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YOUTH TAKING THE REINS: EMPOWERING AT-RISK STUDENTS TO SHAPE ENVIRONMENTAL CHALLENGES WITH DESIGN

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Design thinking is a creative teaching and learning approach that prioritizes observation, problem framing and hands-on prototyping. When compared to more direct methods of classroom instruction, design thinking has been shown to boost students' comprehension of real world, complex domains; yet, few studies have examined the potential of this approach to engage at-risk *students in analyzing the complex environmental challenges disproportionately impacting their lives and neighborhoods, such as urban water depletion. This study evaluates the potential and limitations of design thinking for equipping at-risk students with an ability to understand and propose solutions to the water challenges facing drought-ridden Los Angeles, CA. Over the course of three months, groups of high-school-age at-risk students participated in design thinking workshops, proposing solutions to curb heavy water consumption and replenish groundwater in Los Angeles. Drawing exercises and questionnaires were used to compare participants' comprehension and values surrounding urban water usage before and after participating in design thinking workshops. Finally, semi-structured interviews were conducted to evaluate the thought processes guiding participants' design decisions during workshops, as well as their attitudes toward design thinking as a teaching methodology and learning approach.*

Sitting in classrooms overwhelmed by standardized testing, at-risk students[1] are falling through the cracks of an inflexible educational system that prioritizes uniform approaches to teaching and learning over student interest and creativity (Darling-Hammond et al. 1985). Most recent U.S. Census data shows a 49.6% unemployment rate among the 350,000 high school dropouts reported in 2012 (U.S. Department of Commerce Census Bureau 2014). Ultimately, at-risk students are leaving classrooms lacking the skills required to thrive in 21st century job markets.[2]

Notwithstanding, these students are increasingly being introduced to design thinking as an alternative to commonplace classroom instruction where emphasis is placed on learning precise content for tests rather than the concepts underlying this content (Darling-Hammond et al. 1985).

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[1] McMillan et al. (1994) define at-risk students as those showing persistent patterns of under-achievement and social maladjustment, leading to their failure to finish high school. The specific qualifiers used in this study have been determined by the Boys & Girls Club and can be found in the *Methods* section.

[2] In the Partnership for 21st Century Skills, the Obama Administration underscores the importance of innovation, creativity and problem solving for students entering the global skills race (Carroll et al. 2010).

Foregrounding experimentation and creativity, the design thinking process involves observing and understanding a problem, developing a point of view, sketching ideas, and prototyping solutions (Carroll et al. 2010; Dalsgaard 2014). This hands-on approach provides students with valuable technical, analytical and creative skills, as well as a pathway to actively engage in personal and real world problem solving.

While design thinking lends itself to a playful exploration of complex, multidimensional subject matter[3] like climate change and urban water depletion, little research has been done to assess its effectiveness in relation to understanding environmental challenges; the challenges that will inevitably and disproportionately affect the lives of urban at-risk students. Leveraging design thinking as a teaching methodology can potentially equip at-risk students with employable skills and an understanding of the environmental challenges shaping their lives and neighborhoods. Moreover, design thinking can potentially help at-risk students develop agency by giving them a voice in their learning and the confidence to re-engage in academic pursuits (Carroll et al. 2010).

This raises an important question: Building on the growing success of design thinking in classroom settings, what is the value of bringing this approach to at-risk students? *Can design thinking workshops engage high-school-age at-risk students in comprehending and developing systemic solutions to environmental challenges, namely urban water depletion in Los Angeles, CA?*[4]

This study aims to evaluate the potential and limitations of design thinking by identifying participants' (1) knowledge surrounding Los Angeles's water supply and basic hydrology before and after participating in a design thinking workshop, (2) values surrounding urban water usage before and after participating in a workshop, (3) thought processes driving design decisions during a workshop, and (4) attitudes toward design thinking as a teaching methodology and learning approach.

POSITIONING AT-RISK STUDENTS: WHY CARE ABOUT WATER?

From communities with drinking water shortages to diminished water for agricultural production, the depleting water supply in California continues to receive widespread public attention, with pronounced risks to arid cities like Los Angeles. Given the 60% to 70% impervious, hard surface now covering the city, most rainfall is lost as runoff and only 12% of Los Angeles's water supply is retrieved from local sources (The City of Los Angeles 2007; Los Angeles Department of Neighborhood Empowerment 2015).

The Los Angeles Department of Water and Power (LADWP) recognizes the need to reduce the city's reliance on imported water. To meet this goal, stormwater capture and groundwater replenishment projects have been pushed forward by planning and grant funding efforts like the state's Integrated Regional Water Management (IRWM) program. IRWM groups in Los Angeles

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[3] Dalsgaard (2014) describes the systemic nature of design inquiry as a deliberately iterative process of moving between the whole and the parts.

[4] Along with the timeliness, visibility and relevance of Los Angeles' water shortages to the lives of at-risk students, the complexity of the city's water system lends itself to a rich exploration of design solutions and as such, will be the focal point of design thinking workshops carried out in this study.

County have already received more than $180 million in state grants, which have been allocated across centralized and distributed stormwater capture projects in the city (Council for Watershed Health 2014). Furthermore, California's Governor Jerry Brown passed an executive order requiring a 25% reduction in potable urban water usage by February 28, 2016, and the City of Los Angeles pledged to reduce its water consumption by 20% by 2017 (Executive Department State of California 2015; LADWP 2015).

Studies have shown that economic drivers are the largest determinants of household water usage. In Los Angeles, Mini (2013) analyzed household water usage patterns in relation to socioeconomic variables over a 10 year period. From 2000 to 2010, increases in residential water consumption were shown to be positively correlated with higher income levels. Ultimately, while low income households use significantly less water, they bear the burden of their affluent neighbors' disproportionately high water consumption and are more sensitive to consequential increases in water pricing.[5]

Socioeconomic status is a key variable associated with dropping out of school (McCluskey et al. 2005). Trends of dropping out and falling into cycles of unemployment (U.S. Department of Commerce Census Bureau 2014) position at-risk students to experience amplified effects of climate change; climatic shifts that are exacerbated by urbanization and growing water stress. Wealthier residents living in spatially clustered, greener neighborhoods that use more water also have the means to increase tree canopy coverage, thereby decreasing temperatures in their neighborhoods. While low income residents living in high density urban complexes use less water, they are more vulnerable to the impacts of climate change, such as temperature increases. In the long run, wealthier residents reap the environmental, economic and health benefits associated with urban green spaces (Mini 2013).

That said, community involvement and school programs centered around water issues in the city are also integral to the conservation efforts of the LADWP (California Energy Commission 2011). In addition to large-scale centralized infrastructure renovation, neighborhood-scale distributed stormwater capture systems are being installed across the city at an increasing rate. These systems deploy vegetation, soils and natural processes to capture local runoff for direct use and groundwater recharge. City-wide efforts to design and install features characteristic of distributed stormwater capture systems, such as cisterns, rain gardens and bioswales, provide ample opportunities for young people to learn about and get involved in tangible initiatives early on (LADWP 2016). Equipping at-risk students with an achievable set of goals, skills and the inspiration required to engage in water infrastructure projects could prepare them to enter this growing job market.

HEAD AND HANDS: APPLYING DESIGN THINKING TO WICKED PROBLEMS

Numerous studies have been conducted surrounding Creative Problem Solving (CPS); however, few have examined CPS as a catalyst for changing the behaviors of underperforming youth. When coupled with career exploration and mentoring, introducing these strategies to

[5] Los Angeles currently imports 85% of its water, risking price hikes enacted by the Metropolitan Water District (Los Angeles Department of Water and Power 2015).

at-risk students has resulted in successful outcomes, namely students returning to school, graduating, finding employment and reducing recidivism rates (McCluskey et al. 2005).

