in discarded materials. From watching her grandfather, building with wood, and gluing near her grandpa, she eventually learned to build with more "dangerous" tools. Eva has developed a similar process when working with children and families. Eva described the genesis of her material-rich teaching practice as stemming from memories of watching and participating with family members in Mexico to create new and valued objects. This way of seeing materials became part of a sustaining practice at the Studio.

Creating material possibilities with discarded resources

Community educators routinely practiced searching for discarded materials that were headed to the landfill and recovered them for new possible uses with young people. Creating new material possibilities did not begin with buying computers or art supplies for young people to create. Instead, educators found materials discarded by others to construct an alternative place where young people could freely explore their curiosities. These found materials intertwined with familiar cultural practices, which involved utilizing a deep knowledge of local resources. The process of connecting Harveston youth to hands-on material-rich projects began outside of the Studio. Educators found discarded materials they believed offered possibilities for curiosity, exploration, and project design. Multiple times each month, educators drove the HSS van to the local recycle center to find broken bikes, used wires, parts of engines, old toys, and batteries to stock the Studio with materials for designing new projects. In a field note from the summer of 2015, I shadowed Eduardo as he went searching for materials to build locomotives with young people for the upcoming town parade. Our first stop was at the recycle center where Eduardo was on a first-name basis with Emily, the gate operator. They said hello and he pulled the van into a space next to a dumpster filled with old bikes and toys. He rummaged through looking for parts that might work to support a newly constructed bike, tricycle, or wagon. Within the large warehouse, Eduardo knew exactly where he was going and where the potential materials of value for the Studio might be.

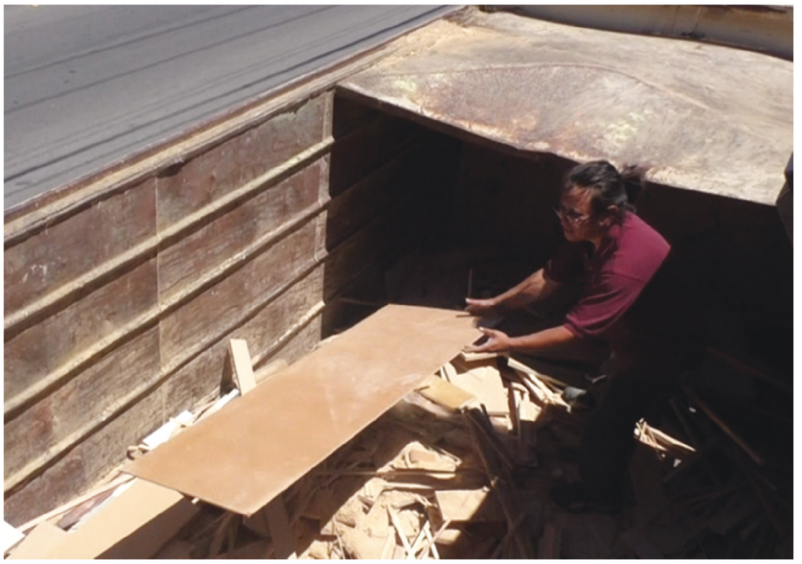

Figure 1. Eduardo selected pieces of wood from a dumpster behind a carpentry shop in Harveston.

Not only were educators attuned to the types of materials that offered potential curiosity for young people, they were also attuned to how these materials could be repurposed in order to engage in community events. The trip to the recycle center was in early summer and it was no coincidence that adults and young people in the Studio were building bikes. They were preparing for the Annual Fourth of July Parade in Harveston. After looking for desirable parts from particular unmarked bins, we drove to a different location: the dumpster at the back entrance of a nearby cabinet company. Eduardo walked into the workshop and introduced himself to the manager as an educator at HSS who mentored young people as they learned to design and build things. He then asked if he could rummage through their dumpster for discarded wood. The manager agreed and Eduardo jumped into the dumpster selecting pieces of wood to bring back to the Studio. This practice of finding used parts and recycled wood is central to designing for material abundance in the Studio. Figure 1 shows Eduardo searching for discarded materials to literally generate new possibilities for life in Harveston.

