TRUST, STUDENT CHOICE, & INSIDER STATUS: PREREQUISITES TO BUILDING GIRLS' SCIENCE SELF-CONFIDENCE

Praxis Project Thesis: Submitted in partial fulfillment of the requirements for the degree of Bachelor of Arts — as part of the Community, Youth, and Education Studies Major at Clark University

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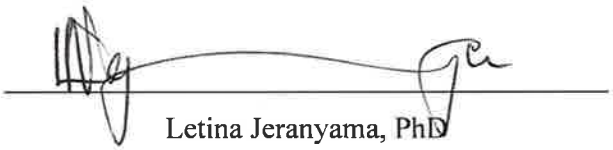

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ABSTRACT

It has overwhelmingly been shown that female-identifying, especially female-identifying students of color go into, and stay in, STEM fields (in higher education and their careers) at a significantly lower rate than their white and male counterparts. This inequity is what inspired the initial aim of this project: to build girls' bravery, self-confidence, and knowledge of role models through an afterschool STEM program. Through challenges in project implementation, numerous new themes emerged. These were: trust between students and practitioner, student resistance as a manifestation of student agency, and practitioner outsider status at the praxis site. The data collected showed that trust, student choice, and some degree of insider status for the practitioner were critical components of effective science teaching and learning.

ACKNOWLEDGEMENTS

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INTRODUCTION & RESEARCH QUESTIONS

In April of 2021, I taught a pilot lesson from the curriculum I planned to implement in my praxis project to a group of sixth-grade girls at the Latino Education Institute (LEI) in Worcester. My final praxis project is a research project which aims to be community-engaged and socially transformative. Praxis is the culminating work in the Community, Youth, & Education Major at Clark University. In my guest lesson at the LEI, I presented a Latina Women in STEM slideshow and talked about Latina women from many different cultural origins who are successful in diverse STEM fields. After I talked about Vanessa Galvez, a Salvadorian civil engineer who grew up in Queens, New York, one of the girls spoke up excitedly to say: "*I'm* Salvadorian and my Grandpa lives in Queens, New York!" The next scientist in my presentation was Scarlin Hernandez, a Dominican spacecraft engineer who works for NASA. Another student responded to this slide saying "Wait what?! Women can work for NASA? Am I the only one who is just now finding this out?"

It has overwhelmingly been shown that female-identifying, especially female-identifying students of color go into, and stay in, STEM fields (in higher education and their careers) at a significantly lower rate than their white and male counterparts ("The STEM Gap," 2021). I suggest, as other researchers and organizations have, that early exposure to STEM in an affirmative, female- and BIPOC-centered curriculum is a necessary step toward closing the gender gap in STEM. The adage "you cannot be what you cannot see" is of particular significance in the plight of women in STEM. Mosatche et al. (2013) write that "the most effective role models are likely to be those who come from backgrounds similar to those of the participants; the similarity can encourage girls to imagine that they could be in those positions one day" (p. 24). This declaration suggests that knowledge of role models is critical in forming a strong scientific self-concept.

When I began my praxis project, I was chasing the excitement of breakthroughs; a student realizing Latina women could work for NASA for example. I wanted girls participating in my program to understand 'I can be a scientist,' and 'there are women who look like me who are successful scientists.' My primary goal was not to have them all express interest in STEM careers by the end of the program but simply to know that they could succeed in STEM if they wanted to.

My initial research questions asked about the efficacy of my curriculum and program in achieving these goals.

- RQ1: Can a curriculum dedicated to empowering and inspiring female-identifying students in STEM improve their self-concept, self-confidence, and bravery in STEM?
- RQ2: Can a curriculum dedicated to empowering and inspiring female-identifying students in STEM improve their knowledge of role models in STEM?

Once I began implementing my project, it became evident that I was not studying the simple application of a curriculum and its impact. Rather, I was encountering numerous challenges in classroom management, student interest, student agency, and trust between myself and students. I added a third question:

- RQ3: How does choice and interest impact engagement in Out-of-School Time (OST) programming?

And a few months later I added a fourth:

- RQ4: Are consistency and trust more important to effective OST programming than curriculum design and content?

This thesis paper is the story of two projects: the one I set out to do and the one I actually did. I initially hoped to implement a structured curriculum that addressed various topics in Science, Technology, Engineering, and Math along with community building activities and a heavy focus on role models, particularly women of color, in science. I imagined myself and a group of students creating a community in which we would discuss ideas, experiment, and be excited to learn. I learned early on that I had underestimated what it would take for students to trust and engage with me. I discovered that many factors, including the setting at my Praxis site, the time of day, the component of student choice, and my initial outsider status had a massive impact on my project implementation.

ETHNOGRAPHIC CONTEXT: PRAXIS SITE & PARTICIPANTS

My praxis site is the Central Community Branch YMCA in Main South Worcester (“The Y”). The Y offers fitness facilities for members as well as a variety of school year childcare programs and summer camps. My praxis project is under the umbrella of the “School’s Out”

program which is open to children[1] in kindergarten through sixth grade. It is important to note that attending the Y is not free. Attending School's Out five days per week costs $98 weekly. However, many families receive state subsidies (vouchers) and YMCA financial assistance to fully or partially cover the cost. 86% of the children in the program are on some sort of financial assistance (Suprenant, personal communication, 2022). This fee decreases with fewer days in the program. I had no prior experience at the Y when I began this project in late September 2021. My role expanded from volunteer to paid staff member in October at which point I began spending more time at the Y.

For my praxis project, I facilitated a 1-hour science lesson on Wednesdays and Fridays from 4 pm until 5 pm. In the recruitment and consent materials sent out to guardians, the program was described as "an afterschool STEM program." It did not have a formal name. Staff and children quickly adopted the simple term "STEM" to refer to the program. Initially, I had between 10 and 20 girls at a time, who ranged in age from 8 to 12, in the room. The girls had not chosen to be there, rather all girls within a specific age bracket were scheduled to come. During the first several sessions I usually had another Y staff person in the room with me. This person's role was mostly classroom management because they knew the children better than I did and they didn't know my curriculum.

The children at the Y are bused there at the end of the school day between 1:30 and 3:30 pm depending on the school. Once at the Y, the children go to their assigned room (grouped by age) and are given a snack similar to a school lunch. They have time to do homework; then, there are 1-hour blocks of activities like art, games, going to the gym, swimming, or playing outside. This lasts until they are picked up, which for some children is as early as 3 pm and for others is as late as 6 pm. On days when I ran my program, the girls were taken out of their other activities at 4 pm and gathered in one room together where I attempted to engage them in structured, semi-academic activities. The lack of choice and timing (late in the day) paired with my semi-academic content became my first major challenge which I will discuss further in the Findings section.

[1] The word "children" replaced the word "kids" throughout this document during a later editing phase when my reader, Pam Suprenant, explained that "children" is more appropriate/industry standard. The word "kids" remains where I am quoting earlier writing.

The Participants

The participants included 3rd, 4th, 5th, and 6th graders. I ultimately chose to focus on the 4th and 5th graders because they make up the largest portion of the group, they participated and engaged the most overall, and as 4th-grade staff, I have the most context for them. Of the initial group of 20 students, 3 presented as white to me, 10 as Black, and 12 as Latina. Many of the Latina students are also Black which is why the total of racial and ethnic identifiers is higher than 20. These racial and ethnic identifiers are based on how students appeared to me, how they described themselves at various times, and my knowledge of them from my work at the Y. Within the group, at least two had a family member who worked at the Y, more than half had at least one sibling or cousin also attending the Y, at least two were in foster care, and at least two lived with a grandparent as their primary guardian. Within the original STEM group, I had one sibling set and one pair of cousins. To maintain the confidentiality of participants, these descriptors are kept general and I will not identify which participants specifically fall into which of the categories I have described. All research participants were given pseudonyms which are used throughout this paper.

Pseudonym	**Grade**	**Description/notes**
Isabela	4th	Full participant
Genesis	4th	Full participant
Anaya	5th	Full participant
Sofia	5th	Full participant
Valeria	5th	Full participant, initially VERY wary of research
Marjani	5th	Full participant
Danae	5th	Non-transcription participant, initially wary of me and hesitant to participate, changed over time
Kaitlyn	4th	Non-transcription participant
Angelie	4th	Non-transcription participant
+4 non-consenting older girls		13 total older girls – 6 full research participants – 3 partial research participants – 4 Non-participants

Younger Girls		
Daniela	3rd	Full participant (rare attendance and low participation)
Serena	3rd	Full participant (rare attendance and low participation)
Camila	3rd	Full participant
+4 non-consenting younger girls		7 total younger girls – 3 full research participants – 4 Non-participants

On the first day of my program, a Wednesday at 4 pm, students at the Y were brought by another Y staff person into a conference-style room with me and told to sit quietly around a rectangle of tables. Before that day they did not know they would be part of a STEM program. Several of them walked in saying "my parents didn't sign me up for this" or "why am I here?" I began by introducing myself, then my research, and then launching into my mandatory Institutional Review Board (IRB) protocol of assent and oral consent. I did my best to remain upbeat and enthusiastic and to give them brief stretch breaks. In the context of my later experience at the Y, I now realize that this first session was still vastly different from the more play-based activities which they usually have there after school. As a result of their introduction to my program, I unknowingly set students up to begin from a point of apprehension, apathy, or outright resentment at having to be in my program. As a volunteer with no prior experience at the Y, I didn't know that structured academic activities were rare in the OST program and that art, games, and movement make up the majority of their afterschool activities. My initial program structure was incongruent with "usual Y things" in that I was asking children to engage in a semi-academic activity followed by a group discussion which was similar to school. This contrast between the first STEM session and the rest of their experiences at the Y is what I think caused students to be resistant to the program.

Within the group, I had students who were close friends alongside students who refused to work together because they "had too many problems" with each other. I had children who were outwardly excited to be there and do the activities and students who rolled their eyes, put their heads down, asked whether they had to be there, and generally expressed disinterest and frustration. Attendance was sporadic. Most children weren't there every session and many left throughout the hour we were together. Students were usually tired. They start school between 7

and 8:30 AM and then come to the Y around 2 PM. They were nearing the end of a long day when they reached me at 4 PM. These factors combined to make the environment chaotic most days.

The Rooms

One of the challenges I encountered in my program implementation was that I had no control over the physical design of the room I was in or even *which* room I was in. Due to various Y programming, limited space, and renovation projects, I held my program in several different rooms over the course of several months. Collier-Meek et al. (2019) identify the physical design of the classroom as the first of three foundational best practices for classroom management (p. 349). Second on their list is routine, followed by positively stated expectations. The unpredictability of physical space for my program (both in room layout and in routine) meant that I encountered greater challenges in behavior and classroom management than I might have otherwise.

We met on the first day and most often in the "Community Room," a conference room on the first floor with windows to the street outside and the YMCA lobby inside. There were long tables arranged in a large rectangle with chairs around the outer perimeter. Sometimes I left this setup but more often I moved the tables around to set up areas for group work or make space for us to move around the room.

Figure 1. This image of the Community Room that we were in initially and most often, comes from the Central Community Branch YMCA Facebook page and was not taken during my program.

We also met in several other rooms depending on availability on any given day. For a few sessions, we were in the Rock Gym (Figure 2) which posed serious challenges in attention and group management. For a few of the sessions, we were in the Purple Room (Figure 3 & 3.1) which is “my room” where I work regularly with the fourth-grade group. We also had one session each in the Board Room (5th grade’s usual room) and the Orange Room (3rd grade’s usual room).

Figure 2: The Rock Gym

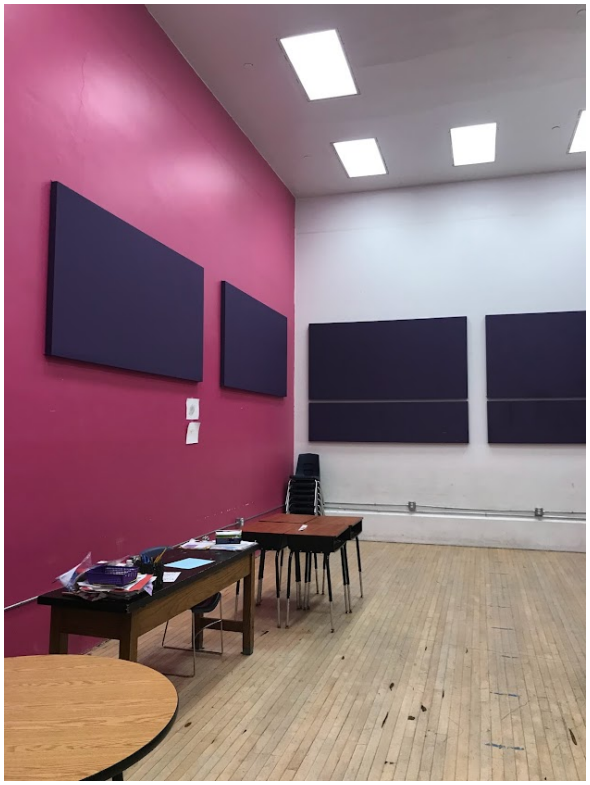


Figure 3 Left: The "Purple Room" before floor replacement and reorganization, Figure 3.1 Right: The "Purple Room" after floor replacement (close to as it is now).

MY POSITIONALITY & IDENTITY

Cann and DeMeulenaere (2013) explain that it is impossible or nearly impossible for researchers to disentangle the colonial relationship between themselves and the participants of their study. They write, "In the process of researching, the voices of the subaltern become secondary to the voice of the researcher who frames, narrates, discusses, analyzes and otherwise interprets the words of the researched" (2013, p. 557). "Subaltern" describes, to quote the definition that topped my Google search, someone "of lower status." More academically phrased, subaltern, refers to a socially, politically, and geographically excluded group (Subaltern (postcolonialism) in *Wikipedia,* 2021). This framing, while in many ways accurate, is deficit-based in the context of my project. It is important to note that, while I hold privilege and power in the space of this research project, the children who participated in the STEM program hold valuable knowledge and also initially held some power through their position as YMCA insiders. That being said, aspects of my identity, as McIntyre (2007) writes, inform "my ability to listen, question, synthesize, analyze, and interpret knowledge throughout the PAR process" (p. 8). While I do not think my praxis project fits into the category of Participatory Action Research (PAR), McIntyre's words still apply to me as a researcher. My identity has shaped my approach to this research and praxis project.

To claim objectivity in a qualitative practitioner inquiry study such as this one would be to misrepresent the study and lose valuable context for data and analysis. It is far more useful to bring my subjectivities as a researcher to the forefront and interrogate how they impact the research. Herr and Anderson (2005) write:

> A common mistake in this type of research is to treat one's personal and professional self as an outside observer rather than as an insider committed to the success of the actions under study. We find it is difficult and perhaps deceptive to attempt to separate the study of one's self and practice from the study of the outcomes or actions initiated in a setting (p. 33).

As sole designer, implementer, and researcher/observer of the STEM program which this praxis project is about, I was certainly "committed to the success of the actions under study" as Herr and Anderson say. My total absorption in all aspects of the project gives me a unique perspective on it yet I am also limited in my ability to see the "bigger picture" and to see the data objectively. The foundation of this Praxis Project is rooted in my values and experiences. Furthermore, changes in implementation throughout were largely made as a result of my feelings

about the process. Sigurdardottir and Puroila (2020) remind us that in Collaborative Action Research (CAR) "the researcher not only works rationally, but also has emotions that affect his/her role. The role, therefore, is rooted in both the researcher's heart and mind" (p. 95). While this study is practitioner inquiry and not CAR, Sigurdardottir and Puroila's observation about emotional involvement in the research holds true.

I came to my praxis project optimistic and with lofty goals. I was influenced by my positive experiences as a STEM student and teaching high school students at the Girls Who Code Summer Immersion Program for two years. I hoped to recreate the energy and atmosphere of this wonderful and transformative program with a group of younger students. My aspirations for a collaborative, joyful community that quickly formed trust through fun community-building activities each session were not realized in my first few weeks at the Y although some of these themes did emerge later on.

I came to the Y seeking out a Praxis site, without any prior experience with the organization. This made me an outsider. Students were unfamiliar with me, and as an outsider, I had limited knowledge of the rules, routines, and structures of the Y. This positioned me as less of an authority figure than other Y staff. Shortly after beginning my project implementation, I was also hired as a Y staff person, separate from my STEM program, which allowed me to become more of an insider over time and develop a better understanding of the context which my participants come from. The theme of outsider versus insider status is further explored in the findings section.