Among the many CPS strategies explored by researchers working with youth, design thinking distinctively brings together art and science to address problems of the present moment. Because design thinking can be applied to subject matter across many disciplines, Buchanan (1992) stresses the unique role it can play in addressing *wicked problems*, or social system problems that are ill-formulated with confusing information. Carroll et al. (2010) explain design thinking as a process that fosters metacognitive skills, or thinking how to think about problems. Furthermore, Barba (2015) argues that design pedagogy can reintroduce an integrated head *and* hands-based learning approach into modern classrooms.

Case studies have provided valuable insight into the role design thinking can play in teaching students about complex systems. For example, Hmelo (2000) used the design process to teach students about the complexities of the human respiratory system. At the conclusion of the study, students exposed to the design process offered more sophisticated explanations and drawings depicting the nuances and interconnections of the respiratory system than those receiving conventional methods of instruction. When looking at complex environmental problems in relation to urban youth, Habib (1996) recognized that ecological literacy increased when teachers explicitly drew connections between environmental challenges and the complicated social lives experienced by youth living in urban communities. Habib emphasized the importance of continuous investigation, reflection and dialogue in connecting these youth to the environmental challenges they face.

Academic research focused on urban ecosystems similarly calls attention to the multidimensional thinking required to analyze environmental challenges in cities. Studies of water infrastructure in Los Angeles, for example, emphasize the influence of complex and interwoven factors like people, power, and institutions in shaping the circulation of the city's water (Cousins et al. 2015). Exploring the role people, power, and institutions play in shaping underserved urban communities, Senbel (2007) discovered the untapped potential of youth. When tasked with analyzing, designing and improving their own neighborhoods, youth easily and radically broke the status quo. Senbel also found that youth were far more engaged when their roles were clearly defined with set parameters. Similarly, McMillan et al. (1994) distinguish clear goal setting as a key characteristic of *resilient* at-risk students. However, in underserved schools where educational goals are not being met, turning to design thinking to support gaps in students' content knowledge is also gaining recognition among educators (Carroll et al. 2010).

METHODS

A three-day design thinking workshop was developed and facilitated for teenagers at three youth organizations in Los Angeles County: The Boys and Girls Club of Burbank and Greater East Valley, Hands4Hope Los Angeles, and North Valley Caring Services. At each location, the workshop was listed alongside other summer programs offered to teenagers who voluntarily elected to participate. From June to August 2016, the workshop was repeated five times for groups of one to six participants, with seventeen participants total.

Participants' ages ranged from thirteen to seventeen; all participants were of high-school-age, with the exception of one participant entering eighth grade (see table 1). The entire group consisted of nine females and eight males.[6] Seven participants came from families of low socioeconomic status and qualified for free school lunches. Though they were not asked formally, most teens brought up their nationality, ethnicity and/or race on their own.[7] Eleven participants identified as Hispanic or Latino/a/x, two as Black or African American, one as South Asian, one as Armenian, and another as Jewish-Ukrainian. One participant identified as both Armenian and Hispanic or Latino/a/x.

To distinguish whether an "at-risk" status influenced participants' performance, groups were comprised of participants who are considered at-risk, as well as those who are not. Data revealing participants' status was only available at the end of each workshop to eliminate bias. Based on the qualifiers presented in table 2, participants fell into three main categories: at-risk, category 1 (six participants); at-risk, category 2 (four participants); and not at-risk (five participants). This information was not available for the remaining two participants.

Table 1 Participant age breakdown

13 yrs old	*14 yrs old*	*15 yrs old*	*16 yrs old*	*17 yrs old*
1	2	4	7	2

Note: One participant did not provide their age.

Table 2 At-risk qualifiers

Category 1	*Category 2*
Attended 85% or less of eligible school days last year	Has a family member who dropped out of school*
Has at least one course failure in reading or math	Has school behavior problems*
Had to repeat a grade	Has attended at least 5 schools during lifetime*
	Has low grades (all C, D, and F)*
	Has at least one disability (e.g., ADHD)*
	Has low educational aspirations/engagement*
	Has a low socio-economic status (i.e., is eligible for free school lunch)
	Has a poor parent-child relationship

[6] An assumption is made here about gender identity based on the pronouns participants used when referring to each other, as well as those used by teen directors and other staff. However, participants were not explicitly asked about their gender identity and therefore, the numbers listed should be considered merely an impression.

[7] Because of the inherent complexity surrounding concepts of nationality, ethnicity and race, problems often arise when making delineations based on limited information. While these concepts are called out to paint a broad picture of the participant group, they are also conflated to focus solely on the information available.

Category 1	*Category 2*
	Has a single parent household
	Lacks extracurricular involvement
	Has low self-esteem

Note: This set of qualifiers was provided by the Boys and Girls Club of Burbank and Greater East Valley. Students are considered *at-risk* if either a single qualifier is selected from *Category 1,* or two qualifiers are selected from *Category 2,* with at least one being education related (*).

Comprehension and values

Participants completed an identical handout comprised of short answer and multiple choice questions before and after participating in the design thinking workshop. Questions included the following: identifying sources of water flowing into Los Angeles, pinpointing key areas of household and agricultural water consumption, charting the water cycle and explaining basic hydrologic processes, and describing values surrounding Los Angeles's dwindling water supply. Handouts predominantly covered material included in grades nine through twelve Science Content Standards for California Public Schools.[8] Pre and post-workshop handouts were compared to evaluate changes in comprehension and values.

Semi-structured interviews were conducted with participants who completed the workshop. Three participants were interviewed a second time, several weeks following their initial workshop, to evaluate whether opinions were retained overtime. Seventeen interviews were conducted and coded between June and August.

The design thinking workshop

Workshops were guided by the following design thinking methodology: observation, brainstorming, ideation and prototyping (see table 3). Observation activities took place along the Glendale Narrows, the only unpaved, soft-bottom stretch of the Los Angeles River. Answering a list of exploratory prompts, participants noted and compared green and grey infrastructure surrounding the river. Group brainstorming activities involved writing down areas of heavy water consumption on post-it notes and clustering words and phrases thematically. Building on the lessons learned from observation and brainstorming activities, during ideation activities participants were asked to develop ideas that reduce heavy water usage and replenish groundwater at their respective workshop site. After individually sketching a variety of ideas, each participant selected one to refine. To conclude, participants made a poster and small-scale cardboard prototype of their selected idea.

[8] Two key sections of the Science Content Standards were drawn from: 1. California Geology 2. Investigation and Experimentation. According to the CA Geology standard, students in grades nine through twelve learn about the basis of geological hazards, the importance of water to society, the origins of CA's fresh water, and the relationship between supply and need. The Investigation and Experimentation standard indicates that reading topographic and geological map data, analyzing and problem solving across scientific arenas and integrating social issues, such as water use decisions in CA, are essential to students' learning (California Department of Education 2003).