The knowledge of people and places distributed across the town of Harveston became a pedagogical resource used to create new imaginations for participating in community events. In these examples, Eduardo was engaged in a kind of expertise that was largely invisible and undervalued work within education. He and Eva's expertise in forming community relationships, finding the most useful discarded materials, and designing opportunities for young people to inquire, build, create and participate in valued community events were essential to creating material possibility within the learning environment. Seeking out necessary teaching materials in dumpsters and recycle center is a practice built from the unequal distribution of material goods and educational opportunities that rendered Eduardo's practice necessary for "housing kid's futures" in Harveston. Eduardo's focus on keeping materials out of landfills and valuing materials for the opportunities that can be created with them, while attending to the care of the planet, was central to how they began imagining and building new futures with young people.

Educators' relationship with the natural world was also a place for seeing material opportunities to support STEAM engagement in Studio. Sourcing materials came from educators' understanding of how natural debris was treated and how the reuse of these objects could support learning. For example, as part of a two-day professional development training, more novice educators learned how many of the bones, skulls, and pelts came to be educational materials in the Studio. In the summer of 2015, I observed Dillon, a bilingual (Spanish and English) white, senior educator who ran a sister Science

Studio several hours away, training new staff to see and value natural objects as potential materials for exploration in the Studio. The first topic of the retreat was the "Marine Mammal Bone Tour" where Dillon shared stories about how many of the more senior educators were involved in finding, collecting, cleaning, and displaying bones in the Science Studios (fieldnote, August 23, 2015). He shared how a whale skeleton became an artifact in the Science Studio. Pointing to a burlap bag next to the van, Dillon described how they used it to tie up the whale carcass and "pull it up the cliff." As he spoke the novice educators huddled around several long buckets filled with whalebones and chemicals meant to clean and prepare the bones for educational uses. The smell of decomposing parts of the whale was pungent as Dillon detailed how he learned of a whale that had died several hours earlier and was beached on a nearby shore. He shared the process of receiving permission from government officials to remove the whale carcass, gathering a group of educators and high school volunteers, driving to the coast, spending long hours carrying the whale to their truck, and cleaning the bones to ultimately display in the Studio. In Figure 2, Dillon describes the process of cleaning the bones and weaves in stories about the function of various whalebones and their similarities to the human skeleton.

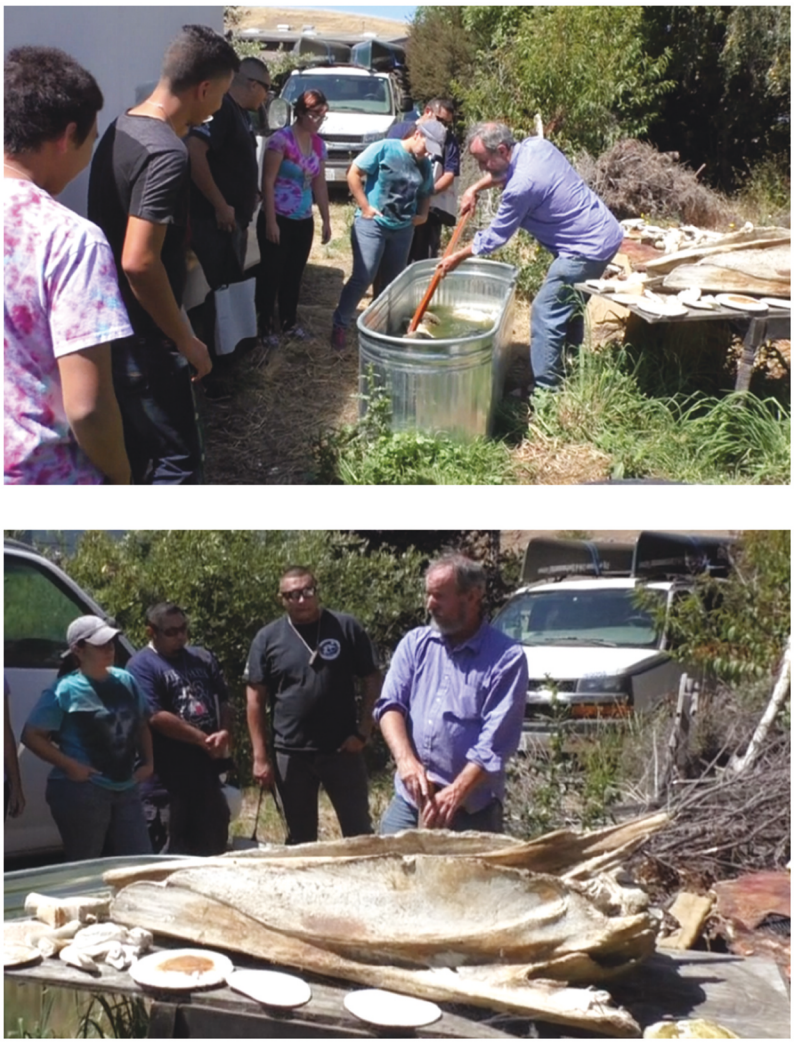

Figure 2. Dillon showing the process of cleaning whalebones and describing the pectoral fin of the whale by pointing to bones in his hand.