When my first few sessions with a group of tired students who had not chosen to be there devolved into chaos, I was forced to reconsider my motivations and goals for the project. I realized that I was out of touch with the students' experiences and interests. I had underestimated what it would take to get them excited about my program and to trust me. Their first introduction to me was as a college student, researcher, and YMCA outsider coming in to make them participate in a program they didn't necessarily want to be part of.

My excitement about STEM programming is rooted in my belief that it can be fun and community building, especially among girls, since that has been my experience. I have witnessed girls experience breakthroughs in understanding that they *can* do STEM and that they *enjoy* it after not believing either of those things to be true. As a result of societal stereotyping in schools, toys, and adult demeanor, girls often learn that STEM is not for them and that they "wouldn't

like it anyway." It is a powerful and exciting bonding experience when a group of young people breaks through these stereotypes together. This phenomenon is what I was hoping to replicate when I chose the focus of my Praxis Project.

My introduction to the students and their initial–largely negative–reaction to the STEM program raise the question: Who does this research serve? While the CYES department at Clark frames the Praxis Project as "original, self-directed work of consequence for the neighborhood or community at large," upon reflection it seems that my project primarily benefits me and my path through higher education (Community, Youth, and Education Studies Major, ClarkU.edu). Whether, and to what extent, I believe this project had or will have a lasting impact–on me, on participants, or the YMCA–is further discussed in the Findings section and Conclusion.

A telling example of my positionality as a researcher relative to the participants in the study is that one of my participants, Danae, did not assent to audio transcription. While her guardians gave full consent to research participation, Danae herself only assented to me using photographs of her work and writing field notes. Group audio captures powerful segments of her speaking and my experience with her was one of the most dynamic of all the participants. I found myself wishing that she had given full assent so I could use some of the fascinating audio which includes her voice. My desire to use transcripts of Danae speaking illustrates how quickly research can become exploitative. Particularly in the context of this study where I am a white, socially privileged, college student and my research subjects are largely of marginalized identities and almost all living in poverty. While I could purport that my Praxis Project had a positive impact on the girls involved, such a claim is difficult to quantify and support. On the other hand, there is no doubt that the attendance and participation of the children involved in my STEM program and research made the completion of this thesis possible. For that I am grateful to everyone at the Y but I also regret that this project was set up in a way where I was essentially guaranteed to come away having benefited and the children—and YMCA program as a whole—were given no such guarantee.

LITERATURE REVIEW

This praxis project initially focused on curriculum design and implementation. Therefore, the literature review was originally conducted to provide background for curriculum to empower and engage girls in STEM. As the project evolved, it became clear that a review of the literature

on trust in youth spaces, insider versus outsider status in youth spaces, and student agency was relevant and necessary. I approached the literature review by focusing on key themes and concepts as search terms. For example, I searched for articles which discussed "elementary STEM programming for girls" and those which addressed "self-concept in STEM." I also relied heavily on citations in key articles to find related works. I made sure to look at any paper or author who was cited repeatedly in literature I was reading. What follows encompasses both out-of-school STEM education and the dynamics of choice, agency, and trust.

Girls' STEM Education

Literature on girls' STEM education consistently emphasizes the importance of role models as well as of encouraging self-concept and self-confidence. Mosatche et al. (2013) found that "role models are instrumental in getting girls interested in technical careers" (p. 24). Halpern et al. (2007) in their practical guide "Encouraging Girls in Math and Science" note that "girls, particularly as they move out of elementary school and into middle and high school and beyond, often underestimate their abilities in mathematics and science," in other words they lack self-confidence in STEM (p. 6).

In relation to self-confidence, self-concept and identity were indicators of STEM outcomes identified by Dou et al. (2019) who found that being seen as a "science person" and then seeing oneself as a "science person" were important (p. 9). They also found that "students at the high end of [the] STEM identity indicator had 21.7 times higher odds of choosing a STEM career than did students at the low end of the identity indicator" (Dou et al., 2019, p. 17). Halpern et al. (2007) also found that girls who "have a strong self-concept regarding their abilities in math or science are more likely to choose and perform well in elective math and science courses…This is noteworthy because it suggests that improving girls' beliefs about their abilities could alter their choices and performance" (p. 6). Halpern et al. (2007) propose several intervention approaches including that female students should be explicitly taught that their academic abilities are expandable and exposed to female role models who are successful in STEM (p. 7). Hill et al. (2010) support this recommendation as well, drawing on Carol Dweck's concept of a "growth mindset" (p. 30). Berwick (2019) explains that: "Adding images of female mathematicians or scientists throughout classroom materials and assigning individual or group work that summarizes or contextualizes women's achievements in these subjects can also shift

perceptions about who belongs." The literature agrees that representation in role models is critical. Therefore, in keeping with my Critical Race Theory (CRT) theoretical framing, role models must be considered from *both* a race and gender perspective.

Ireland et al. (2018) caution against the "the rhetorical focus on 'women and minorities' in STEM" since it risks "obscuring the particular experiences of individuals who exist as members of both groups" (p. 227). Rainey et al. (2018) respond to the phenomenon that "often studies produce data about "women" that is only true for white women, leaving the experiences of women of color in STEM classrooms largely unexamined" (p. 2). In their efforts to fill this gap in the literature, Rainey et al. found that women of color "were the least likely to report a sense of belonging when compared to all other students" (2018, p. 5). Though they caution against over-asserting the weight of this finding due to the small sample size, they concluded that:

> As a student's demographic group becomes less represented, the less likely a person is to report a sense of belonging. We also note that lower sense of belonging was most commonly reported by people of color, suggesting that race significantly impacts belonging, perhaps even more than gender." (Rainey et al., 2018, p. 6).

We can infer from these findings that intentional representation of historically marginalized racial groups in STEM curricula is as important as increased representation of women and other marginalized gender identities. Kimberlé Crenshaw, who is credited with coining the term "intersectionality" in 1989, clarified in 2016 that "her original articulation of intersectionality was a theory not of multiple identities but of how holding certain identities makes one vulnerable to discrimination and exclusion" (Ireland et al., 2018, p. 230). Black, Latina, Asian, and Native American girls are all more likely to lack representation in their STEM curricula than their white peers since they experience compounded exclusion based on race.

Rainey et al. (2018) identified four themes central to a sense of belonging; these were: "interpersonal relationships, science identity, personal interest, and competence" (p. 6). Belonging, self-concept, self-confidence, and role models are all closely related. The literature agrees that these elements are central to facilitating girls', particularly girls of color's, interest, persistence, and success in STEM. In order to encourage the development of positive attitudes toward, and experiences in, STEM, curricula should be culturally responsive. Patchen et al. (2015) note that

> legitimizing participants' home and background knowledge or practices of knowledge building, giving participants ownership over what counts as science and science practices and helping participants navigate conflict between home practices and those valued in science can improve experience and access for participants who have typically been excluded from science (p. 281).

Although they don't use the term "culturally responsive," Patchen et al. are discussing such an approach.

The literature supports starting young to combat underrepresentation in STEM. Quinn and Cooc (2015) found that it is important to start early: "Our findings indicate that the "leaky" science pipeline may begin as early as third grade, suggesting that interventions aimed at closing gaps should begin when students are young" (p. 344). A study by Maltese and Tai (2010) "determined that interest in pursuing a science career had developed before middle school among 116 individuals who were completing PhDs in science fields. This suggests that elementary years are a critical time in the development of interest in science" (Patchen et al., 2016, p. 280). Finally, Mosatche et al. (2013) found that time spent in the program matters "those who attended the program for two years showed greater change in such areas as recognition that women can succeed in STEM careers than did girls who completed one year" (p. 23) This finding supports the idea that starting young is important. However it also suggests that a shorter program, such as the one I implemented at the Y, may be less effective than a longer one.

When starting STEM engagement young, it helps to introduce it in out-of-school time (OST) programming which offers flexibility, informality, and fun beyond that of a traditional school setting. Schnittka et al. (2015) found that "Informal learning environments may serve as entry points in sustained science learning that promote voluntary and differentiated learning experiences" (p. 407). Patchen et al. (2015) note that "afterschool programs at the elementary level are often designed to be dissimilar to school" (p. 281). This connects to Mosatche et al.'s (2013) finding that a "fun factor" is key in a program's success (p. 21). Schnittka et al. (2015) discuss the value of a hands-on, design-based science implementation "where productive failure, freedom to tinker, and extensive dialogue are highly encouraged" (p. 391). "Tinkering" or independent exploration is emphasized by Schnittka et al. (2015) as a strength of OST STEM programming. While they note that this may make curriculum implementation take longer, OST time is allowed flexibility and does not have to answer to the same rigid outcome goals which a

traditional classroom does. My program at the Y revealed that flexibility in curriculum pacing was key to improving facilitation outcomes.

Given the informality of OST programming, facilitators, who vary in qualifications, are central to shaping program outcomes. Patchen et al. (2015) note the importance of training: "Developing materials that can be effectively used by staff with varied background experience is an important consideration in designing scalable afterschool science programs" (p. 281). Mosatche et al. (2013) also found teacher training key in program success. Patchen et al. found that, "there is sufficient evidence to suggest that well-designed and sufficiently resourced afterschool science and garden-based programs have the potential to foster positive attitudes toward science among participants" (p. 282). In addition to its unique strengths which may lead to positive STEM experiences, OST programming faces the challenge of less standardization across facilitator experience and preparation than formal school. Patchen et al. (2015) and Schnittka et al. (2015) each analyzed the implementation of the same STEM programming across three sites and found that facilitator training and organizational resources were central to program success and replication. My experience as a Teaching Assistant for Girls Who Code's Summer Intensive Program in 2020 and 2021, confirmed that detailed, systematic teacher training with a high-level of supervisor support and accountability is central to the success of OST STEM programming.

Despite significant consensus on the problem of girls' underrepresentation in STEM and what is to be done, harmful narratives persist in the literature. Mosatche et al. in their 2013 paper "Effective STEM programs for adolescent girls" begin with a harmful framing which draws on Ceci, Williams, & Barnett (2009). All three of the reasons that they highlight to explain women's underrepresentation in STEM disconnect outcomes from their causes and make it seem as though girls are making choices, independent of external factors, which keep them out of STEM. For example "Women who have high math abilities are more likely than men with high math abilities to choose careers in non-math intensive areas. This preference shows up as early as adolescence" (Mosatche et al., 2013, p. 18). The use of the words "choose" and "preference" are jarring given the background of systemic barriers which keeps women and people of color out of STEM. The authors give little consideration to underlying causes such as the fact that girls "are counseled away from or out of advanced mathematics and science courses" (Ladson-Billings & Tate, 1995,

p. 51). This introduction is incongruent with what is otherwise a compelling analysis of transformative STEM education.

Wieselmann et al. (2020) cite research which found that "interest is a more significant predictor of enrollment in STEM courses than either prior enrollment or achievement in science or mathematics" (p. 234). However, when considering "interest" it is crucial to acknowledge that many factors influence interest. These may include bullying, self-concept, and identity as a "science person." Therefore, it is unproductive to treat "interest" as a free-standing predictive factor in STEM outcomes since it labels what may be an *effect* of earlier factors as a *cause* of STEM outcomes thereby obscuring foundational contributors to the STEM gap.

The comprehensive analysis "Why So Few?" by Hill et al. (2010) which discusses shortages of women in STEM, includes this statement in its introduction to the problem: "While biological gender differences, yet to be well understood, may play a role, they clearly are not the whole story" (p. xiv). This framing perpetuates the dangerous narrative that girls lack innate science ability as a result of biological determinism and it is unnecessary in such a report.

While some literature perpetuates stereotypes without critically examining them, other literature suggests that it may be to educators' advantage to acknowledge and leverage the stereotypes and cultural forces which shape girls' understanding of themselves and the world around them. The literature suggests using these stereotypes and cultural norms, for example that girls are stronger in literacy skills and leadership than STEM, to increase the efficacy of girls' STEM curriculum. Berwick (2019) encourages teachers to embrace girls' greater confidence in literacy skills; "Teachers may want to move away from multiple-choice tests—often a staple in math and science—and place more emphasis on open-ended assessments that allow students, especially girls, to demonstrate their proficiency through word problems or writing, where they feel more confident." In keeping with this recommendation, STEM educational resources targeting girls often incorporate literacy in a way which similar resources targeting boys do not. For example, Engineer Debbie Sterling found through her research that girls quickly became bored with simple toys meant to develop skills related to engineering success. The girls wanted to read instead. Sterling (2013) used these findings to develop GoldieBlox, a toy and storybook pairing which teaches engineering concepts to young girls. Girls Who Code, Inc., an international nonprofit aimed at closing the gender gap in tech, uses storybooks as central components of its elementary coding curriculum ("Girls Who Code," 2021). Similarly, Mosatche

et al. (2013) found that promoting a STEM program with a leadership angle appealed to girls who were not already interested in STEM (p. 20). In my program at the Y I tried to incorporate books wherever possible. For example, I read *Ada Twist, Scientist* and *Rosie Revere, Engineer* to the group. I also used books for role-model spotlights if I could, for example *Counting on Katherine: How Katherine Johnson Saved Apollo 13.*

Girls, especially Black, Latina, Asian, and Native American girls, are underrepresented in college STEM degrees, careers, and as role models in STEM curricula beginning in early education. There is total agreement in the literature that there is a gap in female STEM achievement and some agreement on how to remedy it. Addressing self-confidence, particularly through a growth mindset approach and developing self-concept, through role models are among the top recommendations. There is disagreement in the literature on what causes the gap. Some say it is cultural forces and some allude that it is caused by choice or innate ability.

Overwhelmingly, it is shown that structural and cultural forces have created the racialized and gendered STEM gap. Quinn & Cooc (2015) remind us that "Unequal access to these resources [which may prompt greater learning gains] often occurs at the school level through de facto segregation and at the classroom level due to inequitable student assignment practices and curricular tracking" (p. 337). This indicates the importance of structural overhaul to combat inequality and reminds us that even an excellent OST program cannot close the STEM gap independent of other approaches.

Challenges in Implementation: Choice, Agency, and Trust

Once I began implementing my project I discovered that I had a major gap in my literature review. Challenges in implementation meant that I needed more background on the impact of choice and agency in OST programming. It also became apparent that trust between myself and the students as well as my initial outsider status were factors defining the experience for all of us.

The YMCA is a structured program similar to school. Yoon and Rönnlund (2021) write about school that: "From an institutional perspective, school is an institution which students should attend and adapt to the regulations of in order to obtain a diploma and be integrated into society as future workers, rather than a place where they enjoy emancipation and the rights of citizens" (p. 55). In other words, students have limited choice and autonomy within the structure

of school. The YMCA provides slightly more freedom and choice in activities than school, however many of the behavioral expectations as well as the way activities are scheduled and managed is similar to school.

In a context where students have limited choice, they may try to establish agency within that context. Students' may attempt to establish agency in ways that go against the rules and expectations of the space. Agency "refers to the extent to which a person, or persons, are willing and able to act in order to make a difference, in a situation where not only natural forces, but also rules and interpretations, and the restraining power of others, may limit their action possibilities, and to assume responsibility for their own actions and interpretations" (Wardekker, 2018, p. 2-3). Student agency can be a powerful benefit in more informal STEM programming. Dou et al. (2019) write that "Since informal science experiences are often less structured, students are enabled to be more agential and define new ways of "doing" and "being" science. The structure (i.e., pacing, curricular constraints, power hierarchies) in place in school science limit this agency and the identity construction that comes with it" (p. 8). Here the authors are referring to informal science that primarily occurs at home or out in the world. My program at the Y still included some elements of pacing, curricular constraints, and power hierarchies. Therefore, it was not an "informal" science experience. Dou et al. (2019) explain that "The structure-agency dialectic provides a great deal of insight on why informal science experiences may enable science identity construction in new ways that are accessible to students from marginalized backgrounds" (p. 8). In other words, students, particularly those with marginalized identities, may engage better with science and build their science identity in spaces where they have more agency than they do in traditional school. Yoon and Ronnlund (2013) describe the differences between "formal" and "informal" school life and the implications of each context for student agency. They write that "From student perspectives, the experience of their agency through informal school life (e.g. ways of communication) can be as crucial as the increase of their influence in official school life (e.g. lesson contents) in order to live as democratic citizens" (Yoon & Ronnlund, 2013, p. 57). In the YMCA STEM program this might look like students verbally protesting a planned activity or requesting another one in order to act agentically and influence their experience within the program. Wardekker (2018) notes that "Agency requires attentiveness as the actor must be aware of what is going on to act agentically in context" (p. 4).

Therefore, agentic action on the part of students in the context of a STEM program implies engagement in that program.