Table 3 Design thinking curriculum

Activity	*Description*
Day 1: Observation *(3 hrs)*	
The difference between art and design *(15 min)*	Show a combination of art and design images and ask students to guess which is which. Define design and use the development of the Los Angeles River as a case study to illustrate the design process.
Handout 1 *(20 min)*	Students individually complete preliminary evaluation handouts (see fig. A.1).
Los Angeles River site 1 (Glendale Narrows, Bette Davis Picnic Area): grey infrastructure *(1 hr 30min)*	A set of prompts (e.g., "draw a map of the park and highlight where you see water") is given to each student to guide their exploration. While walking through the park adjacent to the river, students jot down notes and quick sketches describing the landscape's topography, water infrastructure and ideas to improve the site. Looking at the edges of the watershed, students are reminded of the water cycle and basic hydrologic processes.
Los Angeles River site 2 (Glendale Narrows, Elysian Valley, Marsh Park): green infrastructure *(45 min)*	This time, students jot down notes and quick sketches exploring a bioswale, an example of a distributed stormwater capture system. Images of other distributed stormwater capture systems are also shown and techniques to slow down, capture and infiltrate water are discussed.
Discussion *(10 min)*	As a group, students discuss the most surprising and inspiring things observed. What did students connect to most?
Day 2: Brainstorming & Ideation *(3 hrs)*	
Water pictionary *(20 min)*	As an icebreaker and reminder of the previous day's activities, each student pulls a water-related word (e.g., watershed, bioswale, etc.) from a bag one at a time and draws the selected word on a large piece of paper. Other students try to guess what is being drawn.
Where does water consumption occur? *(10 min)*	On post-it notes, students write down all of the areas they could think of where water consumption occurs. The post-it notes are consolidated and clustered thematically (see fig. A.2). A discussion about the areas of heaviest water consumption and virtual water follows.
Where does our water come from? *(20 min)*	Students collectively draw a large map of California that illustrates where water flows to Los Angeles (see fig. A.3). Students are shown reference images of California's aqueduct system for support, as well as conventional and non-conventional maps. They are encouraged to be creative when including elements on the map that are important to them (e.g., using color to represent an emotion experienced when visiting a particular place).
Design project introduction *(10 min)*	Students are introduced to a design challenge that they will work on for the remainder of the workshop: to create a design that reduces heavy water usage and/or replenishes groundwater at their respective workshop site. To begin, the group walks around the workshop site and calls out any visible water infrastructure as well as topographic challenges and opportunities.

Quick sketching and evaluation *(45 min)*	Students are encouraged to sketch as many ideas as possible without limitations or judgement. Reference images of distributed stormwater capture systems are available for inspiration. When finished, students share their ideas with the group. All sketches are laid out and a piece of paper is placed below each sketch. The group is introduced to a color coding system where different colors represent different evaluation criteria (e.g., green is most efficient, orange is most creative, etc.). Students walk around and place a colored mark of their choosing beside each sketch. They then fold the piece of paper so others can't see the color that was selected. When the exercise is over, students unfold the pieces of paper beside their sketches to see what the group thought of their ideas. Was one idea really creative while another practical? The group discusses how environmental decisions are made.
Posters *(1 hr 15 min)*	Based on the evaluation exercise, each student selects a single idea to refine. On a larger sheet of paper, students draw their idea from multiple angles with storyboards and short written descriptions (see fig. A.4). A poster template is provided.
Day 3: Prototyping *(3 hrs)*	
Model making *(2 hrs 15 min)*	Using pre-cut cardboard shapes, hot glue and colored duct tape, each student builds a small-scale model of their selected idea. Students are encouraged to use the colored tape to indicate the flow of water (see fig. A.5).
Handout 2 *(20 min)*	Students individually complete post-workshop evaluation handouts (see fig. A.1).
Show and tell *(20 min)*	Students share their posters and models with the group. Teen directors are encouraged to attend.
Certificates *(5 min)*	Each student receives a certificate recognizing their completion of the design thinking workshop.

Participative inquiry and limitations

Reason (1994) claims that Participatory Action Research (PAR) produces knowledge and action that directly benefit participants, who are often members of vulnerable communities. Theoretically informed by PAR, this study aims to empower and honor the perspectives of at-risk youth who are particularly vulnerable to the long-term effects of climate change. Due to time limitations, however, only certain methodologies that are typically associated with PAR were put into action. That said, Reason also argues that PAR can rely on orthodox techniques, such as systematically gathering information, while foregrounding the community's perspective during analysis.

The basis of this research study was a request made by the Boys and Girls Club of Burbank and Greater East Valley to bring design and science education to their facility. Pushing this request a step further, the research study was designed to address the needs of the organization *and* to collectively shape this approach with participating youth. Though an overarching framework was provided, participants were asked to offer feedback throughout each design thinking workshop and were told that their input would directly shape future workshops, recommendations and the resulting curriculum. Furthermore, participants suggested how to integrate this educational framework into their own communities, outside of the facilities where workshops initially took place. Finally, participants were given the tools to recognize their own expertise and ingenuity in addressing environmental problems.

Restricted to a three-month timeframe and limited funding, the research study had a small *n* and did not allow for sufficient follow-up interviews with participants. Subsequent interviews would reveal the degree to which opinions and lessons were retained and applied overtime. Additionally, a longer time frame would provide more opportunities to connect participants to the outcomes of the feedback they offered during workshops, such as an improved curriculum.

FINDINGS

Barriers to entry and determinants of motivation

Working across three research sites shed light on the institutional, personal and administrative barriers that influenced participants' involvement. A teen director was present at each site, however, their engagement in the design thinking workshop varied greatly. Sites where teen directors made transportation plans, coordinated participants' schedules and collected permission slips prior to the start of workshops required less rapport building and faced fewer communication barriers. At sites with less initial coordination, getting to know the group required attending Teen Nights, personally introducing teens to the design thinking workshop, and talking to teens while preparing workshop materials.

To accommodate shifting schedules, components of the workshop were broken apart. In loosely structured environments, teens had a harder time adhering to the workshop schedule and often forgot or miscommunicated their scheduling needs. Transportation and drivers for field trips were provided by two of the three partnering youth organizations, though transportation availability depended on group size and was also impacted by any miscommunication related to scheduling. Consequently, one participant missed nearly the entire workshop. A fourth day was sometimes introduced for participants to complete any missed activities, posters or models. One workshop was consolidated and completed over two longer days to accommodate scheduling needs.

Spatial availability and restrictions became particularly crucial during summer heatwaves. Workshops that were typically conducted outdoors were moved to much louder shared indoor spaces, making it difficult for participants to concentrate. Designating closed, indoor rooms for workshop activities proved essential in these circumstances.

Nonetheless, teens who participated in design thinking workshops shared several common characteristics: they were motivated, cared about individuality and self-reliance, or were already concerned about the effects of the drought. The teens explained that individuality leads to greater opportunities in the future. In the long run, they wanted to bring their ideas to fruition and be known for doing something good. Several participants expressed:

> *I'm a girl and I'm a Latina, so it's very important because I'm like setting a different example.*

> *I just wanna be independent for myself and know that I can do something by myself, and I don't need help from anybody else.*

Motivation was expressed in a variety of ways among the teens. One participant commuted for over an hour to attend the workshop, while another asked if she could arrive early

to finish her poster. A third teen spent additional time at home researching workshop content, while a fourth found information about water-related public art events in the area to share. Participants motivated each other and were inspired by their peers' efforts. Two participants were encouraged by their siblings to follow through with commitments. More broadly, participants found motivation in giving back to their communities and incrementally making the world better. One teen expressed:

> *I would say that designing for environmental use isn't as hard as you would think it would be, that you could use your own perspective to help the world in a better way. It's pretty easy.*

Participants found value in understanding their community's preferences and challenges. Most participants received community service hours for volunteering at their respective sites. A few teens expressed:

> *I feel really good about myself in making something that helps the community.*

> *[Community involvement] is very important to me because I don't wanna just be sitting there in the corner not knowing what's going on. But, I wanna be active...*

Motivated participants were involved in other extra-curricular activities like food bank volunteering, leadership trainings, academic decathlons, the Outward Bound program, and a variety of sports teams as well. While their future goals varied widely, conversations surrounding college unfolded during every workshop. Participants primarily sought advice about the application process and choosing between community and 4-year colleges. Connecting workshop content to participants' extra-curricular activities and future goals was crucial. For example, a teen who played water polo cared about whether or not the decreasing water supply would affect her ability to swim in pools. Despite their poor performance in conventional classroom settings, most participants pushed their own boundaries throughout the workshop, cared deeply about their communities, and strived to engage academically and make a difference in the future.