These bones, like other bones of animals that had died in the natural habitat nearby, became part of the educational space where young people and families could engage with the more-than-human ecosystem of which they were a part. Across locations of Science Studios senior educators would work with younger educators to share their scavenging process. This work was central to how educators were trained to become "Science Studio Educators" able to see science in the world around them and develop material-rich science practices with young people.

Put in the right places and organized by community educators, materials became part of the collective imagination of what exists in their town and what might come to exist through the community's artful care. Thus, the educational practices that both created material abundance and defined the culture of teaching in the Studio were built from knowledge of community resources and an attention to the discarded objects from the natural world. The materials disregarded by others in the community became objects of study and fascination in the Studio. Designing for material wonder, storytelling, and learning through material exploration was also a response to a broken economic system that left working-class families and children with few resources meant to directly support their educational success.

Designing a space for material wonder

The materials collected from around the community were repurposed in the Studio to offer young people new possible imaginations about what was possible in Harveston. There were bins of recycled materials tucked under worktables with a handmade sign that read: "Sobras Interesantes/Interesting Junk." Rows of low-hanging tools were organized on the walls with a similar sign reading: "Herramientas/Tools." The "Huesos/Bones" discarded in nature were now displayed on a table and affixed to the wall. A crawfish and turtle lived in fish tanks along the opposite walls with donated microscopes nearby. Recycled wood was neatly stacked on shelves in close proximity to one of the most well-loved tools in the shop: the scroll saw. Finally, a string of example projects lined the walls above the tools offering young people an invitation to replicate, revise, or reimagine their relationship to the materials and tools found in the Studio.

In addition to material wonders, the linguistic resources of the Studio also matched many of the young people's language practices at home. The handmade signs on the walls and discussions in the Studio were invitations for students to speak Spanish or English as they inquired about questions of relevance to their lives. The use and placement of materials and the language practices of educators and youth created permission to engage in science differently within the Studio. Often curiosities about objects became science conversations with educators or peers. For example, during one observation in October of 2014, which also appears in Shea and Sandoval (2020), four boys new to the Studio, entered and began participating first by exploring interesting curiosities within:

> There was a terrarium to the left of the doors with a crawfish living inside. They [the four boys] began to observe and saw a stick lying next to the tank. Turning to Eva, they asked if they could put the stick in the terrarium. She explained that the stick was used to feed the crawfish and asked if they might like to feed the crawfish some oysters with the stick. They nodded and Eva brought out some oysters and showed them the process and then gave them a turn. Two of the boys asked Eva, in Spanish, where the crawfish in the tank came from. She explained that it was from a river nearby. Then they pointed to a bunch of carcasses on the wall above the fish tank and Eva offered a story about the carcass of a snake that died with a mouse in its belly. As they talked two boys quietly started fiddling with the skulls on the table next to the fish tanks. David, one of the boys touching the skulls, waited until Eva was done talking about the snake and then told her in Spanish that he knew about skulls because he and his family used to see a bunch of cow skulls on drives in Mexico. Eva smiled at him and said she had seen them in Mexico, too. As they talked, she brought out more pelts of animals that lived in the habitat around Harveston. The boys began touching them and flipping them over to see that the names of the animals were written in Spanish on the back. The boys started sorting through the bones and pelts as one of the "regulars" in the Studio, Fidel, who was sitting two tables away shouted to David, "I told you that you'd like it here.