In addition to challenges which arose from students experiencing a lack of choice and often acting agentically in a way that disrupted the space and what I had planned, students were hesitant to trust me and therefore hesitant to engage with me in a positive way. Jones and George (1998) propose that "trust is a psychological construct, the experience of which is the outcome of the interaction of people's values, attitudes, and moods and emotions" (p. 532). Jones and George go on to explain the role of emotions in establishing trust. They write: "People often decide if they can initially trust someone by examining the feelings they have toward that person. For example, if, when meeting a stranger, a person experiences high negative affect (e.g., feels jittery, nervous, or even afraid), he or she may initially distrust that person" (Jones & George, 1998 p. 534). The implication of emotions during an initial meeting for developing trust is central to my project because the first time my study participants met me was the first day of the program which they did not know they would be part of ahead of time.

DeMeulenaere (2012) identifies six components of the initial framework for a "pedagogy of trust" which is necessary to enable powerful learning. These components are: 1. The use of community rituals, 2. The development of powerful shared experiences, 3. Risk taking on the part of the teachers, 4. The addressing of conflict, 5. The teachers' alignment with students, 6. The grounding of the course's curriculum in students' realities (DeMeulenaere, 2012, p. 30). Implementing a pedagogy of trust in a space with students can aim to build what Jones and George call "unconditional trust." They propose that unconditional trust is key to optimize cooperation in a workplace setting. This claim can be considered in the context of my research to mean that building unconditional trust with students should be a goal in order to create a powerful learning environment. Jones and George explain that "With unconditional trust each party's trustworthiness is now assured, based on confidence in the other's values that is backed up by empirical evidence derived from repeated behavioral interactions" (p. 537). Furthermore, trust is viewed as a sort of agreement between the people involved which includes "confidence that they will not be harmed or put at risk by the actions of the other party" (Jones & George, 1998, p. 531). In my first session with the kids, Valeria clearly did not have confidence in me that I would not put her at risk. Other children seemed to share this sentiment. Students' lack of trust in me was not a theme I anticipated, but it became central once I began implementing my

curriculum. The implications of trust are a critical component of the conclusions I draw later in my paper.

CONCEPTUAL FRAMEWORKS

Original (Pre-Implementation) Frameworks

The conceptual frameworks I initially chose were the concepts through which I intended to consider my research site and participants. These were: **bravery, self-concept, self-confidence,** and **knowledge of role models**. **Bravery** refers to the confidence and desire to take risks, willingness to try new things, and willingness to speak up when you don't know or understand something. **Self-concept**, specifically self-concept in science, is the perception, whether positive or negative, of one's own existing ability and achievement in science and the ability, or inability, to imagine oneself as a scientist. **Self-confidence** is the belief in one's own ability. In the context of this project I was especially considering belief in one's own ability to learn and persist when things are difficult. Finally, in the context of this project, **knowledge of role models** refers to knowledge of women, particularly women of color, who have made important contributions to science.

In my early curricular focus I wanted to ensure a focus on **social constructivism**, and **social constructionism**. **Social construct*ivism*** holds that "students should play an active role in their own learning, work together to solve problems, discussing and debating, while cooperating at the same time" (Schnittka et al., 2016, p. 392). The teacher acts as a facilitator while knowledge "is constructed by the individual, but mediated through social interactions" (Schnittka et al., 2016, p. 392). **Social construct*ionism*** holds that learning by doing is critical and that "learning happens best when children are engaged in creating personally meaningful objects and sharing them with their peers" (Schnittka et al. p. 392). **Social constructivism** is central to powerful learning because it pushes students to think, to create their own understandings, and to take control over their own learning. **Social constructionism**, when paired with **social constructivism**, amplifies learning by increasing students' investment in what they are doing. These theories influenced how I planned my afterschool activities. Throughout my afterschool program I sought to engage students in hands-on activities where they could explore and had flexibility to create what they found interesting and exciting. An example of these conceptual

frameworks in practice appears in my Data Analysis & Findings under the sub-section "Implementation Interventions."

Frameworks Drawn from Early Implementation

Once I began my project implementation, my original conceptual frameworks took a backseat to numerous new themes which emerged and revealed more relevant conceptual frameworks. **Trust** stood out as a primary framework through which to understand my site, my relationship to the participants and theirs to me, and the outcomes of the project. My **outsider status** became highly relevant because it defined my initial position within the Y and shaped the first few sessions of the program. Student **agency** appeared when they acted in ways I had not anticipated within the program, often to shape their experience of it. Finally, student **choice** and **interest** became significant factors since the lack of the former seemed to be a major reason I was battling to create and/or maintain the latter.

Critical Race Theory

Critical Race Theory (CRT) is a crucial theoretical framing for a program that strives toward racial, as well as gender, equity in STEM education. CRT asserts the persistent presence and relevance of race in American society. It acknowledges that race is socially constructed yet still has a serious detrimental material impact through racism which is "ordinary, not aberrational" in American society (Delgado & Stefancic, 2017, pp. 8-9). CRT scholars are skeptical of "triumphalist history and [have] the insight that favorable precedent, like Brown v. Board of Education, tends to erode over time" (Delgado & Stefancic, 2017, p. 5). In other words, CRT warns us against becoming complacent and seeing racial inequality as a thing of the past. Instead we must recognize race as a current damaging social construct in our society. A tenet of CRT is the idea of "interest convergence." This refers to the fact that, in addition to racism being hard to combat since it is not acknowledged, racism advances the material interests of white people and therefore "large segments of society have little incentive to eradicate it" (Delgado & Stefancic, 2017, p. 9). Ladson-Billings and Tate (1995) emphasize the centrality of race in explaining inequity in the United States because "class- and gender-based explanations are not powerful enough" for the intense difference in educational experience and outcomes (p. 51). Class and gender do intersect race and therefore are relevant to consider in conjunction with a

CRT analysis. CRT aligns with praxis research in that it "contains an activist dimension. It tries not only to understand our social situation but to change it, setting out not only to ascertain how society organizes itself along racial lines and hierarchies but to transform it for the better" (Delgado & Stefancic, 2017, p. 8). That being said, as a white undergraduate researcher, I am not the best person to implement a program for primarily children of color which aims to be activist and "change our social situation." The very nature of this project perpetuates racist and classist structures such as academia (which enables me to write a thesis to get a degree) and does very little, if anything, to positively impact the children I work with. Dr. Bettina Love in a 2019 article entitled "Dear White Teachers: You Can't Love Your Black Students if You Don't Know Them," writes that "For Black and Brown children in the United States, a major part of their schooling experience is associated with White female teachers who have no understanding of their culture. [These teachers] who, at their core, were good people but unknowingly were murdering my spirit with their lack of knowledge, care, and love of my culture" (p. 1). Regardless of how much theory I read or how self-reflexive I am, the reality remains that my position in this praxis project is one of white savior at worst and that of someone taking up space and time without making any major contribution at best.

Theory of Gender

The key theory of gender being used in this research is that gender, like race, is a social construct with very real implications. Eckert and McConnell-Ginet (2003) write that "to whatever extent gender may be related to biology, it does not flow naturally and directly from our bodies" (p. 13). However, acknowledging that gender is a social construct which does not flow naturally from our bodies, does not allow us to discount it and simply move on. Gender, like race, has been imbued with deep meaning by our society, it is "embedded so thoroughly in our institutions, our actions, our beliefs, and our desires, that it appears to us to be completely natural. The world swarms with ideas about gender–and these ideas are so commonplace that we take it for granted that they are true, accepting common adage as scientific fact" (Eckert & McConnell-Ginet, 2003, p. 9). For example, ideas about gender "feed directly into social, and particularly into educational, policy, with arguments that gender equity in such ''left-brain areas'' as mathematics and engineering is impossible" (p. 12-13). While I acknowledge that gender is

socially constructed, it is being considered in this research since our society has given it weight and since it has major implications for STEM outcomes.

It is important to recognize that this project is limited in its exclusive consideration of cisgender girls. The project structure and implementation did not explicitly address transgender people. This is because the majority of the literature addresses cisgender girls specifically and does not include transgender girls or other minoritized gender identities (of which there are many). It is also because I did not have any transgender research participants. I considered taking a more gender-expansive approach to the structure of the program and making it open to all genders with an emphasis on female role-models and being female-aligned. However, this approach, which is common at my liberal arts university, did not seem like it would add value to facilitation at the YMCA and with elementary-aged children.

METHODOLOGY

Based on the framing of the praxis project as "original, self-directed work of consequence for the neighborhood or community at large," praxis research should ideally be in one of the following three modes as defined by Herr and Anderson (2005): cooperation, in which research is *with* local people, colearning in which research is *with/by* local people, or collective action in which research is *by* local people without outside facilitation (in this instance the researcher would need to be a local person *and* Clark student) (p. 40). Upon reflection I believe my project falls far more closely under "Co-option" and "Compliance" on Herr and Anderson's continuum of researcher positionality. Herr and Anderson (2005) describe the involvement of local people in Co-option research which is "*on*" local people as "Token; representatives are chosen, but no real input or power." They define Compliance research as "Tasks are assigned, with incentives; outsiders decide agenda" and describe research as "for" local people (Herr & Anderson, 2005, p. 40). I regret that this research does not fall into a more collaborative action research category. I find co-option and compliance research in the social sciences to be largely unethical and unhelpful. This framing creates a very "us vs. them" dichotomy of outsiders studying an "other" for their own learning rather than to benefit the community under study. I would theorize that co-option and compliance research is only helpful if it is accompanied by action which makes a positive contribution.

This research falls into the category of practitioner inquiry. Herr and Anderson (2005) describe a specific challenge which I faced as a practitioner researcher: “Practitioners don’t have the luxury of the ethnographer, who can take copious field notes, write them up, and transcribe interviews. Using the ethnographic approach places practitioners in a logistically untenable position because they can’t work and record data at the same time” (p. 34). This was my experience at the Y because I was constantly inundated with requests from children such as “can I get water?” “I need to go to the bathroom!” “I’m hungry!” “I’m tired” “I’m bored.” I was fielding questions and complaints from children while trying to stay on track with my planned activity and also listening to my walkie-talkie for messages from staff or for children being called for dismissal. The many demands on my attention and time left barely any room to think about research until I left the Y for the day.

Participants:

I facilitated a program with up to 20 female-identifying children between the ages of 8 and 12 present at a time. Twelve (12) were at least partially participating in my research. Of those twelve, nine (9) people gave full consent and assent to all forms of data collection including surveys, photographs of drawings, audio recording transcription, and field notes. Mixed assent with only about half of the group fully participating posed some challenges when analyzing conversation and group dynamics.

Forms of Data Collection:

Data	**Description, Purpose & Intent**	**Reality of implementation**
Surveys	My 22-question survey included both multiple choice and open response questions. It drew heavily on Weinburgh & Steele’s (2000) “Modified Attitudes Toward Science Inventory.” Surveys, usually analyzed using a one or two-way analysis of variance (ANOVA) are quite common in the literature on STEM education,	I intended to complete a pre- and post- survey. However, I changed my plan after not having enough time following assent and consent procedures in the first session. My thinking as I recorded it the day after my first session/day before my second was as follows: “I have decided that I will not be doing the

	gender and STEM, elementary STEM education, and self-concept as it relates to STEM. I intended the survey to be used with a two-way ANOVA analysis or something similar. This is a positivist and quantitative form of data collection and intended analysis among my other more qualitative and criticalist approaches.	survey tomorrow in favor of establishing a group dynamic and trust with students as well as making the program fun. As an undergrad, managing research on my own while also designing and facilitating a program is incredibly difficult. I want the quality of the program to take precedence. Right now it feels like the research took over the whole first session and set a tone for the students different than what I would hope for. Because of this the research needs to be secondary while student engagement, excitement, and joy needs to be prioritized." I ultimately gave the survey during our 7th session together. I got 11 surveys back. 3 were from children who didn't give assent and therefore unusable. 2 were filled in almost entirely by the same child (she was helping her friend so all their answers match and are in the same handwriting). I did not give the survey a second or third time as I had originally intended.
Photos of "Draw a Scientist Task" drawings	The Draw a Scientist Test or Task (DaST) has been implemented repeatedly over several decades beginning in the 1960s. It is used to determine children's preconceptions about what scientists look like. "For instance, children were asked to draw a scientist in a landmark study	All students in the program, regardless of research consent and assent status, participated in this activity. Only the drawings of consenting students were photographed. Students were given paper, crayons, markers, and the prompt to "draw a scientist." They

	of nearly 5,000 elementary school students who were mostly from the United States and Canada (Chambers, 1983). The drawings, collected from 1966 to 1977, almost exclusively depicted male scientists, often with lab coats, eyeglasses, and facial hair, working indoors with laboratory equipment. Only 28 children drew a female scientist (0.6% of the sample), suggesting strong gender-science stereotypes linking science with men" (Miller et al., 2018, p. 943)	were given about ten minutes to draw, then prompted to share their scientist with the group. The following guiding prompts were used to facilitate sharing: 1) tell us about your scientist. 2) does your scientist have a name? 3)Is your scientist a specific kind of scientist? 4) what is your scientist's gender? This activity in our initial session did not go as planned and the results were unexpected. Shortly before the activity, a student asked why none of the boys had come with them. I explained briefly that I am interested in what girls think about STEM and that there is a gap in higher education and industry right now. This may have influenced the activity since all the drawings I received were of women. These drawings ended up being a minor aspect of my data.
Audio recording and transcription	Audio recordings were intended to capture what went on during each session. This includes: dialogue, thinking aloud, examples of pondering, collaboration, teamwork, and key themes such as bravery.	Mixed assent within the group was a major challenge with audio recording and transcription. Audio data was still interesting and provided insight into what was happening in the program. During analysis this emerged as one of my primary data sources along with my field notes.
Field notes	Field notes were intended to round out other forms of data collection with my thoughts, impressions, and observations. They were intended to provide context for audio recordings and to generate autoethnographic data about myself as a facilitator and researcher.	My field notes and "Analytic Memos" assigned for my Praxis course blurred together. I used one document to jot all of my thoughts as soon after the program as I could. These notes provided helpful context for audio data. They also served as useful data on their own about my

		thoughts, feelings, and actions as a researcher.

When selecting forms of data to collect, I tended toward a positivist approach because I had a preconceived idea of what counts as "real research." In my original conceptions of this project, I imagined an approach including pre- and post-surveys and a control group. I even fantasized about a longitudinal component. As I went through rounds of grueling IRB revisions and began to engage in field work, one aspect after another was dropped because it was too positivist and conflicted with other theories which I found important (e.g. Critical Race Theory), or because it was an unreasonable amount of work, or logistically impossible.

Early in the planning process I also envisioned a Participatory Action Research approach in which the participants reflected with me about their own thoughts and experiences and contributed a section in their own voices to my final thesis. As I began to conduct research and collect data, I realized that there were things I had expected and *hoped* to see happen. For example, I had expected students to begin with limited knowledge of role models and low STEM self-confidence, perhaps even low interest for the most part, and then to quickly become interested and excited. I expected to spend most of my time with students on science-related activities, exploration, and discussion. I hoped to build a sense of community and observe collaboration among the participants. Instead, I was experiencing chaos, challenges in classroom management, and lack of enthusiasm. We spent very little time on planned activities and much more time with me trying to get the group to listen. In the first several weeks, I gathered much more autoethnographic reflective data through field notes than any other form of data. I had anticipated that the survey and DaST would be rich and informative data sources. However, survey responses were limited, and the DaST drawings and discussion did not match my expectations or intentions. Ultimately the survey and drawings provided some context for case studies of specific students but did not serve as their own category analyzable data. Although the content of early audio recordings was not what I had expected or hoped for, they still held lots of valuable data.

The ways in which my program implementation differed dramatically from my original plan revealed many of my assumptions and oversights in planning. I underestimated the importance of consistency on my part in order to build trust with students. I also underestimated

the significance of student choice and assumed that I could easily engage a group of students who hadn't chosen to participate in this program.

Initially I wrote that I expected what follows, I now realize that was more what I *hoped*.

- I expect to find that participants begin with some uncertainty about whether they can be scientists (low to medium self-concept and self-confidence) and that there is noticeable growth in self-concept and self-confidence throughout the school year.
- I expect to hear interesting meaning-making in group discussions and talk that reveals students' schemas and understandings of the concepts we discuss
- I expect that students will have preconceived notions revealed through the DaST activity about who is/can be a scientist
- I expect students' knowledge of role models to grow throughout the program

DATA ANALYSIS & FINDINGS

I went into the research process with hopes and expectations of straightforward data collection which would corroborate existing literature and illustrate that elementary OST STEM programming is essential and impactful. In reality, my early data reveals little about STEM programming since I didn't get much programming done. Instead, my early data shows chaos, the implications of my outsider status, the significance of student agency, and the importance of trust between the students and myself. Autoethnography of myself as a researcher and facilitator became a larger component of my data analysis than I anticipated.