Environmental values

Many participants were driven by a preliminary concern for the environment. They had heard about the drought from family members, teachers, the news, or in passing. One teen explained, "it's in the culture right now." Another teen immediately connected the drought to wildfires that were sweeping through the state:

> *The forest is dehydrating and it's just a really tough time for the ecosystem because there's not enough water and because it's so hot out.*

Most participants claimed to conserve water at home, and some even described scolding friends and family members for wasting water. They realized the ramifications of a diminished water supply and wanted to learn how to "correctly use water." Observing landscape changes in their neighborhoods overtime, they identified inconsistencies between dried and green lawns, the ways in which people abused their water privileges, and the subsequent impacts of their actions on future generations. One teen imagined an ideal future scenario:

I wanna see the drought like overcome itself, like get it over with so . . . when I get older I'm like, "Oh my gosh, we were in a drought one time. I remember that was so gross."

Teens who committed to using less water at home believed that a single person could influence others when working toward bigger change. Participants described routines like setting a 5-minute timer when taking a shower, putting a bucket under the rain gutter, or planting drought tolerant succulents. One teen expressed that while he couldn't "force other people to do their part," he could certainly set an example. Another teen used the following analogy:

On a small scale . . . it's really easy to make a change, so it's really easy to go against the flow. Like imagine a duck and imagine a bigger bird . . . you can't really go against the flow in a giant river, but you can go against the flow in a creek. And so you have to start small.

Some teens, though, were hesitant. They were unsure of where to begin or how to find other people to help. They recognized the effort required to create meaningful change at a community scale. One participant pointed out that the drought doesn't affect individuals per se, but instead affects everyone as a whole. Another teen emphasized the holistic nature of the issue:

First of all, our bodies are made of like 70% of water, so we need water for our bodies. And then you need water to like make food and vegetables and plants, and then the animals we eat . . . they need water too. Basically every part of us, like everything that we have in this world, is made from water.

Many teens couldn't recall a time when water scarcity wasn't an issue in California. They claimed to never see the drought first-hand and felt desensitized to the current hype surrounding the issue. While they heard people talking about it, they didn't feel the need to get involved. Others felt that the drought wasn't being taken seriously enough and worried that it wouldn't get addressed until an extreme event occurred.

When asked whether people should be required to pay for water, some teens described water as a sacred resource and said that paying reduces overuse and is justified when considering transportation costs. Others, however, argued that water is a basic need and that paying for water is equivalent to paying for air. They were concerned that corporations profit off of a universal right. Participants considered the effects of water pricing across socioeconomic strata. A teen who visited the LA River regularly with his grandmother, for example, recounted conversations that ensued about the rising costs of water. He expressed concern about the availability of water in larger places like prisons, as well as wealth disparities that could prevent access to affordable water.

Prior experience and subsequent learning

Novelty also piqued participants' interest. The teens were excited to take a chance and try something new that could potentially broaden their horizons. No one had prior experience with design, some had never approached the LA River closely, and others sought opportunities that brought new real world knowledge or "could help [their] life in any way." Many participants did

nothing else all summer and simply wanted something to do. Taking risks in a smaller place with familiar people was less intimidating than branching out and taking a chance at school while surrounded by older students.

At school, participants took a range of science courses, including biology and chemistry, though many had not taken an environmental science course since middle school. Those who had taken a course in high school mentioned that the primary format was a lecture. While participants were familiar with most of the content covered, they found that the workshop refreshed their memory. Two participants even took it upon themselves to describe the history of the California Aqueduct to their group. Another participant was enrolled in an environmental science academy in middle school that integrated outdoor science courses into the curriculum. She was inspired by a marine biology research trip, where the class was taken to the Virgin Islands. For the most part though, field trips were not offered in school and projects were much shorter. One participant expressed:

> *At school you have like text books and you read and you memorize stuff, but this is like a hands-on thing. We went to the river and it just like, it makes it that much more important if you really get out there and like look at the stuff.*

Participants discussed a range of experiences in the classroom. For example, one teen described drawing when he was bored in school, and recounted getting suspended and failing a class due to a poor relationship with a teacher. By contrast, other participants looked forward to taking Advanced Placement courses the following year. Participants who were enrolled in a STEM curriculum were used to building things. Others, however, only recalled hands-on exercises in kindergarten.

The handouts distributed before and after workshops also provoked a range of responses. Most participants found the handouts to be of medium difficulty despite their previous background with formal environmental science education. Participants were familiar with questions that touched on general science and basic hydrology, but were unaware of topics regarding Los Angeles's water supply specifically. One teen explained that she was not used to answering opinion-based questions and spent a lot of time overthinking her answers. One participant complained that he hated filling out handouts, and another opted out of filling out the second handout. Other participants, however, thought the handout was fun and assured me that they would answer all of the questions correctly. Due to time limitations, participants were asked to pause and complete the second handout while they were already racing to finish their model in time. For this reason, many participants rushed through the second handout and simply repeated the answers they had previously written in their first handout to return to model making. Handouts were therefore inferior to models when evaluating how well teens grasped the content covered in workshops.

Handouts were primarily comprised of short-answer, fill in the blank and multiple choice questions, though a few questions asked participants to complete a map or draw a diagram. For example, when asked where Los Angeles's water comes from, participants were given a map and asked to draw a line from LA to each lake or river that supplies the city with water. Open-ended questions that relied on participants' opinions were evaluated based on clear reasoning. For instance one participant indicated that beef production requires the most water, but justified their

response by claiming that "you have to give the cows water to drink and shower the cows." The second time around, however, this participant justified their response by explaining that "cows need water to drink, wash themselves [and that the] plants they eat need water too." The first response received partial credit, while the second response was marked as correct because the teen considered the water footprint of a cow's food.

Of the twenty-two questions listed in the handout, seven touched on broad attitudes and values and are consolidated with other findings throughout this study. The remaining fifteen questions covered specific topics with right and wrong answers and are evaluated below (see fig. 1). It is important to note that even questions with incorrect answers oftentimes included details that participants learned during the workshop, which did not appear in their first handout. For example, when asked to draw water moving through a watershed, several participants showed the water meandering—as opposed to flowing straight down the mountain—even though the direction of water flow was ultimately incorrect. Clear improvements were visible across six questions, and slight improvements across three.