The connection to an array of materials in the Studio was an invitation for young people to inquire into the world around them. Eva offered a constellation of local knowledge about the habitat, the artifacts curated in the Studio, the language practices of young people, and the lives of young people who lived in her community. Her generosity with the artifacts allowed for new questions and stories to emerge. David brought a curiosity about interesting animals and animal artifacts. After feeding the crawfish and hearing Eva's story (told in Spanish), he felt comfortable enough to share knowledge he had of skulls seen in Mexico. Eva authenticated his experience, and this led to deeper investigations. As they shared experiences seeing bones in Mexico, the animal bones from Harveston took on new interest. The connections between the objects in the Studio and knowledge of the world outside the Studio and across borders became part of a science conversation that centered on community-held knowledge. Young people were able to draw upon resources and experiences that were familiar to them. Then as quickly as their knowledge was affirmed, Eva invited them to extend beyond that knowledge to consider other types of animals from the local area. These resources that were once unwanted debris became objects for learning and connecting with the natural world both near and far.

The resources of the community extended to the expertise of parents who came to build alongside their children. One father-daughter pair constructed a doghouse for their new puppy. Eva worked alongside the pair to support their process of selecting recycled wood, measuring parts, planning angles, and supporting the eight-year-old daughter as she used power tools for the first time (fieldnote 1/9/2015). Another educator, Jorge, worked with Pablo to weld pieces of an old bed frame together to create a metal wagon for the back of Pablo's bike in order to carry groceries home for his grandmother (fieldnote, 9/14/15). Eva spent time with young people growing vegetables and observing their growth, and then used what they had grown to cook meals in the HSS kitchen. On countless occasions over the life of the study, the placement of materials and tools in the Studio became invitations for young people to explore their curiosities together with educators. Educators used the entire space of the Studio and their knowledge of the greater community to design new ways of seeing what others might consider junk or debris in order to create new and valued knowledge, practices, and objects.

Adapting material use for environmental justice

The relationship between materials found for use in the Studio and concerns about consumption practices within society was evident in written material about the Studio as well as in the educators' design of projects. The HSS website, educators introduced the Studio as "a unique program for students to engage in hands-on science concepts, while gaining an appreciation for how surplus materials can be kept out of the landfill and re-used in creative and exciting ways" (HSS Website, January 13, 2021). Material reuse raised ethical and environmental concerns for Studio educators. On the one hand, they relied on the material consumption of others to supply the afterschool program with objects to think and build with. On the other hand, they became witness to over consumption and environmental harm caused by recycling without knowing where those materials ended up. In an interview with Eduardo, he explained how and why they adapted their practices. In this case, he describes how he had recently changed the boat project:

> We used to make boats out of reused plastic bottles and Styrofoam, material that already floats. but we no longer want to use materials that are not biodegradable, [because] our recycling gets shipped somewhere else becoming another country's problem, eventually the entire world's problem. We want people to realize that we can actually use many things that will be less affecting to the environment and without consuming too much. So, we have to adapt . . . everything can float! This brought up a bigger question: We have never tried to make boats out of just anything. I ask them can a piece of rock float? And I say 'well yes it can, it all depends on how you shape it. It's all about the shape, it's not about the material.' (Interview, 5/6/2018)

Concerned with the kinds of supplies that the program relied upon and the messages this would send to young people, educators began to change their own practices. Rather than continuing to make projects with "plastic bottles and Styrofoam," they adapted existing projects using more environmentally friendly recycled goods. Over the five years of studying the practices in the Studio, plastic bottles

had been a staple for building projects and conducting science experiments. Although difficult to change long-held practices that Eva and Eduardo had cultivated over years, they never relied on having the perfect materials, but were practiced in using "whatever we had" to create new possibilities. Thus, they were able to retain the essence of a science project without needing to be reliant upon supplies that no longer met their standards of ethical practice. Other changes included no longer using plastic bottles, instead encouraging water bottle use when going on field trips or holding workshops. Eduardo's critical reflection on both needing recycled materials to conduct projects and interrogating the larger political landscape was part of what made their pedagogy a dynamic justice-centered practice. The challenge of adjusting his practices as he learned also allowed him to see new teaching possibilities within projects. If you designed boats with materials that easily float (plastic bottles and Styrofoam) then you missed the pedagogical opportunity to explore why the shape of materials is central to designing boats that float. This is an example of how educators attended to the life cycle of materials, the potential of materials to support open-ended learning, and the harms the materials cause for the environment.