I began the data analysis process by creating a comprehensive, chronological catalog of my data. The raw data consisted of analytic memos, field notes, audio recordings, written surveys, and images of student work. I then worked to identify key themes, narrative threads, turning points, and rich data segments which could exemplify larger themes. I also worked on building the narrative of individual students within the program.

My chronological data catalog was in a Google doc with a date and brief description of each piece of data. Data from the same day, usually audio and an analytic memo, were grouped

together. This organization of data gave me a sense of what I had to work with and prepared me to begin the task of chunking and selecting useful and illustrative data while trying not to cherry-pick. I had just under 13 hours of audio data which I collected between late September and mid December. The prospect of listening to it all was daunting so I relied on my notes and analytic memos to identify recordings which were worth my attention.

Once I reread my notes and listened to most of my audio, three students emerged as strong examples in relation to the themes of distrust, student choice, and agency which I noticed in my data. These students: Valeria, Genesis, and Danae are the focus of my analysis in each theme below.

(Dis)Trust

Valeria

During my first session, in September 2021, students expressed distrust of me, my research, and my programming as well as frustration with the unexpected change to their schedule. Valeria, a fifth grader, for example, was wary of audio recording and hesitant to trust me as is illustrated by the transcript segments below. This transcript is all from one 2 minute and 30 second audio clip.

	Speaker	**Speaker Turn**
1	Valeria	[referencing my audio recorder] But what if somebody takes it and then they can listen to what we're saying?
2	Ellie	That's a great question! so what I'm gonna do is I'm gonna keep this in my car locked and when I get home I'll put it in my computer and I go and I'm gonna put it on Google Drive–
3	Valeria	I don't like it.
4	Ellie	You don't like it? That's ok, you don't have to be part of it.
5	Valeria	Like I don't like how it's recording.

6	Ellie	[Lengthy explanation of deleting recordings and maintaining privacy]
7	Valeria	But what if you forget to delete it?
8	Ellie	Then I would be in trouble with Clark [continued explanation of strict guidelines for confidentiality]
9	Ellie	...and if you wanna ask me more questions about it after I finish telling you this, then you can ask me more questions about it
10	Valeria	Yeah but you really didn't ask us if you could record us though

This transcript illustrates the initial wariness of me and my research. In line 10, Valeria's comment "Yeah but you really didn't ask us" implies that she is feeling a lack of choice in the situation. Valeria is acting agentically by speaking up about her discomfort and questioning me (e.g. line 1: "But what if somebody takes it and then they can listen to what we're saying?"). Student agency and choice emerged as an important theme across my data which I will discuss later. Jones and George (1998) describe the establishing of trust as a "joint definition of a social situation [which] involves each party trying to understand the other party's expectations, needs, and goals" (p. 535). In the transcript above, Valeria is trying to understand my expectations, needs, and goals and is making hers clear to me (e.g. line 3: "I don't like it." and line 7: "but what if you forget to delete it?"). While it is clear from this transcript that she does not initially trust me, she is engaging in foundational steps to build trust as defined by Jones and George.

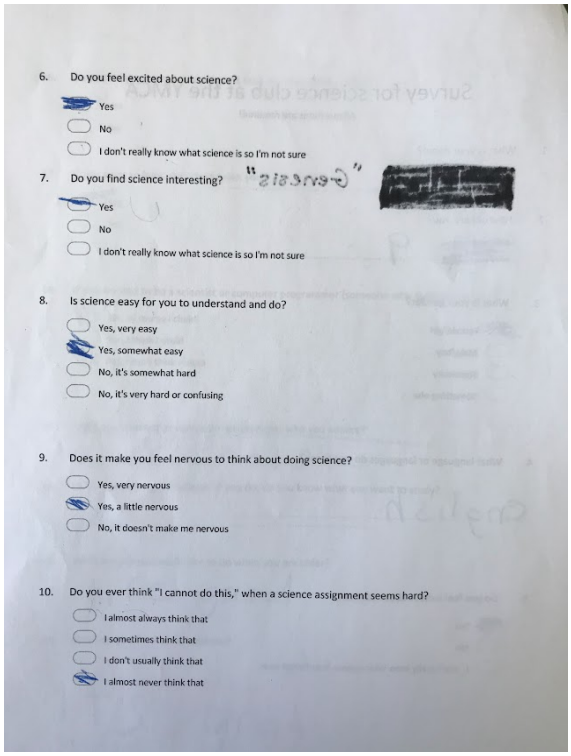
Genesis

Not every child showed as much trepidation as Valeria did. Genesis, for example, showed more confidence initially which may suggest a greater predisposition to trust me. She was the first to share her drawing of a scientist during our activity on the first day.

1	Ellie	Does someone else wanna be the next one to share their scientist? Yes, go ahead *(I say someone else here because I had just shared)*	 *Figure 4: Genesis' "Draw a Scientist" drawing from the first day of the program.*
2	Genesis	Um, my scientist's name is Lily and she's working on a project where she has to write and-- and she has to write [OV chatter makes speaker's voice unclear] and she has [OV Y Staff person reminding kids to be quiet] she has a bottle here that has some red um stuff in it and then she's working on her writing to see like if it works or not?	
3	Ellie	Ok so she's taking notes, she has a bottle of red stuff, is that a sink next to her? Or is it like a light?	
4	Genesis	This?	
5	Ellie	Yeah.	
6	Genesis	It's a light to see her work cause she (unclear) dark, this is her (unclear)	
7	Ellie	Nice. I love the--I love the details you added around it.	
8	Genesis	And then, see I--I wouldn't forget the shoes. She's wearing purple pants, she's wearing a red coat and she's wearing glasses and her hair's colored black.	

9	Ellie	Awesome. She looks great, thanks for sharing. Ok, who would like to share their scientist next?	

Genesis' confidence in being the first to share and her easy engagement with me suggests that she didn't have a problem with trusting me initially. Her survey responses from the 7th program session (see Figures 5 and 5.1 below) also indicate a largely positive and confident attitude toward science. In questions 6, 7, and 8 (Figure 5) she says she feels excited about science, finds it interesting, and finds it somewhat easy to understand and do. In question 9 (Figure 5) she says she feels a little nervous when she thinks about doing science and in question 10 (Figure 5) she says she "almost never" thinks "I cannot do this" when a science assignment seems hard. Questions 16, 17, and 18 (Figure 5.1) reveal strong self-confidence in general and in relation to science. For example, in question 16 she replies "yes" to "Do you think you can achieve goals that are important to you?" In question 17 she replies "yes" to "If you want to learn something, can you?" Finally, in question 18 she answers the question "If you wanted to be a scientist or computer programmer (someone who codes) could you?" with "Yes, of course I could!" She concludes the survey with an open response stating that science is "grat" (great).



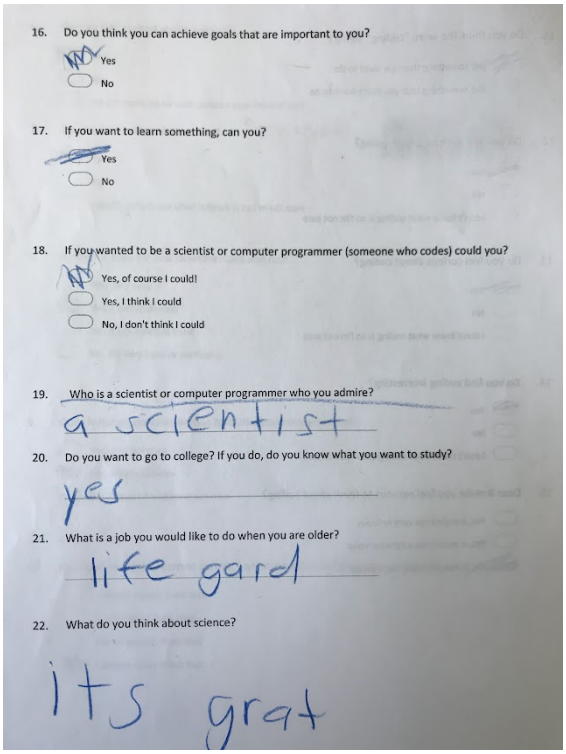


Figure 5 (left): a page from Genesis' survey from the 7th session. Figure 5.1 (right): another page from Genesis' survey.

Genesis's initial engagement with me and with the program was positive and indicated openness to trust. Jones and George (1998) describe this stance as suspending the belief that another person has sinister motives and instead beginning with an assumption of trustworthiness until proven otherwise (p. 535).

Danae

Danae is a 5th grader who assented to notes and images of her work but not to audio transcription. She showed serious trepidation about the program initially. During the first session she seemed grumpy and resisted engaging. During the 5th session, I noted her disengagement again. Her voice appears once in the audio when she asks what time it is while everyone else is discussing a book I just read to them. In the Analytic memo about that day I wrote: "Three kids put their heads down on the table and fell fully asleep. Two of those are kids who generally act disinterested and say they don't want to be there." One of the children who I perceived as acting disinterested and who put her head down was Danae. At one point in the audio recording I say "Danae's napping I think Marjani. Ok, so we have some more time. Ok, some people are feeling

sleepy so I'm gonna let the people who are feeling sleepy chill out." Danae began to engage a little toward the very end of that day. Her initial resistance to me and the program and later shift to greater engagement is discussed further in the "Choice and Student Resistance" section.

Ellie (Practitioner/Researcher)

Before I began project implementation, I underestimated the importance of trust between myself and students as well as how long it would take to build that trust. It was clear within the first session that several of the children did not trust me. I realized that the "community building" activities which I had planned were not going to quickly build trust since the children were resistant to participating in the first one, an activity called "the Story of My Name," where they introduce themselves and share some background about their name. The day after my first session I wrote in my notes "I need to rework my next lesson plan for tomorrow. I have decided that I will not be doing the survey tomorrow in favor of establishing a group dynamic and trust with students as well as making the program fun." I also prioritized building trust in my lesson plan for the second session as can be seen on the index card I brought with me (see Figure 7).

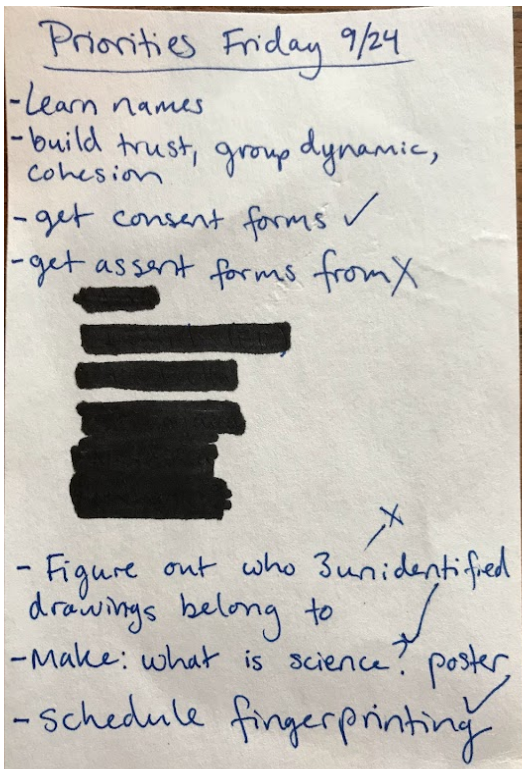


Figure 7: An index card with a list of reminders to myself for the second STEM session.

The check marks and x's on this index card indicate whether I completed that item. The note about fingerprinting on the last line refers to my hiring process to transition from volunteer to YMCA staff. This is significant in relation to moving from outsider to insider status which is further discussed later.

It was clear from the beginning that at least some of the children did not trust me. However, trust is a two-way social agreement which means I am implicated as well. In reflecting on how I felt early in my program implementation and how I changed my implementation in response to early challenges, I think there is evidence that I did not entirely trust the children. I developed a first impression of them that they could not do everything I had planned and therefore lowered my expectations of them.

For example, when students initially resisted my lessons or acted out during them, I interpreted this as an inability to handle the material on their part rather than a failure in design and implementation on my part. This was a misguided interpretation that represents a lack of trust in the students rather than seeing their behavior as communication for how I could improve (something I only came to realize later). I wrote in my analytic memo about my 5th session: "I then read *Ada Twist, Scientist* aloud to the students. Most were very excited by the book. I had intended this book for the first week but then changed plans because I thought it might be 'too young.'" My notes, and the fact that I changed my planned lesson, reflect that I thought the students might not engage well with the book as a result of their ages. This assumption turned out to be wrong since my memo continues "We had a great discussion as we read which I also have recorded. The discussion included what the "traits of a great scientist" are and whether the girls in the room count as scientists." Although I had initially assumed that the group couldn't engage with this book in the way I hoped and planned, they proved me wrong. In fact, I began my analysis of the 5th session with "I think it was the best session I have had so far." A week after this was written, I went in and added a layer of analytical comments. On the sentence about it being the "best session so far" I commented: "What was different? Group was a bit smaller, I went in with lower expectations, I was on top of names for the first time." A week after the fact I hypothesized that group size, my lowered expectations, and my knowledge of students' names all contributed to that day's success. The fact that I wrote "I went in with lower expectations" brings us back to the theme of trust. There seems to be a fine line between adapting lessons to meet the children's needs, and not trusting that the children are capable of what I am asking. I

believe that the fact that I recorded my lowered expectations shows that to some extent I did not trust the children's ability to engage at the level I had planned.

Much later in the program, in November, Marjani and Anaya expressed their thoughts about me trusting two other children, Valeria and Angelie. The interaction is transcribed below. It takes place in the stairwell by the bathroom where I have brought the group. Two children, Valeria and Angelie, are called to go home and have to go back to the room we were in to get their things.

Line	**Speaker**	**Turn**
1	Ellie (to Valeria)	You may choose 1 bag of chips or 1 piece of candy from the bag that is on the table, 1 ok? And Angelie can have one too
2		Angelie (NP) runs up and tells me she forgot her stuff in the room
3	Ellie	You may go, wait listen to me, you may choose one bag of chips or one piece of candy from the bag
4	Anaya	That's all we're getting?
5	Ellie	Yeah
6	Marjani	Do you know how much, um, how much chip bags are in there?
7	Ellie	How many chip bags? No. I'm trusting them Marjani, I know, ok can you guys wait here?
8	Anaya	You shouldn't.
9	Marjani	You shouldn't.
10	Ellie	Well, I'm just gonna take a risk.
11	Marjani	I mean at least you're trying
12	Ellie	Thank you Marjani
13	Marjani	Yeah

Marjani's question in line 6, "Do you know how much, um, how much chip bags are in there?" implies that she thinks Angelie and Valeria are going to take advantage of choosing a snack unsupervised and take more than one. In line 7 I explicitly say "I'm trusting them

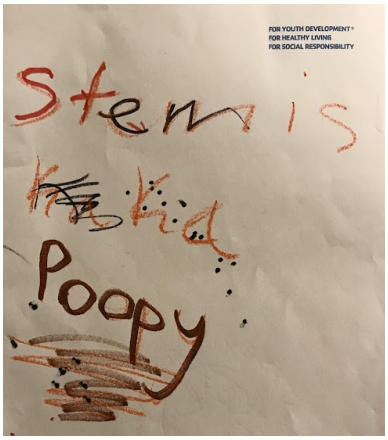
Marjani." Anaya and Marjani's immediate responses of "You shouldn't" in lines 8 and 9 reveal a prior schema about trust in this context. There is no way to be certain whether the two girls mean I shouldn't trust Valeria and Angelie specifically or whether I shouldn't trust any children who are going to choose a snack unsupervised. Marjani and Anaya may have had prior experiences which taught them that adults don't trust children or shouldn't trust children.

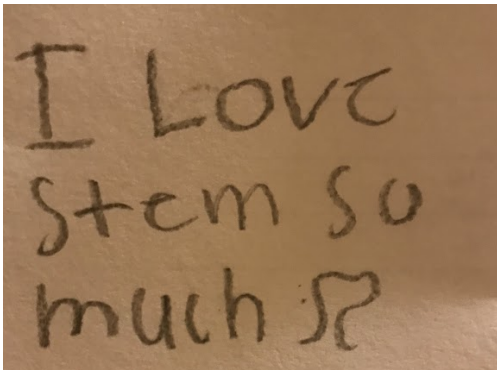
The evidence from my first session, which included Valeria's distrust of me and of audio recording and the fact that most children resisted my community building activity, begins to answer my 4th research question: Are consistency and trust more important to building an empowering after school program than curriculum? The three-page detailed lesson plan I had on the first day did very little to help me connect with the children in front of me. This suggests that not only is trust more important than any curriculum, but that it is an essential *prerequisite* to implementing a curriculum. Without a space where a pedagogy of trust is being enacted, no powerful learning can occur.