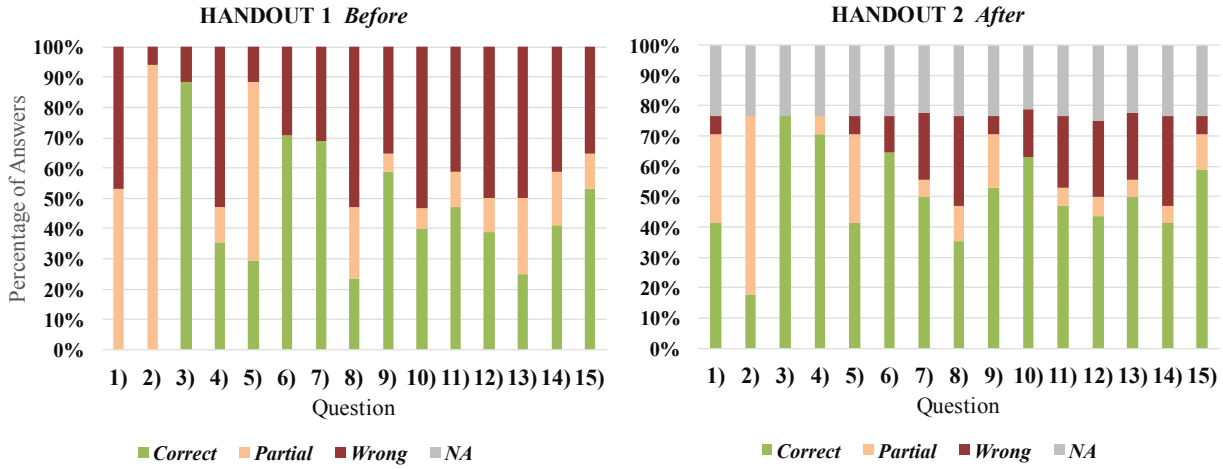

Figure 1. A comparison of participants' handout questions before and after completing a design thinking workshop. The graphs above compare the percentage of correct, partial, wrong and unavailable (NA) answers for the following fifteen questions: 1) Where does LA's water come from? 2) What is the largest use of household water? 3) What can you do to use less water at home? 4) What food product requires the most water to produce and why? 5) What are the processes of the hydrologic cycle? 6) Does LA have enough local water to meet the needs of everyone in the city and why? 7) What should we do to meet the water needs of everyone in LA? 8) Where is freshwater stored underground? 9) Non-bottled freshwater travels by ____ to get to LA. 10) What is groundwater? 11) Why is groundwater important? 12) Which river (paved or unpaved) carries water faster and why? 13) How will rainwater flow through a watershed once it hits a mountaintop? 14) And what do you think will happen to the water once it settles? 15) If I pour water into a glass of sand and a glass of rocks, in which glass will the water touch the bottom first and why? Four participants did not complete the second handout and received an NA across all answers.

Building literacy and connecting to the waterscape

To begin, participants differentiated between art and design, a rather new distinction for most. They defined good design as a "better state environmentally, for all animals and humans," and recognized that design thinking could be used to inform many activities. The teens realized that design is more complex than aesthetics alone and requires thinking about people and the physical environment they occupy. One participant described the thorough nature of the design process, where justifications are required for all choices.

When tasked with listing areas of heavy water consumption, the teens came up with many overlapping words and phrases. These primarily related to household activities. However, once they were introduced to new concepts like *virtual water*, participants used related terms, such as *blue*, *green* and *grey water* comfortably. One teen expressed:

> *Yesterday [my family and I] were going to my brother's [soccer] practice and we were just talking about the water and I told them about the green water, the blue water, and the grey water. They were like interested because you know it's something different than . . . you hear or we talk about.*

One teen remembered the names of water features she saw on the field trip, such as *bioswale* and *culvert*, while another remembered words and phrases she thought were cool like *cistern*. The design thinking workshop provided ample opportunities to repeat new terms because participants needed instructions to apply theoretical concepts to their design projects. Games like water pictionary served as an additional reminder of the vocabulary learned.

Participants described the importance of building literacy when involved in a topic for a long time. Multiple teens wanted to sound like they knew what they were talking about when teaching someone about a new concept. Participants passed along the words, phrases and concepts they learned to family members and friends:

> *I've told her [pointing to a friend]. I've also told my mom. And I keep telling my mom about it. She's like, "Oh, that's cool, you've learned a lot [sarcastically]."*

> *When I'm talking to [my family] about this . . . it just seems so fascinating for them, just the way it could be and how and why the river is like the way it is.*

The teens mentioned that it would now be easier to have conversations and explain "what's going on with the river" and "where we get our water from." One participant decided that while she might not change anything herself, perhaps her words and actions might serve as inspiration for someone else.

Other participants, however, weren't sure if they'd continue to engage in conversations about the drought. One teen saw building literacy as a long-term goal to return to in college. Others mentioned:

> *I'm probably not gonna touch on [the concepts learned] for a while because I'm not focusing on science at the moment, so I don't really need to.*

> *I feel like I might take a friend down to the river, show them it, just be like look this is really cool . . . it really just depends on the opportunity and what might be*

happening. If [my friends] don't ever bring up the drought, then I'm not really gonna have a chance to say anything.

While the LA River crossed most participants' daily commutes, many were surprised to see pools of water in an otherwise paved landscape. The teens recognized that the river was part of a larger ecosystem requiring diverse habitats for species to thrive. They began to question why certain areas supported vegetation and wildlife while others did not. Observing someone riding their bike directly through the shallow river reminded participants about the severity of the drought. Furthermore, links were made between trash found in the river and litter typically tossed out on city streets. One participant gazed in awe at an art instillation made from trash found in the river. Others were impressed with how human-made features, such as culverts, directed water flow. A teen noted that well-maintained trails along the river were an indication of care, and people *were* making a difference to improve the LA River.

Without ever coming in direct contact with the river before, participants ran toward the water, took pictures of public art framing the river's edge, climbed barriers and trees bordering the river, and paused to observe waterfowl. Prior to visiting Marsh Park, most participants were unfamiliar with wetlands and marshes. Safe, nice parks didn't exist in some teens' immediate neighborhoods. One participant expressed, "I have to admit, this place is pretty." Another teen was surprised to find that an individual's idea, such as a bioswale, could be fully realized in a public park. Participants mentioned that the bioswale, as well as other features like it, would have been overlooked had they not been informed of its function.

At the river, participants reimagined the floodplain. Their sketches included trees dropping shadows to prevent water from evaporating, a meander forming to slow water flow, as well as amphitheaters with scenic views, picnic areas and gardens to attract people to the river. While participants were reluctant to begin sketching, most were excited to find that the features they envisioned at the first two underdeveloped locations were actually present at the developed Marsh Park.

The influence of others

While some participants signed up for the workshop on their own, others were influenced by a friend. During workshops, the teens found comfort in working with a small group or partner on design tasks. Others enjoyed working alone and described having more ideas that way. Most participants looked over their peers' shoulders when beginning activities and asked each other for suggestions. Workshops were livelier when the teens already knew each other. They encouraged their friends to keep up and pay attention. Conversely, participants who were previously friends also distracted one another and had a harder time actually focusing. Some even requested extra time to refine their work the following day. Only one group was comprised of teens who did not know each other prior to the design thinking workshop. This group was shy and extremely polite. Handouts were completed quietly and thoroughly. However, despite whether or not participants knew each other prior to the start of workshops, all of the teens initially hesitated when asked to share their ideas with their peers.

Non-participating teens oftentimes tried to distract participants on purpose. For example, one teen passed by yelling "four days!" in disbelief that his peers had committed to an activity

for that long. Younger kids regularly stopped by and asked participants what they were doing. After the workshop, some participants continued conversing with one another about the drought and were excited to show each other their work. One teen asked if I could share her model with other groups. Other teens had previously told her that they'd like to see what she comes up with. After the workshop, she shyly approached me and said:

> *"I want to give you my model to use as a student example, because remember those girls…"*

Another participant didn't finish his project on the third day of the workshop and was visibly upset. That week I came in a fourth day to make prototypes with participants who had missed a day of the workshop. The teen approached me and asked if he could join the group to finish his project. When I agreed, his mood shifted dramatically. In a small group, he was extremely focused and finished his poster. However, when other teens and staff entered the room and asked what he was doing, he pretended not to care and quickly responded with, "[I'm] just finishing something I didn't finish last week."