In addition to revising existing projects, Will, the director of the Studio, worked with the city of Harveston to expand their afterschool space to include a room dedicated to raising environmental awareness. Will, Eduardo, and Eva created exhibits exploring energy consumption, renewable energy alternatives, recycling, and composting. Additionally, they had information on the "true cost" and the harm to the environment caused by plastics (see, Figure 3). This practice centrally considered the health of the human and more-than-human neighbors and the implications of human consumption. Plastic bottles had once been a central part of building projects at HSS, but educators rethought these priorities and undertook a major effort to redesign these projects. Here we see how having material repertoires of practice that see potential in all materials made educators less reliant upon any one resource and instead able to shift and see the larger picture of how materials used for building could be adjusted to rely less on an extractive economy. Their actions were at once locally concerned, globally conscious, and endlessly resourceful.

Coordinating material-rich designs to support community-youth engagement

Material possibility in HHS was built through the use of materials for expanding what young people knew and could imagine was possible. Educators also designed for these expansions to build toward new ways of being seen and heard by the larger community. Educators' use of the whole community as a material resource for teaching was synchronized with community events like town parades, school projects, and community events. They timed projects, procured materials, and co-designed builds so that young people could meaningfully participate in community life. In the month of June, young people came for all-day design sessions to build locomotives that would eventually be featured in the Annual Fourth of July Parade. In late June of 2015, Eduardo helped Ciamara and her brother Paul build a new tricycle from a recycled big wheel and scraps of wood from the dumpster. As seen in Figure 4, Eduardo worked with the siblings to imagine, design, and build the tricycle Paul eventually rode in the parade. The process included placing new wheels in the back, fixing the stem, recalibrating the design when errors arose, and painting it before riding it in the parade.

As part of the preparation for the parade one novice educator, Jesus, and several young people wired skulls to the front of the new wagons they had built (see, Figure 5). As they worked, Eddie, a 10-year-old shared that the skull affixed to the wagon was a cow skull. The bones, wood, and recycled bike parts were all part of the creation process where science, engineering, art, and material knowledge were brought together.

In addition to organizing materials, educators gathered permission slips from parents, kept lists of participants and the status of their projects, and coordinated with parade officials to enter the parade. Each year, young people shared their ingenuity and their voices. They made signs reading: "I made this at the Harveston Science Studio" or "Create, Imagine, Build." Recycled materials were used to