Student Resistance/Student Agency

Over the first two months I witnessed continued resistance to the program from several children. Resistance often seemed to surface because the children didn't have a choice of whether to participate. It also seemed to be their way of expressing agency. Often in the hallway at the Y, a child would call out to me "Ellie, do we have STEM today?" sometimes in an excited tone but more often full of dread. Sometimes I would walk into a room and be greeted by a child whining "oh nooo I don't wanna do STEM today!" During the first month or two that I worked at the Y, this happened whether or not we actually had the STEM program that day because students associated my presence with the program.

Children were not very consistent about whether they were happy or unhappy about STEM. It seemed to depend on intergroup dynamics (if their friends were there or if children they didn't like were there), how they were feeling that day, and the level of excitement expressed by children around them. Three children–Valeria, Anaya, and a non-consenting student–collaborated to make me the drawing on the left during one of our sessions. Another student made the drawing on the right a different day.





Valeria

While Valeria showed significant resistance to the idea of research during our first session (see her section with transcript analysis under (Dis)Trust above), she seemed to adjust quickly within the first session. She went on to engage well that day and ultimately assented to all forms of data collection although she had expressed serious misgivings about audio recording earlier in the hour.

Valeria was easily one of the most vocal students in the group. She always brought high energy and was loud. Sometimes her energy manifested as enthusiastic engagement and sometimes as distraction. During our tenth session in late October, children were complaining that they didn't want to be there and do the activities I had planned. I decided to try a different tactic and gather some data which resulted in the transcript below which takes place over 6 minutes.

Line	**Speaker**	**Speaker Talk**
1	Ellie	Ok so actually this is a great–this is a great idea. So a lot of people don't really wanna do STEM stuff right now and that makes sense to me but do you know–you remember how I told you guys a long time ago that I was doing research? And basically I'm trying to figure out like what makes people like STEM and if they get excited about it, so even if you don't wanna do anything maybe you could tell me about why you don't wanna do it
2	Genesis	I don't wanna do it because it seems boring

3	Ellie	Ok, because it seems boring. Is it ok if I put out my recorder and you talk about why you don't like STEM?
4	Non-participant	XXX
5	Ellie	I'm gonna put this here and we're gonna talk about–anyone who wants to tell about why they don't like STEM
6	Genesis	(yelling)I don't like STEM because it seems boring and I can't draw
7	Ellie	You can't draw?–Why–why–Oh, you would rather draw than do STEM? Y–You don't mean you need to draw to do STEM? Ok.
8		… (some time passes — less relevant or non-consenting audio skipped for clarity)
9	Isabela	I don't–I don't really like STEM, kinda like [Non-participant] and [Non-participant] cuz like I already do like enough writing and like science and stuff [OV Ellie: At school?] like at school and then it's like I have to do more stuff [unclear] instead of doing like–not saying that you don't do activities or nothin'–instead of just doing like
10	Ellie	What you wanna be doing?
11	Isabela	Yeah
12		…
13	Anaya	Ok, ok, why I don't like STEM is because [OV Ellie: It's like a podcast] it's boring and sorry I just wanna do activities and I don't wanna be here, I wanna be home eating some fried chicken (laughs)
14		…
15	Valeria	Ok ok ladies ok ok, n- (chanting) S-T-E-M, I don't wanna do STEM, ya y'all hear me riiight? (laughter) [screaming & unintelligible] (shrilly) I can sing a song for youuuu [unintelligible]
16	Ellie	Ok
17	Valeria	I'm not done, I'm not done with my (singing) podcaaaast ooh yeah. Stee– (chanting) S-T-E-M I don't wanna do STEM yeahhh
18	Ellie	But why? Can you tell me why?
19	Valeria	Oh why? because, well I'm t–Imma be honest witchu, [OV: non-participant] Imma be honest witchu ok?

20		[interruption & chaotic background noise]
21	Valeria	Ok, ok one way I don't wanna do STEM because I just–I just don't wanna do it I'm sorry but
22	Anaya	STEM's boring
23	Ellie	That's ok, what do you wanna do instead?
24	Valeria	I just wanna go with the boys and do what they do–I don't wanna be with the boys–I do wanna be with the boys cuz they get to play games and
25	Ellie	What do you think they do? They play games?
26	Valeria	I read the clipboard it says they play games, [Group Name]: play games
27	Ellie	Ok, well we can play games, we'll figure it out, ok Sofia–
28	Valeria	Actually Y-E-S S-T-E-M, I wanna do STEM!
29	Ellie	If it involves games you wanna do it?

This transcript reveals some of the reasons why students weren't excited to be at my program. It also shows some of the chaos which permeated many of the STEM sessions. In line 2, Genesis gives "because it seems boring" as a reason. Later, in line 6, she adds that "she can't draw." This becomes a theme that students don't want to be there because they feel like there are more appealing options for what they could be doing. In lines 9, 10, and 11 Isabela explains to me that it's too much like school which she feels she has done enough of for the day. Her mention of "activities" indicates another theme which I discovered: that students prefer more hands on, open-ended lessons without much of an "academic" component. For example, when I let them build freely with index cards they had a great time but when I tried to engage them in a discussion about engineering after the activity they lost interest and enthusiasm. Valeria, who dominates this transcript, expresses feelings that align with the theme of "rather be doing something else" which Genesis introduced. My conversation with Valeria between line 21 and line 28 reveals that she is experiencing Fear of Missing Out (FOMO) for whatever the boys are doing and that she felt like STEM is not "fun" enough or that we didn't play games which we didn't for the most part. Line 6 where Genesis is yelling, lines 15 and 17 where Valeria is

laughing, screaming, singing and chanting, and the many interruptions and overlapping speech illustrate the chaotic nature of many of our sessions.

In this transcript, Valeria, and several other students are resisting my planned programming as an act of agency to regain control over some of their highly scheduled day. For example, in line 13 Anaya was being goofy when she said “it's boring and sorry I just wanna do activities and I don't wanna be here, I wanna be home eating some fried chicken” but there is important information in her comment. She is bringing up the common theme that children want to be relaxing at home and have had enough of structured activities. Isabela supports this theme as well when she says “I already do like enough writing and like science and stuff [OV Ellie: At school?] like at school and then it's like I have to do more stuff.” Interestingly, as soon as I respond to Valeria’s agency where she expresses what she wants to be doing in lines 21-26, she changes her tune–or her chant–immediately and is suddenly willing to participate. This quick change from Valeria, as well as students’ willingness to explain to me on record why they didn’t want to participate in my planned lesson (at least 5 contributed their thoughts), indicates that allowing students choice and space to act agentically is a pathway to better engagement in programming. Once children felt like they were present and participating in activities of their own volition, they seemed to engage more positively.

Danae

Danae was very resistant the first day as I mentioned in the trust section above. She was grumpy toward me and other children. She crumpled her first drawing during the Draw a Scientist Activity and was resistant to sharing. She exercised agency by being selective in the assent process. Danae continued to exercise agency by refusing to participate in activities regularly. For example, during our 5th session I noted in her (Dis)Trust section above that she was removing herself and put her head down on the table rather than participating. Over time, Danae became less resistant to the program and eventually even came to show excitement.

It took her until we were around the 10th session together to begin being more open with me and positively engaged with the group and activities. In fact, in late October she told me she didn’t care any more if I recorded her and used her words. On November 12th, (15th session) I noted that she expressed that she loved STEM unprompted during our session. By December she would run up to me and give me a hug whenever she saw me in the hallway. From January

through February of 2022, when we were no longer having regular STEM meetings, she often asked when we could meet again. Until the time of writing she continues to give me a hug almost every time I see her and even has requested to move to my room. These experiences are not only heartwarming and gratifying for me, they illustrate a dramatic change from reserved and resentful to enthusiastic and excited. I perceive the reason for this shift to be twofold. First, I let her disengage when she wanted. Second, I was consistently present and positively interacting with her. These two factors built trust between us as well as her sense of agency thereby making her more comfortable engaging with me and the program.

Genesis

Genesis rarely resisted coming to the program, however at the program she often acted in ways that went against my requests or expectations, for example by making a mess, acting goofy, or yelling. Her agency was not an expression of resistance to my program as much as it was resistance to controlling structures within her life and at the Y. Sometimes her acts of agency which were messy or disruptive were actually true scientific exploration.

A strong example of Genesis acting agentically is from the last session I had which was in March. It was the only session after winter break and was intended to serve as a wrap-up and reflection opportunity along with one science activity. Four children from my fourth grade room, Genesis, Kaitlyn, Angelie, and a Non-participant came. The only two older girls (5th and 6th grade) who were at the Y at the time decided not to come. Below is a transcript with illustrations from 4 minutes of a scientific exploration activity using a liter bottle filled with water which had 3 holes in it that were initially covered with tape

Line	**Speaker**	**Speaker Turn**
1	Ellie	Great, so now I want you all to make a guess [OV Genesis: Sixty!] of what's gonna happen--(laughs) sixty? [OV Genesis: Fifty!] What's gonna happen when I take the tape off the first hole
2	Genesis	It's gonna, it's gonna leak into the bottle, it's gonna look like someone's peeing
3	NPs	Comment

4	Ellie	It's gonna look like someone's peeing, it's gonna leak into the bottom of the thing
5	Genesis	I wanna poke it!
6	Ellie	NP do you think anything different? (NP replies)
7	Genesis	It's gonna pee all of its juice out
8	Kaitlyn	(Gives hypothesis)
9	Ellie	Ok, everyone watch closely
10		Several seconds of Genesis making very goofy comments, Kaitlyn adds another guess
11	Ellie	Ok, so everyone watch the hole carefully, people are thinking that water's gonna come out, alright?
12	Genesis	It's gonna look like it's peeing!

Figure 8 (left): Bottle full of water, tape is covering all 3 holes. (Images are from a recreation of this experiment, not from the day the audio recording was done. Water is dyed blue to make visuals clearer. It was not dyed blue on the day the audio is from).
Figure 8.1 (center): The bottle with the tape removed from the first hole. No water is coming out.
Figure 8.2 (right): The bottle with the tape removed from the first hole seen looking directly at the hole.

Figure 8 above shows the bottle as it was when the children were making their guesses about what was going to happen in the transcript above. Right after Genesis' comment in line 12, I peel the tape off. Genesis' "guesses" of "Fifty!" and "Sixty!" which she calls out as I am talking in line one seem to be in response to me saying "now I want you all to take a guess" but

her tone indicates that she knew she was being goofy. This sets the tone for her behavior throughout the transcript. She is highly engaged but pushing boundaries of what is expected of her (acting agentically). She is highly engaged with the activity in the sense that she is paying attention and verbally engaging in line 2, line 5, and line 7. Her comment “I wanna poke it!” in line 5 can be read as curiosity and scientific exploration. She may have a hypothesis that water will come out if she pokes it and she wants to test her hypothesis. While she is acting goofy and seems to be trying to get more attention through her comments like “It’s gonna pee all of it’s juice out” in line 7, she is displaying scientific thinking. Below is the continuation of the transcript where we see Genesis displaying scientific exploration through disruptive agentic action.

Line	**Speaker**	**Speaker Turn**
13	Ellie	[NPs screaming and OV commentary] Don't touch it Genesis! (Genesis and others laugh)
14	Ellie & Kaitlyn	(Discuss what happened)
15	Ellie	So everyone--Genesis do not touch it--so guys, I'm now wondering, hey! I'm now wondering what would happen if I take off the second piece of tape?
16	Genesis	It's gonna do the same thing! [OV NPs]
17	Ellie	Wait, it's gonna do the same thing what?
18	Genesis	It's gonna-It's gonna-I'm gonna squeeze it, it's gonna come out on me and like I did last time
19	Ellie	If you don't squeeze it, then we'll have a better time [NP asks a question] Cause there's no air where?
20		NP yells at Genesis and asks me not to face the holes in the bottle toward her
21	Ellie	Genesis, can you please stop touching it? [OV NP XXX] (stern tone) Genesis, you are gonna need to go back [OV Genesis: there's only drops in it] to the room if you're not able [OV Genesis (annoyed tone): I'm looking in the bucket uh!] so stop touching. Ok there's drops of water cause you squeezed it right?
22	Genesis	(smiling and tone rising) No!

23	NP	(comments)
24	Ellie	If I take off the second piece of tape, what do we think is gonna happen?
25	Genesis	Wait, why is it in the box?!
26	NP	(comments)
27	Ellie	Because when it leaks then it-
28	Kaitlyn	(shares thinking)
29	Ellie	It might come out?
30		Several seconds of screaming and goofiness, question from NP about the room we're in
31	Genesis	Can I rip it? Can I peel it?
32	Ellie	Ok, gently [OV NP shrieking]
33	Genesis	(Genesis peels tape off, see Figure 9 below) Pee! Pee! Pee!

In line 16, Genesis provides a hypothesis which I ask her to clarify in line 17. In line 18 she clarifies "I'm gonna squeeze it, it's gonna come out on me and like I did last time." She knows at this point that she should not be squeezing the bottle but she also knows what might happen based on prior experience. She is resisting my instructions not to squeeze the bottle in order to continue her scientific exploration and have fun. In line 21, I am asking Genesis "can you please stop touching it?" In reference to the water in the plastic bucket which we are using to catch water as it comes out of the bottle. She replies to me in annoyance "I'm looking in the bucket uh!" which I think is justified. I am losing patience because the children aren't responding to me in a formal academic way by answering the questions I pose and then waiting quietly for the next step. Genesis especially is deviating from my plan and exploring the water in the bucket. In line 25 she asks "Wait, why is it in the box?!" This illustrates that she is paying attention and curious about every aspect of the experiment. In fact, although she is acting goofy and causing disruptions, she is the most engaged out of the four children present. In line 31 Genesis' question "Can I rip it? Can I peel it?" followed by "Pee! Pee! Pee!" in line 33 shows clear excitement about the activity.

Figure 9 (left): Bottle with the first two pieces of tape removed. Water is coming out of the second hole only. Figure 9.1 (right): Bottle with first two pieces of tape removed and my finger covering the top hole. No water comes out of the second hole.

Line	**Speaker**	**Speaker Turn**
34	Ellie	Ok, now what happens if I do this? (put my finger over the top hole, see Figure 9.1 above)
35	Kaitlyn	(Has a realization and explains her thinking)
36	Genesis	Wait, can I do it, can I do it? (asking to peel off second piece of tape)
37	Ellie	Wait, we're talk---then you can do it. Yes Kaitlyn?
38	Kaitlyn	(Explains thinking)
39	Genesis	(Puts her finger over the second hole) N-n-n-n-n(nonsensical/noisemaking) wait try let-going the top!
40	Ellie	So you're covering the middle one, what did you think might happen if you covered the middle one? Ooh (Genesis squeezes the bottle, water sprays, NPs shriek) Genesis, that is your [NP tells Genesis to stop] Genesis, [OV NPs and Genesis laughing] Genesis, I asked you not to squeeze it [Genesis laughing, NP commenting that it's not funny] Ok, guys when I took the second tape off, it started coming out right?
41	Genesis	It started peeing!

42	Ellie	It looks like it's peeing
43		40 seconds pass with more discussion and some chaos, we take the 3rd piece of tape off.
44	Ellie	(calmly and slowly) Genesis, I need you to stop, ok, Gen, please move, please move your hands or your sweater is gonna get wet (saying this as I am lifting the bottle to turn it horizontally and Genesis is trying to keep her hands in the stream of water) now what happens? (see Figures 11 & 11.1 below)
45	Genesis	(screaming) What?!?
46		Three others are confused and surprised, Kaitlyn posits why no water is coming out now that the bottle is horizontal
47	Genesis	Squeeze it NP!
48	Ellie	Don't squeeze [Angelie reaches in and squeezes it, laughter] Angelie, I said, don't squeeze it.
49	Angelie	(Protests/makes excuse)
50	Ellie	Ok, nobody squeeze it.
51	Genesis	The water looks so cool in the bucket, what is this?
52	Ellie	It's part of the paper, Genesis, take your hands out, Genesis
53	NP	(Comment to Genesis)
54	Genesis	No, it's going in the bucket!
55		5 seconds of chaotic overlapping noise
56	Ellie	So wait, why doesn't there, why isn't there water coming out right now? If I flip it--Genesis, listen to me--If I flip it so that the cap is facing down, what's gonna happen?
57	Genesis	It's gonna all pour out from this side (indicates hole nearest to the cap)
58	Ellie	Oh yeah? Oh, you were right! Ok what if I flip it so the cap is facing up? (Figure 10.2 below)

In line 39, Genesis interrupts my conversation with Kaitlyn about why no water comes out when I cover the top hole in order to run her own experiment. She covers the middle hole and tells me "wait, try let-going the top!" She seems to be testing whether no water will come out if

only the second hole is covered rather than only the top hole being covered. This is an excellent example of experimentation and social constructivist exploration. In line 40, I push her to explain her thinking by asking “So you're covering the middle one, what did you think might happen if you covered the middle one?” She does not respond verbally and instead squeezes the bottle causing it to spray water. She is repeatedly causing chaotic disruptions in the lesson however there is evidence that she is highly engaged and thinking scientifically.