Observation and brainstorming

Seeing the river in person is very different from pictures people put on the internet, participants remarked. Observation activities helped clarify the stark differences between paved and soil surfaces. Participants noticed the variation in rock sizes and hypothesized how infiltration rates would differ as a result. Surrounded by mountains and with the help of visual aids, participants questioned why so much water is imported without optimizing the capabilities of their own watershed. One participant exclaimed that he would now notice how the river flows. After seeing "the workings of the river" and the influence of design, he was excited to track any progress made. Another participant described areas for improvement:

> *I would just look at maybe an area that isn't like as nice or isn't as developed. I would just see, I think, possibility more than anything because I saw some of those sites and I saw what it could be and I think just some of those areas could be improved, and I guess I'll also be kind of bummed that they're not . . . it's not as prosperous as it could be, but I think more than anything I would just see like possibility for future [events]...*

The teens were shown images and reminded about groundwater and aquifers, watersheds, and aqueducts during the mapping activity that followed the field trip. Collectively drawing a large map of California, participants sketched landmarks like the Sierra Nevada Mountains, the California Aqueduct, patches of sequoias, as well as fast food chains and theme parks. Though all groups received minimal instructions about what to include on the map and were able to reference external images, most maps looked fairly similar at the end.

Returning from the river, most participants were excited to reimagine their workshop site. Walking around each site as a group, I pointed out landscape features that could direct water. Participants easily chimed in with more ideas. Nearly every group noticed inefficiencies like downspouts that led water to asphalt instead of vegetation.

Most participants had a hard time generating many ideas at once. A few described their process:

> *I think at a certain point you kind of do hit a wall . . . it is difficult because I think after like the third one I was kind of having trouble coming up with any new ideas and then I found myself kind of rehashing the same idea.*

> *Well it takes a lot of thinking, like a lot of creativity. You kinda have to have lots of ideas, put them on one paper and then separate those and then keep separating them.*

Nevertheless, after challenging themselves to imagine several ideas, participants found that having multiple options to work with was helpful. One teen explained that original ideas came when she "allowed [herself] to think outside the box." Another participant commented that generating ideas was easy, but executing them was difficult. Exposing participants to images of stormwater capture systems at other sites was beneficial. The teens were encouraged to look at their peers' work for inspiration and prompts were provided if they got stuck. While most participants remained on track, one teen was disengaged and created a list of ideas about basketball rather than sketches about water despite the instructions given.

Ideation and prototyping

"It's fun to think of what [my idea] could be," stated one teen. Other participants were unfamiliar with iteration and were confronted with the difficulties of committing to a single concept and improving it overtime. One participant described the dilemma she faced:

> *I think that once you pick one idea you definitely do start to see flaws or just benefits more. So you kind of think of it critically, because when it's just five ideas that you have, you're kind of thinking of all of them just in general . . . But I think once you really pick one you kind of get attached to that one and you wanna see [it] become true.*

Once introduced to the environmental evaluation criteria (see table 3), participants selected their final ideas for a variety of reasons. For example, one teen selected a bioswale because she saw one on the field trip. Another participant landed on his final idea because it would require the least amount of effort to implement, but had the most impact overall. Similarly, one teen decided on her concept because it was practical and easy to build. Many teens considered the costs associated with building their designs. One teen explained:

> *We don't really get too much rain here, so I thought if we splurge on something that really depends on us having a lot of rain we're just gonna be in a hole, you know financially. So, I just did something that wouldn't cost too much but would still be effective, like I kind of found a middle ground...*

Once they began working on larger posters, participants slowed down and refined their drawings. Professional marker paper and felt tip pens were provided. Upon seeing the materials, one teen exclaimed, "wait, this is like the final-final one?" and another similarly paused and

commented, “Oh, okay, this is like official.” With nicer materials, most participants also took their projects more seriously. The teens now asked more questions like “will that be enough to get the point across?” and requested my approval before moving forward. Similarly, most participants put a lot of effort into refining their designs and helped their peers as well. They explained:

> *When I commit, I put both feet in. Just like, go big or go home . . . if it's commitment, it's full commitment.*
>
> *I’m gonna keep doing this until I finish. Like it’s my design, I’m gonna keep it, I’m gonna stay with it.*
>
> *I feel like if you commit to it and you know what you want, you're gonna get something out of it. And even if it takes a little bit longer, it's still worth it to create a project that's gonna help other people and that's gonna do something good...*

Participants carried this enthusiasm into building their models. Working in 3D helped them envision how their idea would “work if it was put into real life.” They were able to fine-tune details that were overlooked in their posters. For example, one teen struggled figuring out how rainwater would flow through his model. Another participant noted, “It's helping me a lot because I could probably actually do this.” Several participants commented that model-building was their favorite part of the workshop. One teen, however, mentioned the difficulty of making precise shapes with the materials available, “the harder part was cutting rain drops from duck tape [laughs]. That was just horrible.” The teens were excited when they found out they could keep their models. One participant exclaimed that his grandmother “won't believe that [he] made it himself, she'll think someone else made it.” Others couldn’t keep their models due to space limitations and younger kids in their homes, but kept their posters.

Regardless of each workshop setting, many designs included overlapping ideas. While participants easily incorporated green infrastructure into their designs, reshaping the landscape’s topography to optimize gravity was a harder concept to understand. Participants easily grasped the benefits of connecting downspouts to rain barrels and underground cisterns, rock and vegetable gardens for infiltration, and trees. One participant split and redirected a downspout to multiple areas for infiltration. Another teen addressed a very real challenge at her site by positioning a garden directly below a dripping AC unit. Two participants included bioswales in their designs. Others relied solely on grey infrastructure, with a system of pipes carrying water to plants, underground cisterns, aquifers and the LA River. Roofs and fields were slanted and rounded to maximize water collection as well. A few participants considered how stored water would be used and included smart sprinkler systems in their designs. One teen added an educational component to her design by suggesting signage that explains the benefits of green infrastructure to younger kids. A couple of concepts included topographic changes such as small hills or berms with culverts to better direct water.

Several considerations were noted when evaluating final concepts. First, ideas were difficult to judge because not all decisions were overtly expressed. For example, many participants added vegetation to areas designated for water infiltration. However, some considered the resulting improvements to water quality, while others did not. Second, in one

group, a similar concept appeared across almost all participants' models. Furthermore, participants' ideas varied in scale, making it difficult to assess the degree to which interrelationships were considered. Some participants, for example, considered the entire landscape, including the highway running adjacent to their workshop site. And finally, participants' sketches included many thoughtful ideas that were ultimately left out of their final designs. While three teens could not attend the last day of the workshop to build a model, two of the three completed posters illustrating their final concepts.

Final concepts were evaluated based on a scoring rubric (see fig. 3). Participants' scores were then assessed in conjunction with their at-risk status. Preliminary findings showed the following: 80% of participants who are considered not at-risk scored in the top half of the entire group; 60% of participants who are considered at-risk (category 1 and 2) scored in the bottom half of the entire group; 67% of participants who are considered at-risk, category 1 scored in the bottom half of the entire group; And participants who are considered at-risk, category 2 fell evenly across the top and bottom halves of the entire group (see fig. 2).