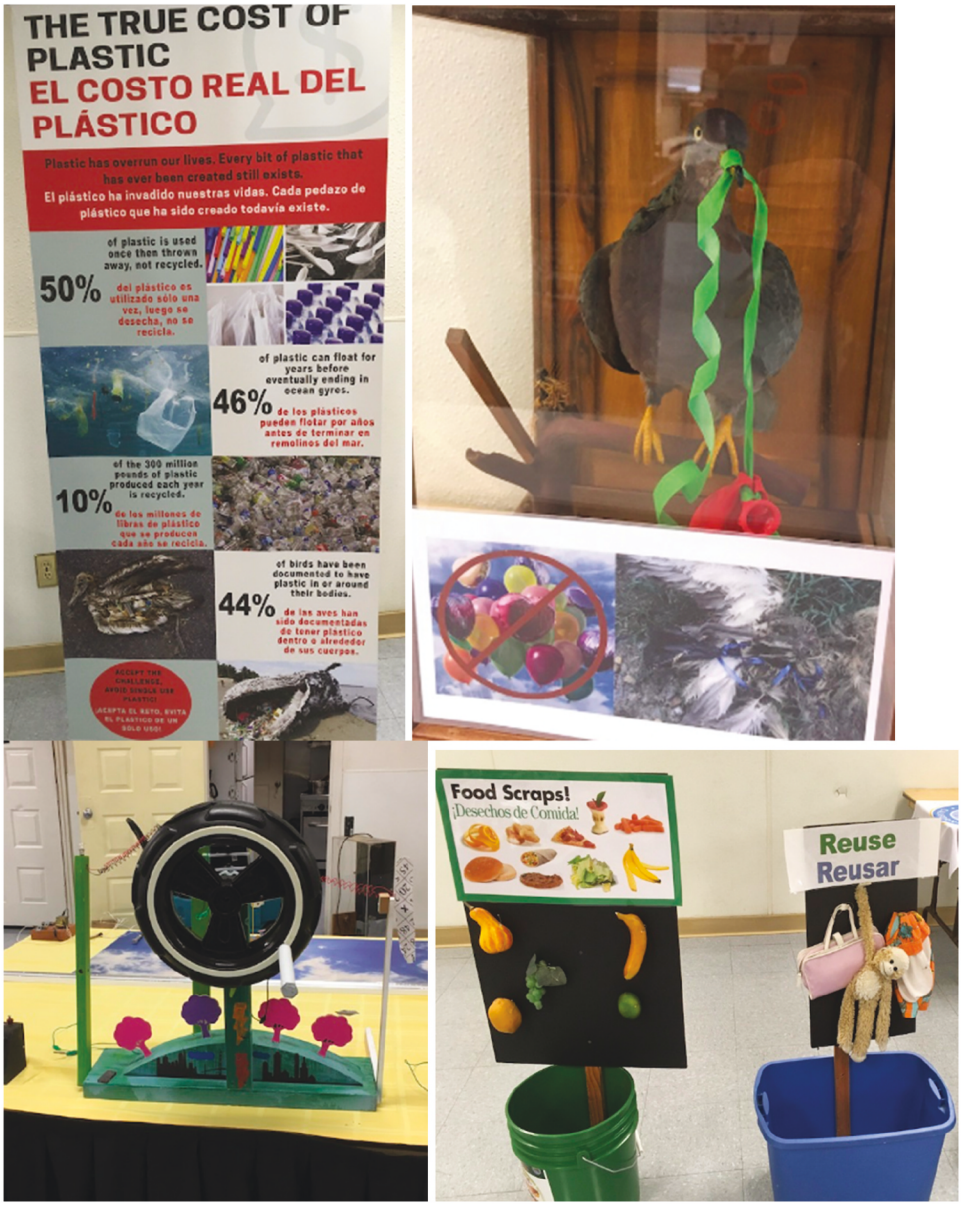

Figure 3. HSS exhibits about waste practices; harm to more than human neighbors; clean energy possibilities; and everyday practices of composting and reusing to slow environmental destruction.

communicate young people's environmental concerns, such as: "No dumping, drains to ocean," with pictures of fish in the ocean. And "Que triste es ver como se destruyen los bosques! Cuidalos por favor!"/"How sad it is to see the forests are destroyed! Take care of them please!." In 2018, Eva and several young people expressed their political concerns and protests with signs that read: "Las Familias tienen que estar juntas" on one side of the sign and "We believe that families belong together," on the other side. Eva explained the sign was a direct protest against the U.S. government's recent policy to separate children from parents at the US-Mexico border (July 4, 2018). The materials, once discarded, became repurposed to speak back to large-scale political and economic forces that created these circumstances. Although not an answer to the dehumanizing practices at the US-Mexico border, the Studio used material designs to state their protest.

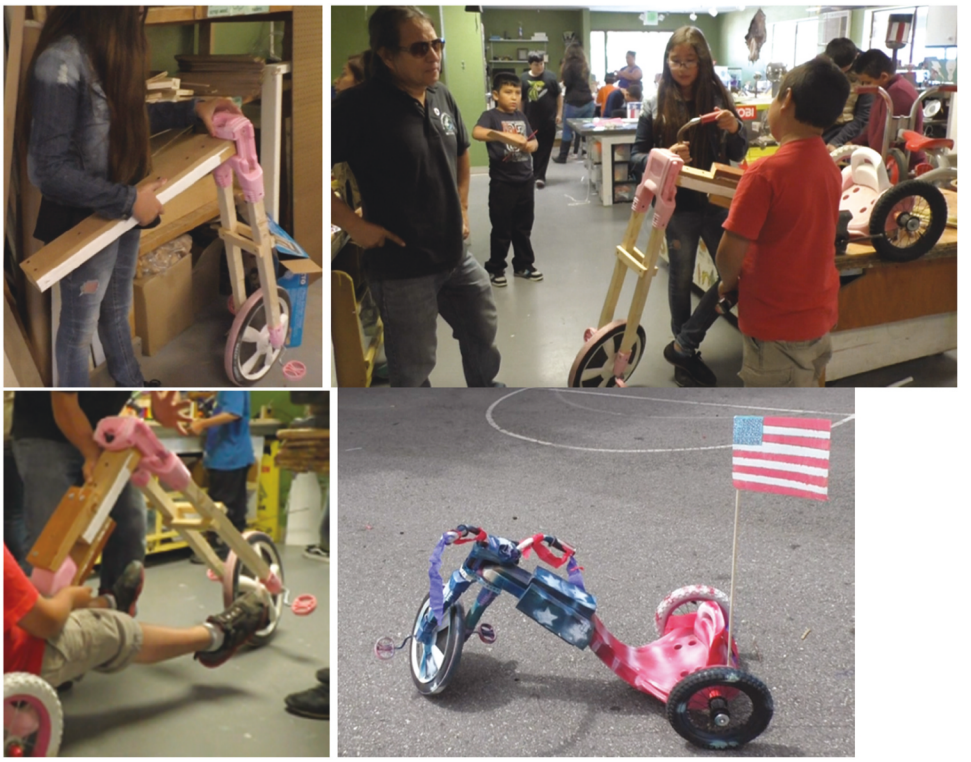

Figure 4. Eduardo, Ciamara, and Paul designing and building a tricycle.