I move on to the next step and try for the most part to ignore Genesis’ silliness. In line 44 I turn the bottle horizontally (see Figures 11 & 11.1 below). This causes the water to stop flowing out of all three holes because there is even pressure on all of them and therefore there is nowhere that air can enter. If the bottle is even slightly angled, then air begins entering through the side with less water pressure and water flows out of the other two holes.

In line 45 Genesis’ screamed “What?!?” indicates her surprise that no water is flowing from the horizontal bottle. In line 47, she says “Squeeze it NP!” indicating that she has a hypothesis that water will come out if the bottle is squeezed and wants to test it. At this point she has been told repeatedly not to squeeze the bottle but she is acting agentically. Angelie joins in with her own agentic action by squeezing the bottle even though she wasn’t the one who Genesis asked.

In line 51 Genesis shows that she is continuing to explore and build her understanding “The water looks so cool in the bucket, what is this?” I am losing my patience with her and in the moment I can’t see that what she is doing is actually wonderful constructivist learning. Instead, I am perceiving her behavior as disruptive. My response in line 52 reveals how I am feeling: “It's part of the paper, Genesis, take your hands out, Genesis.” The way I repeat her name while telling her to take her hands out of the bucket of water reveals my frustration and discourages her from exploring. It is not my best moment in facilitating constructivist learning.

Despite my growing frustration, I push forward in the lesson and Genesis keeps engaging with me. In line 56 I ask her to hypothesize what will happen if I flip the bottle over. She replies with a clear and accurate hypothesis in line 57: “It's gonna all pour out from this side (indicates hole nearest to the cap)” (see Figure 10.2 below). In line 58 I affirm that she was right and continue probing the group “Oh yeah? Oh, you were right! Ok what if I flip it so the cap is facing up?.”

Figure 10 (left): Finger over the second hole. Very slow trickle of water out of the top hole. Figure 10.1 (center): All 3 pieces of tape removed. Water is coming out of the 2nd and 3rd holes (the two nearest the bottom). The lowest hole has a more forceful water flow. Figure 10.2 (right): All three holes open, bottle turned upside down).

Figure 11 (left): Turning the bottle to horizontal. All 3 holes are still dripping. Figure 11.1 (right): bottle is horizontal, all holes face downward but none are dripping.

Although Genesis almost never resisted coming to the program or participating in an activity, she did show resistance and act agentically. The example detailed above illustrates how she disregarded instructions repeatedly with the explicit purpose of sating her curiosity. Her agentic action resisted what were often unnecessarily strict controls on her body and behavior from adults around her (me in the example above and most often). This resistance did not imply dislike of the program or of science but rather of the controlling structures they were wrapped up in.

Ellie (Practitioner/Researcher): Response to Resistance

My response to resistance was often one I viewed as permissive or "giving up" out of exhaustion. Beginning quite early on, I let the children do their own thing if they didn't want to participate in the activity because I felt like it wasn't worth my energy to try to force them. I didn't want to engage in a power struggle. For example, I wrote the following about my 9th session, a Friday in late October:

> Only ~5 kids were paying attention to me. I let other kids do other things as long as they weren't being loud. People kept leaving for the bathroom and water. Tried to organize paper airplane lesson and discussion of how they work. Few kids engaged. Ended up chaotic. I notice that I have lost a lot of my intended original structure.

Originally I had intended to have lessons follow a pattern of community building activity followed by a main activity and then a reflection and conclusion. The children did not respond well to this structure. I often found myself spending several minutes trying to get them to pay attention to my instructions. As a result, I decided to let go of some of my original elements and make the program more open-ended. However, I'm not sure whether I balanced between flexibility and completely letting go of the reins.

The following Wednesday was the day the children explained to me at length why they didn't want to do STEM. I wrote:

> After students "podcasted" into the recorder about why they didn't want to do STEM, I let them go do arts and crafts at other tables while I set up my video and activity on paper airplanes at one table. I had 4 takers who sat with me and later a 5th joined. Once we finished making airplanes a few kids who hadn't made airplanes showed interest in flying them but otherwise it was only a small segment of the group that engaged with me.

Initially, I felt like I was being too permissive and taking the easy way out because I was tired. Now, upon reflection and in light of my later experience, I have concluded that allowing children to disengage if they wanted may have actually helped by giving them a choice and thereby lessening the negative associations with the program. When students felt they had less choice, it seemed to negatively impact their behavior and the program. For example, when Danae was forced to come to the program she barely participated for the first several weeks. In the example above of Genesis and the water bottle experiment, the more I told her not to explore her

curiosity, the more she disregarded my instructions. When the students had more choice, it positively influenced their behavior and engagement. For example when I responded to student requests to spend more time working with Ozobots (an example described in "Implementation Interventions" below) they engaged enthusiastically. These findings suggest that student choice and sense of agency–like trust between students and facilitator–is a *prerequisite* to effective STEM teaching and learning.

Outsider Status and Researcher Emotions

Students' distrust of me as well as their refusals and my ineptitude at responding to those refusals demonstrated that my outsider status as a volunteer, college student, and researcher had a significant impact on the early implementation of my program. I found that I struggled to engage the students and to respond when they asked to go to the bathroom or get water since I didn't yet know the rules. I also struggled to command their attention and keep the group organized. In an analytic memo about my fourth session on October 1st, I coded the themes of "unpredictability," "chaos," and "overwhelm." This coding was done quickly and informally during an in-class coding exercise before I had established key themes within my data or had begun my analysis. The coding still proved relevant and useful. The memo is as follows:.

> I went in determined to have fun and thinking this session would be easy and a guaranteed success however the 10/1 session was hectic. I planned to launch our rockets which we made 9/29 out of film canisters and construction paper. The launch mechanism is alka seltzer and water in the film canister which causes it to pop open and shoot the rocket upward several inches or up to a few feet. We had to do this outside. Normally the field behind the Y would be perfect but there happened to be a vaccine clinic with a DJ, an ice cream truck, and a bouncy house for the older kids going on. My coworker suggested we use the parking lot. This was less than ideal since it was right next to what all the kids saw as a much more fun activity. There were also cars driving by regularly and it was difficult to keep the group contained. To top it all off, the rocket launch was not a huge success. The launching technique could have been refined more and essentially we weren't able to launch many of them successfully but managed to make a big mess. Kids expressed frustration at not getting to go to the bouncy house and ice cream truck and at being in what was seeming like an unstructured program. I felt overwhelmed and overstimulated.

This early analytic memo illustrates the recurring theme of unpredictability within the program because of the many factors out of my control at the YMCA. I struggled to keep the

group organized because of the unusual setting (the parking lot), the major distraction next to us (bouncy house, dj, etc.), and my outsider status at the Y. Because I was new to the Y and in a volunteer role at this point, I did not know what would be happening at the Y that day nor did I have the knowledge or authority to effectively problem solve. In these early sessions I was always accompanied by a Y staff person who usually commanded the children's attention much more easily than I did but who was not typically involved in the activity beyond telling the children to be quiet or pay attention.

The analytic memo excerpt above reveals my emotional response as a researcher to the challenges I encountered. I wrote that I felt "overwhelmed and overstimulated." These feelings affected my excitement and motivation when planning future lessons. The challenges that come with practitioner inquiry–such as multiple tasks falling to the same person and the inability to simultaneously facilitate and observe/collect data–are highly evident in this example.

My lack of authority was an ongoing challenge which began to improve in November when the children talked over me less and did what I asked more easily. It seemed like my frequent and consistent presence at the Y as a staff person beginning in October helped the children see me as someone who they could potentially trust and who was on the same level as other staff rather than a visiting volunteer. I also found more agency within the Y as I became more comfortable in my role as a staff person. In my notes on Monday November 1st I wrote "agreed with [Supervisor] to split the group into a younger and older group each coming once per week. This is intended to help with group management, engagement, and allow me to tailor lessons and activities better to students' needs." In late November I switched participation in the program to fully optional for the children at the recommendation of my supervisor. Each day when I went to get them, they could choose if they wanted to come with me or not. I was very nervous because of my extensive experience of negative responses to me and the program from earlier on. I thought no one would come if given the choice. The transcript segment below from November 19th provides evidence that student attitudes had changed. I hypothesize that this is because of my flexibility and my consistent presence at the Y.

Line	**Speaker**	**Speaker Turn**
1	Valeria	So what did [Supervisor] say about people who (unclear)

2	Ellie	[Supervisor] said that today I could try when I come in to take people for STEM, she said, if you wanna come you can come and if you don't wanna come you don't have to come, but that made me kinda scared because I was like no one really likes STEM, what if they don't wanna come?
3	Valeria & 2+ others	I like STEM! [OV: Everybody came!]

In the audio recording which this transcript is from, Kaitlyn, a non-transcription participant expresses that she finds the activity we are doing fun. My shift from volunteer to paid staff was critical in improving several aspects of the STEM program. Once I knew the rules and routines of the Y and the children knew who I was and what to expect, things ran more smoothly. My expectations for what I could accomplish in a lesson were more realistic than they had been when I was unfamiliar with the Y and the children. This made my lessons more effective.

While there were clear improvements which often seemed correlated to changes I made like those I described above, these improvements were not consistent or linear. On Friday, November 5th, I wrote the following memo about a challenging session:

> 11 older girls only. We were in the rock gym. Group management was incredibly difficult from the beginning. Kids were complaining. Kids were climbing on the walls and swinging from ropes. One kid [Danae] had a rock tied to a string which she was swinging around. Other kids beat their hands on the table. I did not have command of the group. I yelled at them a few times. I was overwhelmed. The session did not feel like a success at all. I was trying to teach them how to code a simple game but I did not manage to get anywhere in the lesson because of the chaos. One of the kids who was engaging with the activity [Genesis] was frustrated almost to tears that she couldn't get the characters on her screen to do what she wanted right away

Based on my previous analysis that my "insider status" as a result of consistent presence at the Y and my flexibility were key to the increased success of program sessions, along with the date of November 5th on this memo, it should be a record of a successful session. Unfortunately, it is an example of the ways in which my progress was nonlinear and the program was unpredictable. In fact, I wrote "The session did not feel like a success at all." I also noted that "I

did not have command of the group" which would suggest that my insider status had not dramatically increased students' respect for me or my ability to enforce Y rules.

Another reading of this memo could focus on the location: The Rock Gym (see Figure 2 in "The Rooms" subsection of the Ethnographic Context section above) and the fact that I was trying to teach them to code which was a new skill for most and a new activity format for us as a group (using chromebooks). The two factors of physical setting and lesson content actually represent a disruption in consistency which may explain why this session was especially difficult. Notably, Genesis was one of the only children really engaging with the lesson and I observed that she was "frustrated almost to tears." My shift from outsider to insider status at the Y facilitated improvements in my program however, this shift did not guarantee complete or permanent success. Instead, my outsider/insider status was one of many ever-changing factors in program implementation.

Implementation Interventions

When things weren't working in the program, I remained flexible and adjusted my lesson plans. Some of these interventions worked, some didn't, and when they did, change wasn't always permanent. For example, I spent more time on things the children liked and responded well to. I let them tinker with Ozobots (marker-code-controlled robots) for multiple sessions rather than scaffolding from the robots to other coding concepts over a few lessons as I had intended.

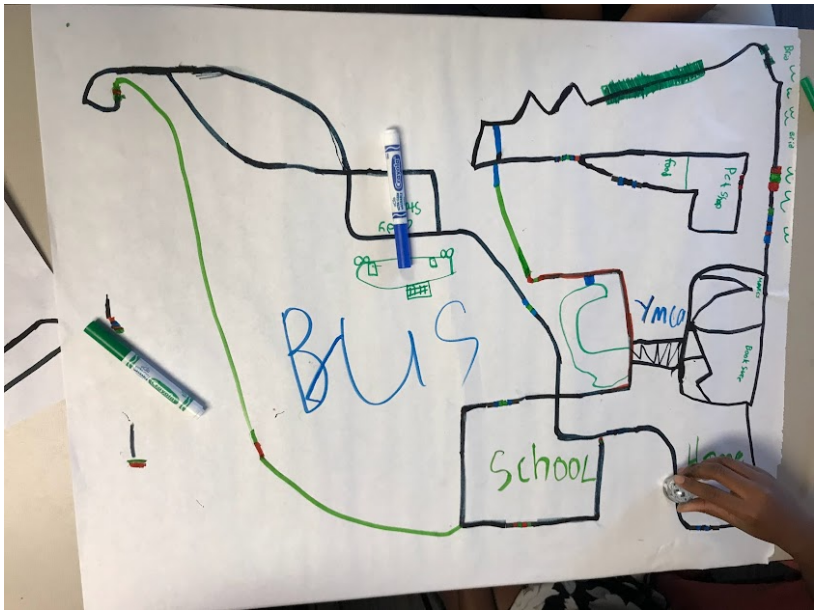


Figure 12: A student places an Ozobot on the map they drew for it with peers. These robots have a color sensor and read to different color sequences consisting of red, green, blue, and black as coded instructions. This map is imbued with creativity and storytelling that represents the children's lived experiences. For example it features the bus, school, and the YMCA.

Letting them work with the Ozobots for a few sessions kept them engaged and excited. This was an excellent manifestation of two of my core conceptual frameworks: social constructivism and social constructionism. I saw evidence of social constructionism when students drew maps including places from their own lives (Figure 6 above). Students were creating "personally meaningful objects and sharing them with their peers" which is social constructionism as defined by Schnittka et al. (2015) (p. 392). Students were learning how to manipulate the robots through independent exploration, trial, and error along with some guidance from myself. This was social constructivist learning in action!

Other attempted interventions were not as successful. I tried several ways to get them to engage with role models. I initially intended to have a weekly role model connected to the science theme we were focusing on. Our first week we focused on Katherine Johnson and I read them a picture book *Counting on Katherine: How Katherine Johnson Saved Apollo 13* by Helaine Becker (Figure 13 below). Picture books for each role model would have been my preferred approach, however there is a dearth of picture book biographies of women of color across diverse STEM fields. The next role model, Ayanna Howard, was high-profile enough to have a PBS Kids video about her which I could use (Figure 15 below). They didn't engage with

the video as well as they had with the book. Throughout the book and afterward, students asked questions and added comments. When I played the video, students talked among themselves. I had to ask them to be quiet and pay attention several times. I played the video again and some students still didn't seem to be paying attention. After Ayanna Howard, it was a few weeks before I introduced a new role model. I noted after my 9th session in late October "My attempts at role model spotlights have not gone over very well and I need to re-examine how to present role models to the students." While I'm not sure there is a perfect way to present role models, I think consistency over time so that students know what to expect, would be key in making this successful. In the future I would consider asking children to research a woman in STEM from a list provided and then present what they learned to their peers. I would rely on diverse and accessible media such as picture books and videos to make profiles of role models dynamic and interesting.

Following the mixed results I got with the Ayanna Howard video, for my 17th session in mid-November, I tried a graphic organizer which I pre-filled with information (Figure 14) and brought in a stack of STEM trading cards (Figure 16).