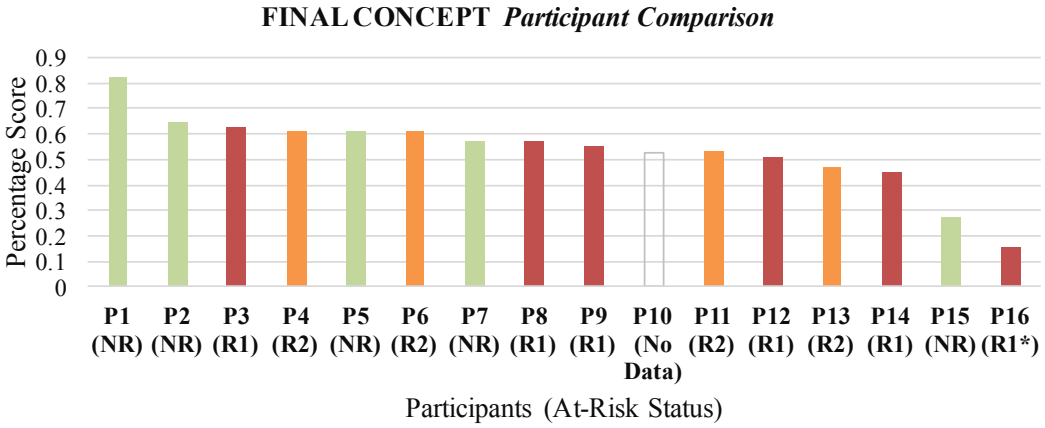

Figure 2. A comparison of participants' final concept scores and at-risk status. Participants are shown in four main categories: not at-risk (NR); at-risk, category 1 (R1); at-risk, category 2 (R2); and no data. The seventeenth participant did not complete a poster or model and was not included in this evaluation.
*While this participant did not complete a formal questionnaire indicating his at-risk status, a verbal account of past experiences that place this participant in at-risk, category 1 was provided.

Applying a set of criteria to evaluate participants' final concepts also revealed specific areas where the teens succeeded or struggled. For example, most participants thought of their site as an entire system and clearly applied concepts learned in the workshop. They considered how the features of their design would work with the existing landscape, how topography would direct water, and where water would be stored for later use or infiltration. In contrast, most participants avoided labeling features of their model and did not account for humans or other species in their ideas. They did not consider evaporation or the speed of infiltration in their designs, and did not include floodplains. Finally, most teens did not consider the natural tendencies of water, such as meandering.

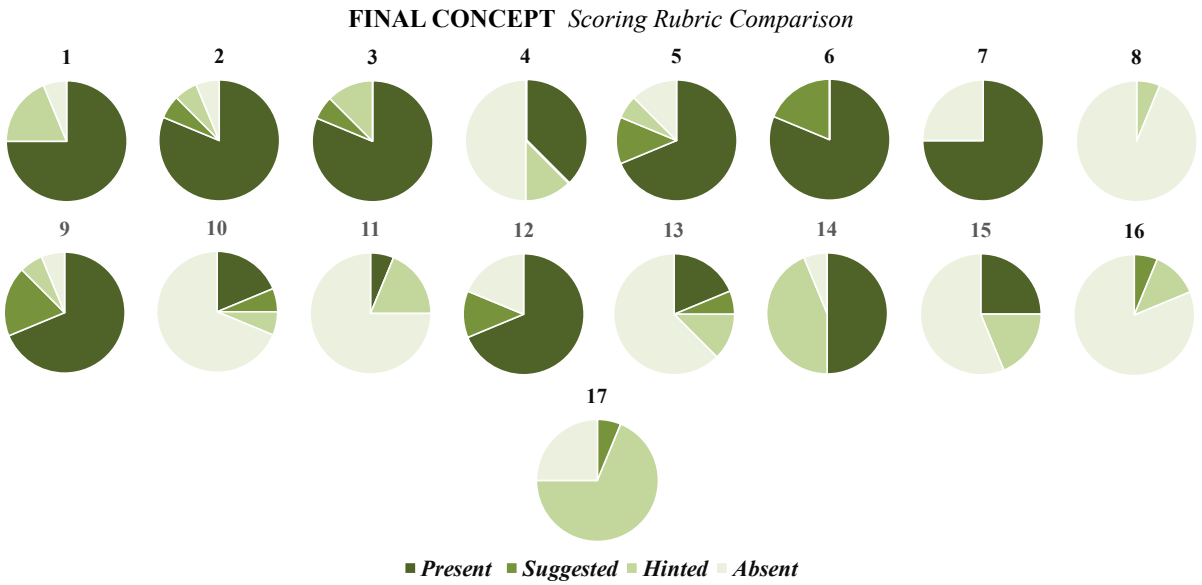

Figure 3. A comparison of scoring criteria based on participants' performance. The following criteria were used: 1) Model features represent a whole system; 2) Relationships between model elements are clear; 3) Model features relate to concepts discussed in workshop; 4) Labels include language learned in workshop; 5) Demonstrates understanding of how green infrastructure solutions work; 6) Considers existing features of site; 7) Landscape topography directs water; 8) Considers natural tendencies of water; 9) Includes infiltration areas; 10) Considers speed of water infiltration; 11) Includes floodplains; 12) Includes areas where water is stored for direct use; 13) Considers evaporation; 14) Indicates where water consumption can be reduced on-site; 15) Considers human factors; 16) Considers other species; 17) Considers water quality.

Thinking critically

Participants left the workshop with a raised awareness about the built environment. "I don't think I would even be asking the questions before," commented one participant. The teens also raised questions about infrastructure above and below ground-level. Some considered the importance of converting to a less meat-intensive diet for water conservation, while others thought deeply about urbanization and population growth:

> *There might be millions of gallons of water everywhere in LA, but there's more than that much people and they don't have enough water for each person . . . That's a little bit harder to understand because when you think of water you see all these lakes. You see so much water, but then like if you were to divide it for everybody it's not enough.*

The teens wondered why seemingly simple solutions were not being implemented. One questioned, "it kind of made me mad in a way, but it's just like some of these [solutions] aren't even that hard [and] they wouldn't cost too much money." Another participant added, "there is a way to fix things . . . instead of just learning about something, reading books, looking at stuff, you actually get to think of ways to help out." He continued, "and you never know, you might be

able to use that idea later in life for something completely unrelated." Participants also recognized the expertise they could offer. One teen commented:

> *I'm an expert on what's what in North Hollywood, California. But some people that have never been here wouldn't even know this place exists . . . They hear that California has a drought [but] they don't know like what it is . . . how it affects us.*

Confidence, empowerment and reflecting on individual performance

Reflecting on their performance, most participants were proud of their accomplishments. While participants compared their designs to those of their peers, for the most part, all of the teens were glad they stuck to their own idea. One participant expressed:

> *Knowing that people like my idea makes me feel like, oh if I can get it to be this good, maybe I can continue coming up with ideas like this.*

Even while recognizing that their ideas would not be implemented, many teens still felt that their solutions were important and helpful. Receiving compliments from other peers and staff, including teen directors, also boosted participants' confidence. One teen exclaimed, "well if I could do this one thing then maybe I can do something greater." Another teen said in retrospect, "I do look at [my idea] and I'm just like, this was good, I like this." Some participants, however, did not want to present their ideas to their teen director and said they have social anxiety. Most participants easily grasped the workshop content. One teen mentioned that hearing something and then doing it was helpful. Ultimately, several participants envisioned themselves contributing ideas, but did not consider themselves leaders. One explained, "I don't really see myself as the type of person that can, you know, solve a big problem or anything."

Most teens were insecure about their drawing ability at first. Stick figure drawings were shown as examples throughout the workshop to reduce insecurities. Similarly, nearly all participants expressed that they were not creative. One participant explained that she could instead help with "the logical side of [a project]." Further, this teen expressed that because she's a perfectionist, trying to realize an idea raises additional insecurity and fear. After throwing away a sketch, she asked me whether I liked her poster several times, making sure that I was being honest. That said, over the course of the workshop this participant's confidence in drawing increased. While working on her poster she asked, "Did I mention how much I like this? I made something bad into something decent [pointing to her drawing]." Another participant felt insecure about writing and hesitated to write a description of his idea on the poster. After some deliberation, he eventually wrote a sentence in pencil, but didn't want to trace it with a felt tip pen like the rest of the poster content.