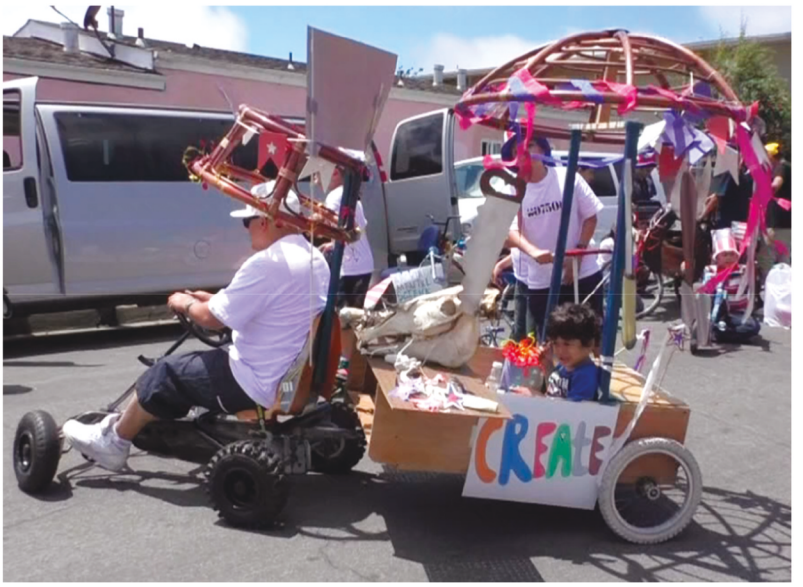

Figure 5. Repaired go-cart with cow skull adorning the wagon carrying a young HSS participant.

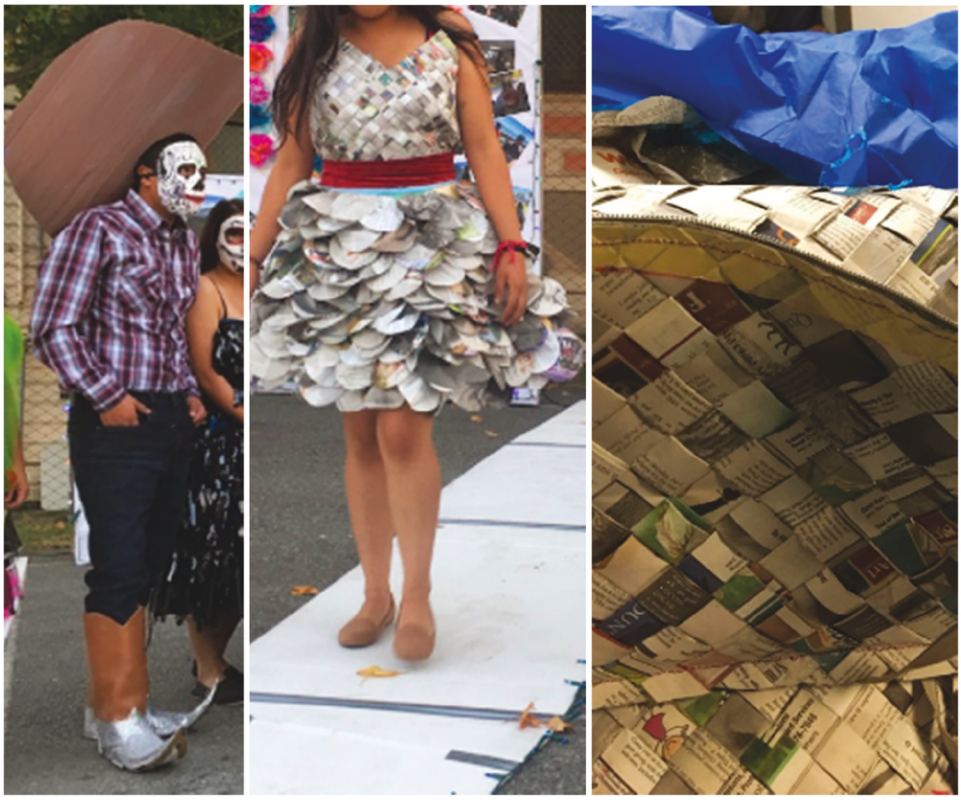

Figure 6. Boots made from recycled shoes, dresses made from recycled VHS tapes and newspapers, and zipper sewn into newspaper fabric.