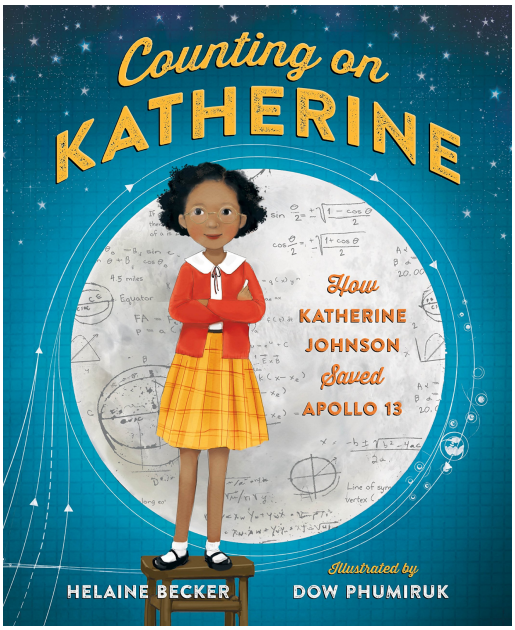


Figure 13: Counting on Katherine by Helaine Becker

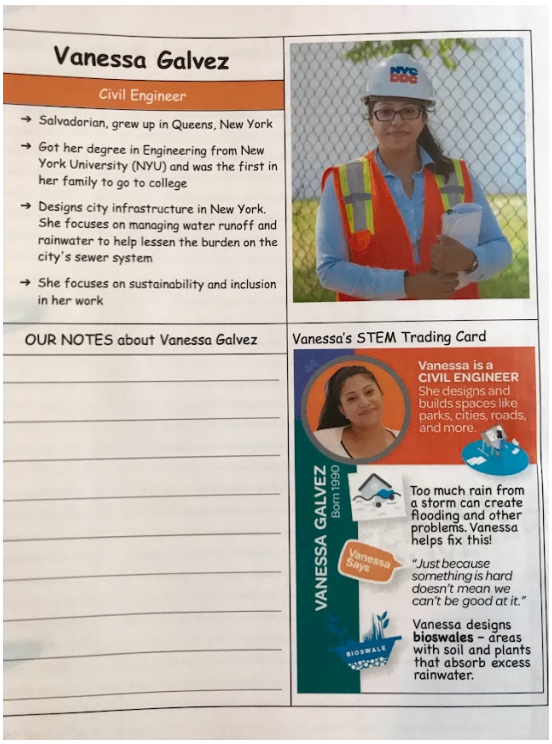


Figure 14: Vanessa Galvez Role Model Spotlight graphic organizer with space for thoughts from

the group

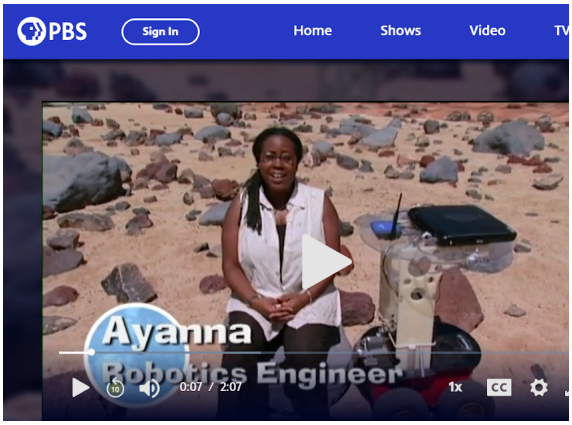


Figure 15: SciGirls PBS Profile of Ayanna Howard

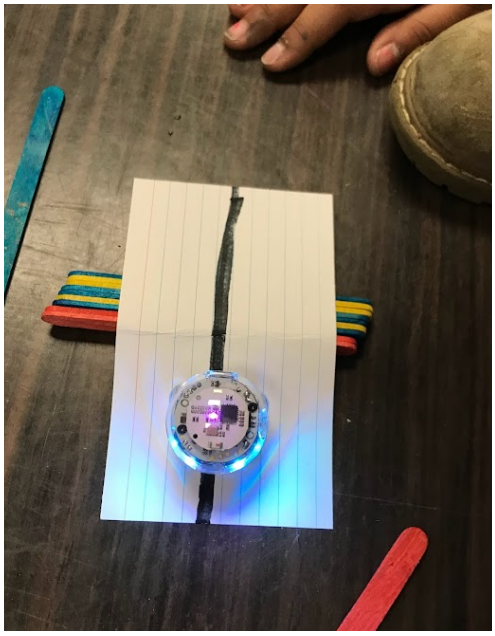
Figure 16: Assorted Women in STEM Trading Cards from STEMTradingCards.org

I thought the cards would be a huge hit and, paired with a one-page graphic organizer, a surefire way to continue the role models week to week. Unfortunately this was not the case. The children were curious about the cards when I brought them out but this interest faded quickly and they weren't excited to learn more about the women on the cards. Danae notably loved the cards and asked to take several home with her. While most of the children weren't excited about the role models, they were highly engaged with building bridges out of index cards, popsicle sticks, and tape for the robots to drive over, Danae remained invested in the cards I initially provided. She was sitting on the floor away from the other children when the following exchange took place:

Line	**Speaker**	**Speaker Talk**
1	Valeria	Danae I can't believe you're missing out
2	Danae	XXX
3	Ellie	She's not, she's--she has all the cards over there, she's looking at the cards and she has a robot

Valeria's spontaneous statement about Danae "missing out" indicates a highly positive response to the activity. My only prompt was to build a bridge which the robot could drive across using the materials provided. This led to a lot of variety in construction (See Figures 17 and 18

below for some bridges the children built). The bridge activity was yet another example of constructivist learning in action because my prompt was open-ended and encouraged student creativity. Creativity, and varied interpretations of what constitutes a "bridge," are evident in the images below. The positive response to this very loosely structured activity from Valeria and others supports my hypothesis that students engage better when activities are more open-ended and less academic in the OST setting. This example also emphasizes the importance of student choice. I planned to explore engineering concepts and work on building structures but the children were excited about the Ozobots. I compromised and incorporated the Ozobots into a building activity because I knew this would promote students' engagement.



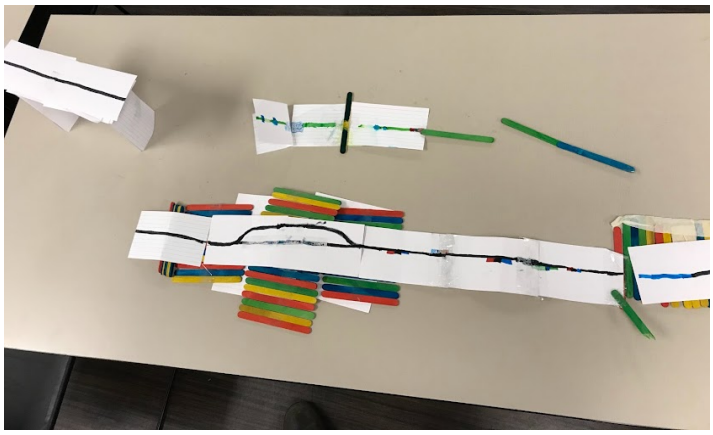
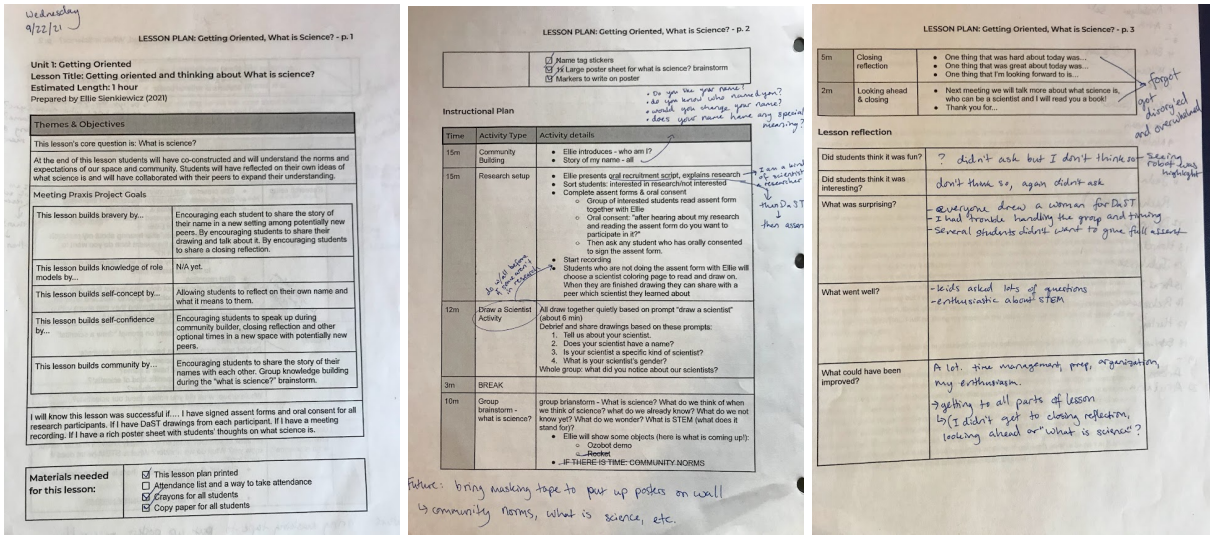


Figure 17 (left): An Ozobot drives successfully across a simple bridge. Figure 18 (right): Various bridge constructions.

Some changes I made to implementation were ones that felt forced upon me by tricky circumstances, while others were intentional and preemptive in trying to solve problems. For example, I felt forced to drop community building activities because of chaos and lack of engagement during them. I felt like it wasn't worth the power struggle to get children to participate the way I wanted. I found that community building needed to be less explicit and woven into our other activities. For example, I built teamwork into several lesson plans and then encouraged teams to show each other what they had done. An intentional change was splitting

the group into older and younger. This bigger implementation intervention came with my shift from volunteer to paid staff when I gained confidence and found agency in my role at the Y.

Learning to let go of my original expectations and assumptions was crucial as I modified my project implementation. I dropped the cohesive unit plans I had prepared for in the summer because they were too rigid and academic. Instead I responded to what the children wanted and expressed interest in week-to-week. I realized in practice that I couldn't cover as much content as I had expected. The change in my lesson plans over time reveals the changes I was making to implementation.



Wednesday 9/22/21

LESSON PLAN: Getting Oriented, What is Science? - p. 1

Unit 1: Getting Oriented
Lesson Title: Getting oriented and thinking about What is science?
Estimated Length: 1 hour
Prepared by Ellie Sienkiewicz (2021)

Themes & Objectives	
This lesson's core question is: What is science?	
At the end of this lesson students will have co-constructed and will understand the norms and expectations of our space and community. Students will have reflected on their own ideas of what science is and will have collaborated with their peers to expand their understanding.	
Meeting Praxis Project Goals	
This lesson builds bravery by...	Encouraging each student to share the story of their name in a new setting among potentially new peers. By encouraging students to share their drawing and talk about it. By encouraging students to share a closing reflection.
This lesson builds knowledge of role models by...	N/A yet.
This lesson builds self-concept by...	Allowing students to reflect on their own name and what it means to them.
This lesson builds self-confidence by...	Encouraging students to speak up during community builder, closing reflection and other optional times in a new space with potentially new peers.
This lesson builds community by...	Encouraging students to share the story of their names with each other. Group knowledge building during the "what is science?" brainstorm.
I will know this lesson was successful if.... I have signed assent forms and oral consent for all research participants. If I have DaST drawings from each participant. If I have a meeting recording. If I have a rich poster sheet with students' thoughts on what science is.	

Materials needed for this lesson:	
	☑ This lesson plan printed ☐ Attendance list and a way to take attendance ☑ Crayons for all students ☑ Copy paper for all students

LESSON PLAN: Getting Oriented, What is Science? - p. 2

☑ Name tag stickers
☑ Large poster sheet for what is science? brainstorm
☑ Markers to write on poster

Instructional Plan

Time	Activity Type	Activity details
15m	Community Building	• Ellie introduces - who am I? • Story of my name - all
15m	Research setup	• Ellie presents oral recruitment script, explains research • Sort students: interested in research/not interested • Complete assent forms & oral consent ○ Group of interested students read assent form together with Ellie ○ Oral consent: "after hearing about my research and reading the assent form do you want to participate in it?" ○ Then ask any student who has orally consented to sign the assent form. • Start recording • Students who are not doing the assent form with Ellie will choose a scientist coloring page to read and draw on. When they are finished drawing they can share with a peer which scientist they learned about
12m	Draw a Scientist Activity	All draw together quietly based on prompt "draw a scientist" (about 6 min) Debrief and share drawings based on these prompts: 1. Tell us about your scientist. 2. Does your scientist have a name? 3. Is your scientist a specific kind of scientist? 4. What is your scientist's gender? Whole group: what did you notice about our scientists?
3m	BREAK	
10m	Group brainstorm - what is science?	group brainstorm - What is science? What do we think of when we think of science? what do we already know? What do we not know yet? What do we wonder? What is STEM (what does it stand for)? • Ellie will show some objects (here is what is coming up!): ○ Ozobot demo ○ ~~Rocket~~ • ~~IF THERE IS TIME~~ COMMUNITY NORMS

Future: bring masking tape to put up posters on wall
↳ community norms, what is science, etc.

LESSON PLAN: Getting Oriented, What is Science? - p. 3

5m	Closing reflection	• One thing that was hard about today was... • One thing that was great about today was... • One thing that I'm looking forward to is...
2m	Looking ahead & closing	• Next meeting we will talk more about what science is, who can be a scientist and I will read you a book! • Thank you for...

Lesson reflection

Did students think it was fun?	? didn't ask but I don't think so
Did students think it was interesting?	don't think so, again didn't ask
What was surprising?	- everyone drew a woman for DaST - I had trouble handling the group and timing - several students didn't want to give full assent
What went well?	- kids asked lots of questions - enthusiastic about STEM
What could have been improved?	A lot. time management, prep, organization, my enthusiasm. → getting to all parts of lesson b/c I didn't get to closing reflection, looking ahead or "what is science"?

Figures 19, 19.1, & 19.2: The three-page lesson plan for my first session.

Figures 19, 19.1, and 19.2 above show the three-page, detailed lesson plan I prepared for the first session. I found myself getting lost trying to flip through the multi-page plan while leading the group. While it was helpful to have a detailed plan, the document wasn't useful to me in the room with the children. For my second session, I brought an index card which I could carry around with me (Figure 20 below). This worked better and from then on my plans were simple and written on an index card or sticky note which I could hold in my hand as I moved around the room.

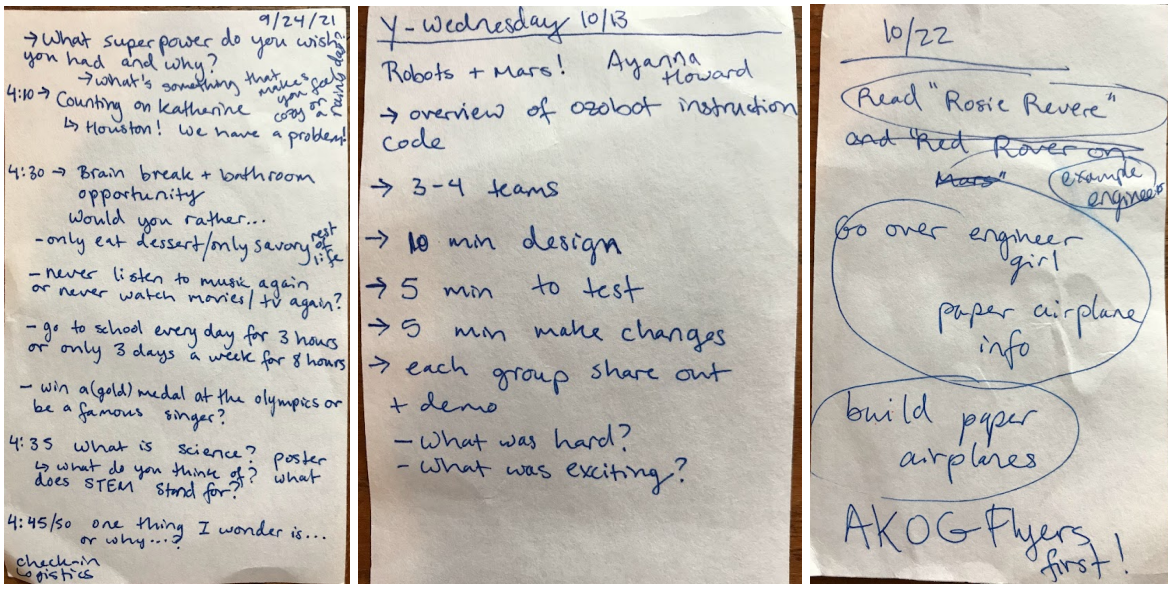
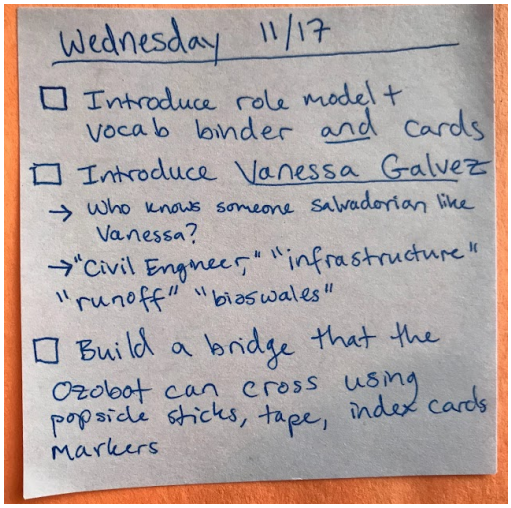


Figure 20 (left): Lesson plan for the second session on September 24th. Figure 21 (center): Lesson plan from October 13th on an index card. Figure 22 (right): Lesson plan from October 22nd on an index card.