Integrating design thinking

Participants pictured design thinking in schools, clubs, out in nature or in everyday life. One participant envisioned design thinking offered as an elective alongside engineering in school. Another teen mentioned that she would tell her department head about the workshop so that it could be replicated at her school. Some participants imagined that employing the design process would help their ideas stand out regardless of where they were. One teen mentioned that

she “can see this approach being used [to address] theoretical problems” and wanted to use the environmental evaluation criteria (see table 3) to make life choices. Further, she expressed that the models would be more relatable if they were implemented on-site. Many participants agreed and said they would commit to a longer program if this were the case.

The teens also pointed out areas for improvement. One participant mentioned that including step-by-step instructions with a clear start and finish, as well as demos for some of the activities would be helpful. She found the ambiguity of the observation activity difficult, but appreciated aids like the poster template.

Because each participant worked at a different pace, including additional tasks for those who work at a fast pace and make-up sessions for those who work at a slow pace was valuable. Asking participants to help their peers if they finished early was another strategy that worked well. While time was limited, building in unstructured time sparked numerous conversations. For example, walks through field trip sites and snack breaks opened up opportunities to get to know participants. Furthermore, asking the teens to create music playlists to listen to during ideation and prototyping activities broke the ice and provided great fodder for conversation.

CONCLUSION & IMPLICATIONS

As design thinking gains traction in educational settings, the aim of this research is to contribute to the growing body of literature bridging the fields of design and environmental studies. Creating accessible pathways to engage at-risk students in environmental challenges can potentially solidify their involvement in current and future environmental movements, which are in need of diverse voices. A fully funded research program offering skills enrichment to teens was widely welcomed by under-resourced youth organizations. As such, several considerations are outlined below. It is my hope that this study will be of relevance to fellow researchers and educators working at this intersection.

Recognizing the ethical challenges associated with over-incentivizing research participants, snacks were offered during workshops as a compromise between overly persuasive and ineffective gifts. That said, the opportunity to go on a field trip sparked participants’ interest most often. While additional online resources were distributed, opportunities for sustained involvement in similar projects were lacking. However, most of the youth organizations involved were happy to support participants in pursuing related projects down the line. With limited resources, single-handedly preparing workshop materials was a labor intensive process that would have been better supported by a research team. Additionally, following students who have been immersed in this approach for a long period of time and comparing their success to that of other students would likely reveal even greater insights. For example, running the research study as an elective course during the school year would alleviate coordination challenges. Yet, it’s important to note that one-on-one attention, a potential contributor to workshop success, would be significantly reduced in a classroom setting.

Given the increasing environmental hurdles cities now face, it’s crucial to leverage teenagers’ genuine concern for the environment and passion for making a difference. Seeing at-risk teens motivated and enthusiastic about solving complex, real-world problems emphasized the significance of design thinking, a teaching and learning methodology that rewards

overlooked strengths, develops underutilized capabilities, and recognizes the potential of at-risk students. Furthermore, exposing at-risk teenagers to a variety of teaching and learning styles can help foster their interest in staying in school, going to college, and ultimately finding gratifying employment. Most importantly, though, design thinking can help support at-risk teenagers in recognizing the tremendous value of their own ideas.

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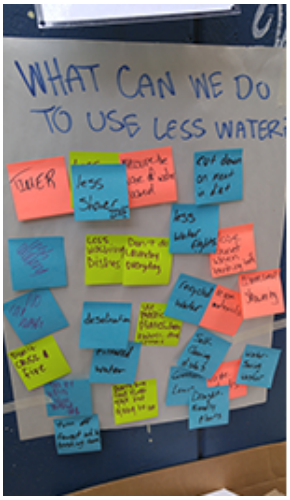
APPENDIX 1

Figure A.1. Evaluation handout



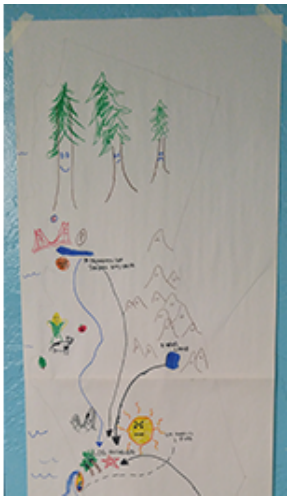


Figure A.2. (left) Brainstorming exercise: Where does water consumption occur?
Figure A.3. (right) Mapping exercise: Where does our water come from?

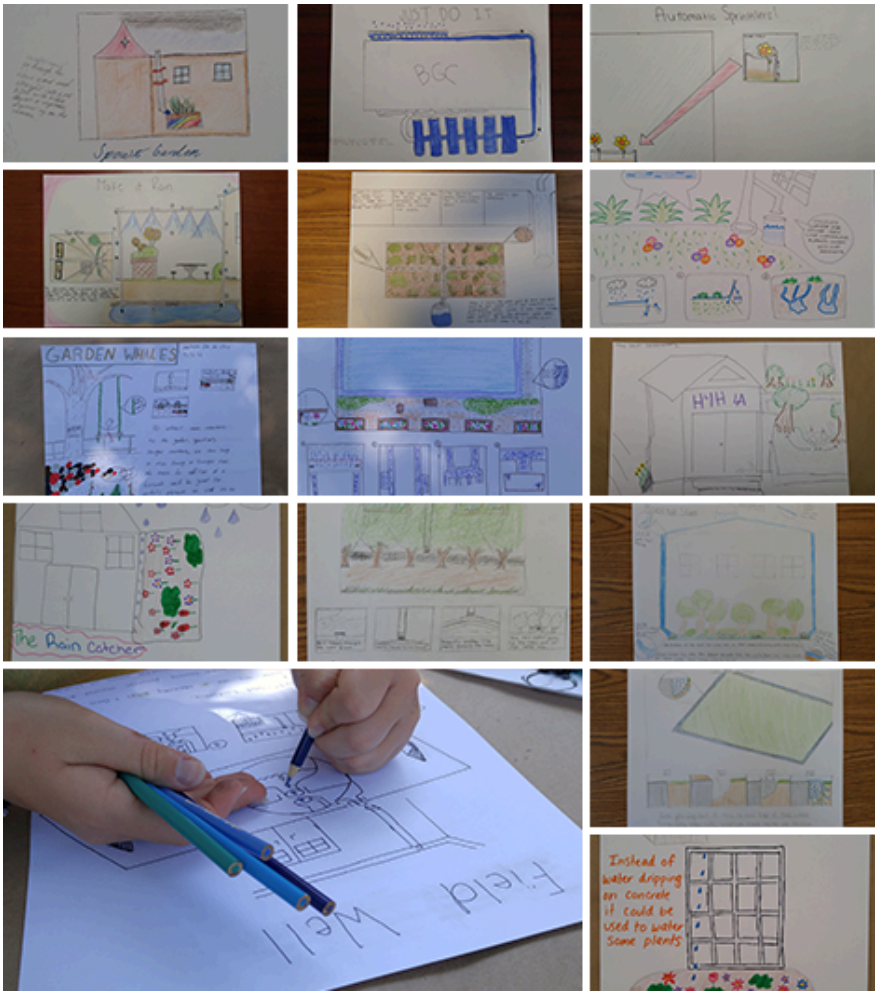


Figure A.4. Examples of posters.

Figure A.5. Examples of models.