In addition to the annual events, educators hosted special events with and for their community. They designed with discarded materials to bring the community together in collective memory and celebration of loved ones. For their 20th Anniversary Dia de los Muertos Fashion Show in 2018 educators and young people invited their families, other educators from around the region, and local government officials to attend. Eva led a group of teens in making dresses out of recycled materials. They wove strips of recycled newspaper together to make fabric for dresses; and deconstructed old shoes, using the sole as a base to create cowboy boots with tin foil and cardboard (see, Figure 6). They bought plaster to create masks and wore them down the runway they created outside the Studio in the public park. Over 100 people gathered to eat food, learn about science projects, take in the fashion show, and celebrate the 20th anniversary of HSS.

Other events were also part of the fabric of pedagogical design at the Studio. For example, educators had relationships with several public school teachers who sent students to the Studio to make Rube Goldberg machines and trebuchets for their physics class. Educators knew when to expect these school projects and would have suitable materials on hand when students came for support.

Educators were not simply teaching within the four walls of an afterschool program. They were building upon deep knowledge of local materials, events, and community spaces to create a place of thriving for youth and families. Bringing discarded material resources into contact with cultural practices and community events afforded young people the opportunity to participate in the political and cultural life of the town in inventive ways, and to expand the possibilities of meaningfully engaging in STEAM activities. Thus material possibility was not only about supporting the immediate needs of young people, it was also about building toward more just futures for our human and more than human communities.

Discussion

Harveston educators cultivated material possibility through a wealth of expertise built up over a lifetime of making objects out of available materials. This expertise included seeing potential in materials that were discarded and using their historically-informed imaginations to create new material possibilities. The wood from the dumpster became a desk for a young girl to work, dream, and create at home. An old mattress frame became the base of a wagon for a boy to carry groceries home for his grandmother. Recycled cardboard became signs in the parade to protest family separation at the US-Mexico border. The materials that were taken for granted or seemed to hold no value to some, became invitations to see new possibilities, spark new curiosities, construct new opportunities to participate in activities, and "house" a future that may not have been perceived before. The educators' commitment to using materials in ways that are unintended, based on the history of the original use, developed an imagination alongside young people to create new possible futures.

Material possibility, then, was a co-construction between discarded materials pushing in on the environment and human beings improvising with those materials to change the social and environmental conditions that shape their worlds. Educators brought young people into a practice of inquiring *with materials* about the world around them in order to act upon it or shape it in some way. The materials they collected were not predetermined. And importantly, the available materials also shaped possibilities for learning and becoming at HSS. Educators developed a sophisticated improvisation with the environment, and its damage, to offer young people insights into new ways of seeing possibility. These entangled new possibilities came from the convergence of discarded waste from human consumption, bones in the environment, and the creation of educators and youth designing new objects side-by-side (Barad, 2007; Deloria, 1999). Educators' work with materials is not fully in their control; it is a response to the unjust systems of capitalism, racism, and education that converged in Harveston. Thus as we design learning opportunities with materials, we cannot assume that everyone sees materials in the same way for an ideal intended use. Instead there are multiple and emerging possibilities with any given object or material (Coole, 2013; Coole & Frost, 2010); and living in a political economy built from disinheritance is one powerful force that shapes how objects and environment are perceived and how people, things, and land are entangled. The collection of material waste within communities is not in the control of one individual or group of educators, but we will need to respond to these forces and understand how we are attending to material waste within our communities. This piece contributes to discussions within the field about whose goals have shaped the historically constructed uses of materials. What might be gained by seeing the emergent, transient, and opportunistic possibilities offered by materials as they accumulate and get reimagined by those experiencing economically "strained" conditions (Kabayadondo, 2016)? These questions can powerfully inform what becomes valued and possible in material-rich learning environments.

Note

1. All names of places and people are pseudonyms.

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