I found that my extensive planning didn't always hold up in practice. I also was busy with my own academics outside of the Y. Because of this, my lesson plans became simpler over time. Occasionally, they weren't even a full plan. Figure 20 above, although on an index card, includes timings and is highly detailed. Figure 21 above is less detailed but still includes my plan for the beginning, middle, and end of the lesson along with times. Finally, Figure 22 above looks quite chaotic. Clearly I wrote it in a hurry. It is not well organized,as my note to hand out "AKOG flyers first!" is at the bottom and was added later. Additionally, there are no time estimates or examples of questions I plan to ask the children. Not all lesson plans following October 22nd were as chaotic as the one seen in Figure 22. Figure 23 below is a more organized plan from November because it includes three lesson parts and is clearly written, despite being brief. This reveals that my lesson plans didn't consistently devolve, but ratherbecame dramatically more simple over the first few sessions. Overall, I learned that planning on an index card was more useful to me in practice than full pages of paper.



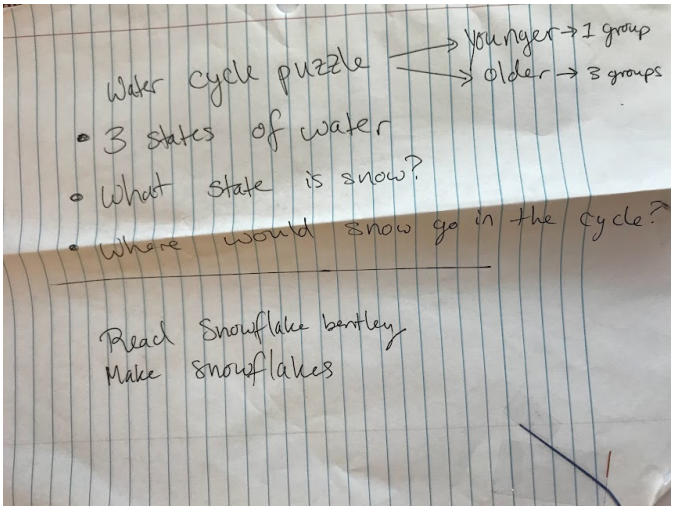
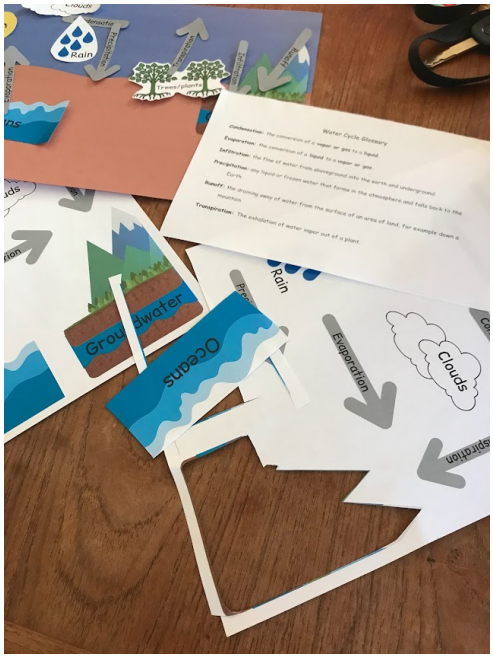


Figure 23 (left): Lesson plan from November 17th on a sticky note. Figure 24 (right): Lesson plan for December 3rd.

The quality of the lesson plan did not always determine the quality of the session. Figure 24 above shows one of my messiest and simplest "plans," however, that day was one of my best sessions. On December 3rd (18th session), Danae, Valeria, and Anaya–all 5th graders–were the only ones who chose to come. All of the 4th graders who I'm with every day that I'm at the Y chose not to come. We were working with the water cycle and snow's place in it. I had a detailed lesson and materials including manipulatives. I just didn't have it all typed up in a plan document. We had a great time. We chatted, completed the activities, and dug into science which is evidenced by the transcripts below.



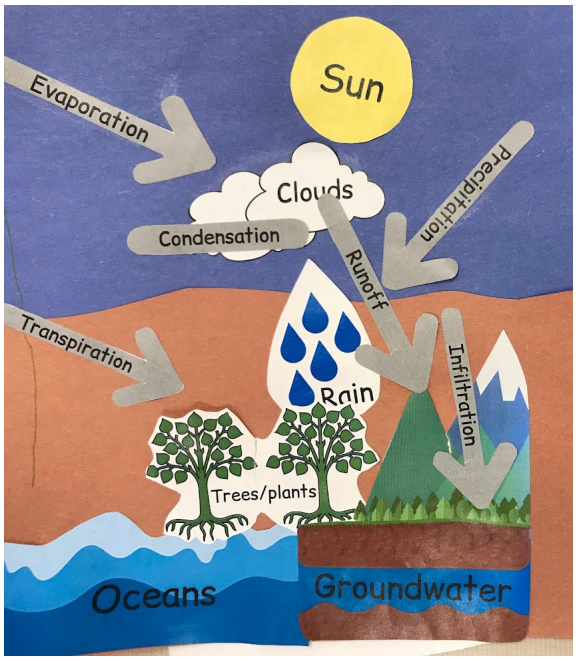


Figure 25 (left): Preparing materials for water cycle activity. Figure 26 (right): Anaya's completed water cycle. Note the pen line at the left of the image which goes from below transpiration up to evaporation; this was intended to show that evaporation comes from the oceans up to the clouds.

For the water cycle activity, I had supplies for the older girls to work in three groups. Since I only had three children, I let them each make their own water cycle. Below is a transcript segment from the beginning of the session.

Line	**Speaker**	**Speaker turn**
1	Anaya	Is it ok if I get it wrong?
2	Ellie	Yeah it's ok, we can talk about what--how it's
3	Valeria	I–we know–we know this girlie because um Ms. A told us this already
4	Anaya	I get it, it's just that it's mixed up, that's why I'm like
5	Ellie	If you get confused I gave you the definitions on a little list here and I can help you work on it, and so then what I wanted to also tell you about while we were getting ready--
6	Anaya	Yeah but like what if I need like a ocean?
7	Ellie	Oh I--you should have a ocean, this is the ocean

8	Anaya	Oh
9	Ellie	(laughs)

Anaya's question in line 1 "Is it ok if I get it wrong" indicates a prior schema that there is a right and wrong way to do science activities. She also seems to be probing me for my expectations in order to determine how she will engage in the activity. In line 4 she says "I get it, it's just that it's mixed up, that's why I'm like." This indicates that she is not completely confident in her ability in contrast to Valeria who in line 3 has just said "I–we know–we know this girlie because um Ms. A told us this already." Valeria's comment indicates that she is feeling self-confident. She also seems to be encouraging Anaya when she amends from "I" to "we know this already." By line 6 Anaya seems ready to engage when she asks "Yeah but like what if I need like a ocean?" This question indicates that she is already thinking about how to complete the activity and has committed to trying. The following transcript comes from about 4 minutes after the first one.

Line	**Speaker**	**Speaker Turn**
1	Valeria	My mom's gonna love this, she's gonna hang this up
2	Ellie	Nice
3	Valeria	She always–
4	Ellie	I wanna take pictures of it before you take em home though because I wanna see all the cool work you did
5	Valeria	(picking up the "precipitation" label) Precipitation–oh it starts in the–it starts in the sky [Ellie: and it comes down] and it goes all the way around. It's like a water cycle, it's all about the water cycle. [Ellie: This is the water cycle] sleet, hail, rain, and snow
6	Ellie	Ok so that's my question is--what I--because we were talking about snow today cuz it's December and hopefully it's starting to snow soon
7	Valeria	It snowed on Friday
8		(Danae asks a question and we go on a brief tangent)
9	Anaya	I want it off because this is evaporation is going up but like it's supposed to

		rain down on here
10	Ellie	Ok but what you could do is [Anaya: Oh oh oh] if you want it to rain down you could put your down arrow, and you could put your up arrow like this
11	Anaya	Look it, look it and then it goes down and then goes back?
12	Ellie	Exactly, yeah
13		(30 seconds pass of working and chatting)
14	Valeria	Condensation, it all starts up--right up here like it's--I think it's--no it's
15	Ellie	You're right, y–well it go–condensation is i–in the clouds right? When the wa–
16	Valeria	Mhmm. Water–it's something that was gas that turns into liquid like you see the steam on the shower like on the mirrors

This transcript opens with evidence of self-confidence from Valeria when she says “My mom's gonna love this, she's gonna hang this up” in line 1. Throughout the transcript Valeria displays prior knowledge. For example, in line 5 she says “Precipitation–oh it starts in the–it starts in the sky [Ellie: and it comes down] and it goes all the way around. It's like a water cycle, it's all about the water cycle. [Ellie: This is the water cycle] sleet, hail, rain, and snow.” Clearly she has prior knowledge of the water cycle from school and feels confident talking about it. Anaya is engaging with the activity but she continues to show concerns about “getting it wrong.” In line 9 she says “I want it off because this is evaporation is going up but like it's supposed to rain down on here.” She is referring to a piece of her cycle she has already glued in place but feels is wrong. This transcript and the previous one show lots of science thinking, examples of self-confidence at varying stages, and students asking questions and engaging with me.

The success of this session may have come from many factors. First, every child had chosen to be there, reinforcing the significance of student choice in science learning. Second, all of them knew me and had had a chance to establish trust, emphasizing how central it is to construct meaningful teacher-student relationships in science learning. And finally, there were only three students and me so my attention was not divided and it was easy for everyone to engage, proving how critical small groups can be for science learning. This session is an example of implementation interventions having a positive outcome.

CONCLUSION

While I would still hypothesize that a curriculum dedicated to empowering and inspiring female-identifying students in STEM can improve their self-concept, self-confidence, and bravery in STEM, this project did not answer my first research question (Can a curriculum dedicated to empowering and inspiring female-identifying students in STEM improve their self-concept, self-confidence, and bravery in STEM?). Nor did it answer my second question: Can a curriculum dedicated to empowering and inspiring female-identifying students in STEM improve their knowledge of role models in STEM? I began to answer my third question: How does choice and interest impact engagement in Out-of-School Time (OST) programming? And I most effectively answered my fourth question, as I gathered that consistency and trust are more important to effective OST programming than curriculum design and content. This project taught me that you cannot even begin to implement a science curriculum until you have established some degree of insider status and trust with students and have empowered students to choose to participate. Despite only having fully answered one of my research questions, it is imperative to explore how my research impacted my students, my praxis site, and myself.

Impact on Participants

I wanted girls participating in my program to understand 'I can be a scientist,' and 'there are women who look like me who are successful scientists.' My primary goal was not to have them all express interest in STEM careers by the end of the program but simply to know that they could succeed in STEM if they wanted to. I'm not sure whether I accomplished this goal. I think if I did it could certainly be accomplished to a greater extent. I saw science thinking and scientific exploration as well as some evidence of self-concept, self-confidence, and bravery. However, these were not the most interesting or valuable takeaways from this project. I learned more about trust, student resistance, student agency, and the implications of insider/outsider status.

Students who were initially resistant, like Danae, came to like and engage with the program. When I shifted to optional participation, some students chose not to come some days but overall I still got enough participants to run the activities. These outcomes along with evidence I saw of scientific exploration suggest a neutral or positive impact on the children who participated. It would be bold and presumptuous to claim that I made children love science or

changed their worldview through this afterschool program. In fact, I'm not sure whether I would claim any positive impact on the children who participated. A key difference to note here is between my impact on children through my regular role as a Y staff person and the impact of the STEM program I implemented. I think I did have an impact on children in my role as a regular staff person at the Y because I shaped their afternoons three days each week over several months. I planned and led activities and was the go-to person to mediate conflict, help with homework, and answer questions. When children were curious or confused, we had serious conversations about things like sexuality, religion, and race. However, I'm not sure how much my STEM program or research project, outside of my regular staff role, impacted the children who participated.

Impact on Praxis Site: The YMCA

Similar to the ambiguity of the program's impact on the children, the impact on the YMCA overall is not clear. If there was an impact, it was not substantial nor necessarily positive. The program created a demand on my direct supervisor in terms of working it into the weekly schedule and making sure that we had a room. The program was also often chaotic which may have caused disruptions or created additional strain on other staff. The fact that there was not a noticeable positive impact on the YMCA as a whole raises the concern that this research was extractive and self-serving. This is a theme I will explore further in the next section "Impact on Practitioner/Researcher."

The previous paragraph was written before my thesis defense. During the defense, I had the opportunity to discuss the impact my project had on the YMCA with my entire committee. Committee member Pam Suprenant, who is the Vice President of Youth Development and Community Services at the Central Community Branch YMCA, was able to give valuable insight into the impact this project will have on the YMCA moving forward. She articulated that while it may seem as though there wasn't an immediate impact on the organization, they will be taking my learnings from this project and applying them to improve how they engage with "outsider" projects in the future, particularly with college students. Pam shared that reading about the challenges I faced gave her insight into what the Y can do better when beginning new initiatives. She also expressed that this paper was useful food for thought about how the Y can include enrichment, like STEM, in their programming in an effective way. Pam also shared a

wonderful framing for the potential impact on children in response to my concerns that the children involved did not benefit from this project at all. She first assured me that she believes there was some degree of positive impact on the children involved. She then expressed that while the impact may not be immediately evident, this project had a substantial impact on me as a future teacher and therefore will impact my future students. Hearing Pam's feedback was encouraging and made me feel better about the impact of this project in the future.

Impact on Practitioner/Researcher (Myself)

The design and implementation of this project were challenging and filled with unexpected adjustments. It was a huge learning experience for me. I learned that it is unrealistic to create an effective new program where design, implementation, and evaluative research are all done by one person and that person is an undergraduate student. As I reflected and wrote my analysis, I was prompted to reflect on the potentially extractive nature of this research because I felt I got the most out of it of everyone involved.

There is danger and privileged ignorance in sending inept undergraduates such as myself to complete a "social change project" in a strict time frame, including human subjects research within the bounds of the IRB's rules. It might be more productive to encourage CYES juniors and seniors to engage thoroughly with a site for a year and a half; to reflect on practice and learn and build skills; to work with mentors to overcome obstacles and grow as effective social change makers. Only after months of engagement in a site should a student observe and pose problems to approach with action. In addition, I'm not sure there should be human subjects research as part of this action.

I understand that the intention of the Praxis Project is that students theorize a problem and enact a change project within a site they are already familiar with or a part of, however, this is not the reality for the majority of my cohort. As I conclude my praxis project I feel uneasy with the way the project played out. I, an outsider, stepped into a site with high hopes and expectations for a program with children I had never met. I became frustrated when things didn't go the way I had hoped and planned. Ultimately, the arc of my praxis project represents a common theme of white Clark students taking up space for their own learning in Main South without producing significant benefits to those around them. This outcome is against my own expressed values therefore it feels important for me to explicitly acknowledge and reflect on this

reality. After talking with my committee during my defense, I recognize that the impact of this project is nuanced. The process contributed to significant learning and personal growth for me. As a result, this project will shape the way I show up as a teacher and therefore I hope it will positively–if indirectly–impact children in the future.

Implications of Findings & Impact on Literature - So What?

The key finding of this project is that you can't teach science until you know the children, have established trust, and are willing to let student interest guide some of your activities. Furthermore, in an OST setting, an academic, highly-structured curriculum is misplaced. Instead, freedom to tinker and explore should be prioritized. If I were to implement this kind of a program again, I would draw on my experience to improve the quality of the program. I would focus on building trust, ensure that I had more structural support within the site/organization, and ensure that there would be consistency and potential for longer-term implementation.

There is extensive research on girls' engagement with STEM, however, trust, student resistance, and agency, and outsider/insider status are not often paired with STEM in research efforts. In prioritizing the latter, my research puts forward the way in which these themes interact. I believe it would be beneficial if future research could explore building trust and routines with a group before beginning a science curriculum. It would also be useful to juxtapose OST science programs where students choose to participate alongside those where participation is involuntary. Programs with a longer implementation period, though some are described in existing literature, should continue to be considered. Finally, further research could explore the implications of an external practitioner coming in to lead a program as opposed to someone inside an organization starting a program.

I hope future research and programming (ideally facilitated by more experienced practitioners who are already embedded in a site) draws on my findings to create STEM programming that prioritizes trust and student choice. I also hope future CYES students who read this, reflect on my experience and thoughts about the often inherently extractive nature of CYES projects.

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