Family Creative Learning: Designing Structures to Engage Kids and Parents as Computational Creators

Ricarose Roque

S.M., Massachusetts Institute of Technology (2012)
M.Eng., Massachusetts Institute of Technology (2007)
S.B., Massachusetts Institute of Technology (2006)

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Signature redacted

Author ................
Department of Media Arts and Sciences
August 5, 2016

Signature redacted

Certified by .............
 Mitchel Resnick
 LEGO Papert Learning Professor
 Thesis Supervisor

Signature redacted

Accepted by .............
Pattie Maes
Academic Head
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Abstract

The ability to create, design, and express oneself with technology is an important fluency for full participation in today’s digitally mediated society. Social support can play a major role in engaging and deepening what young people can learn and do with technology. In particular, parents can play many roles, such as being collaborators, resource providers, and co-learners with their kids.

In this dissertation, I explore the possibilities of engaging kids and their families as computational creators – providing opportunities and support to enable them to create things they care about with computing, to see themselves as creators, and to imagine the ways they can shape their world. I especially focus on families with limited access to resources and social support around computing. I describe the design of a community-based outreach program called Family Creative Learning, which invites kids, their families, and other families in their community to create and learn together using creative technologies. I use a qualitative approach to document the complex and diverse learning experiences of families. Through studies of family participation, I examine how kids and their parents supported one another and how the Family Creative Learning environment, activities, tools, and facilitation supported families in their development as computational creators. As families built projects, they also built perspectives in how they saw themselves, each other, and computing – developing identities as computational creators.

Thesis Supervisor: Mitchel Resnick
Title: LEGO Papert Learning Professor
Family Creative Learning: Designing Structures to Engage Kids and Parents as Computational Creators

Ricarose Roque

Signature redacted

Thesis Reader

Mizuko Ito
Professor in Residence
University of California, Irvine
Family Creative Learning: Designing structures to engage kids and parents as computational creators

Ricarose Roque

Signature redacted

Thesis Reader:
Jane Margolis
Senior Researcher
Graduate School of Education and Information Studies
University of California, Los Angeles
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To all the families that ate, met, made, and shared with us.
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Preface

One of my earliest memories I remember was when I was four years old. I was busy making a jump rope with my older sister. We were using colorful rubber bands, looping them together into a chain that would eventually become a jumping rope. Meanwhile, there was a lot of activity around us. My other family members were talking and walking around us with great energy, going in and out of rooms and organizing things. There was some talk about going somewhere. I asked where they were going. "The States," someone said. I then asked if I could come.

My family and I immigrated from the Philippines to Los Angeles, California in 1989. My dad came the year before to get settled. My mom, my two older siblings, and I followed. We had to leave my youngest sister behind. She was two years old at the time and my parents were worried about being able to properly take care of her. (After some legal and financial challenges, my little sister joined us nine years later.) We lived in immigrant neighborhoods that had families from all over Latin America and Southeast Asia. I played in the streets, in parks, and playgrounds with kids from Cambodia, Vietnam, Philippines, Mexico, Guatemala, and El Salvador.

These early years felt like I was on an adventure with my family. Many pictures we took at the time showed all of us in our 1-bedroom apartment eating McDonalds on the kitchen counter, in front of a bus stop at night, or in a department store sitting on the displayed furniture. Most activities were a family affair, which included trips to laundromats, visits to the homes of family friends, or our weekly trips to church. As more years passed I got the sense of how complicated our lives were. When I was 10 years old, California voters passed proposition 187 which denied "illegal aliens" services like healthcare and public education. I remember feeling surprised that the state of California, which contained my city full of immigrants,
had people that didn’t want us to be there. Fortunately, it was found to be unconstitutional.

Almost 30 years later, I’m about the age of my parents when they first immigrated. I can’t imagine how stressful that time must have been, juggling multiple jobs and multiple children. My two older siblings, who were just entering their teen years when we immigrated, became my surrogate parents. They were often put in a position of taking care of me as much as they were trying to take care of themselves in this transition. I think back to my jumping rope memory when I was four years old and see it from my family members’ perspectives. My older sister must have been playing with me to keep me busy while the rest of my family dealt with the complex task of immigrating. My mom balanced both logistical and emotional struggles — saying goodbye to her large family and leaving her youngest daughter behind. My dad anxiously waited for us on the other side, doing what he could to make sure we were comfortable with what we had. This was one of many stories of the ways that my family rallied around me and around each other.

Today, as a designer, educator, and researcher, my work focuses on engaging kids to create and express themselves with technology. As I study and design for kids particularly from underrepresented groups in computing, I can’t help looking back to understand how I got here. Some people might see me as exemplary — that I made it despite my background. I see it and know it to be different. I am an exception and I made it because of my background.

I think about my background as an immigrant. I’ve learned to thrive as an outsider, to negotiate my multiple identities as Filipino, American, immigrant, daughter, student, and colleague as I left my immigrant city, to connect across multiple cultures and backgrounds, to make the most with what I have, and to be creative, persistent, and compassionate. My family, my peers, and teachers played important roles. My family moved halfway across the world and rallied behind me. My peers shared their interests, support, and strategies for navigating school and college. My teachers recognized me and directed me towards more opportunities.

When I talk about the groups of people that I work with, I struggle with the labels: underserved, disadvantaged, marginalized, less privileged, minorities, non-dominant, low-income. These labels recognize the challenges and differences, but they tend to focus on the deficits or imply less than they are. Instead I see kids and families who had
similar stories to mine, their own stories of immigration, of struggle, and of success. They have their own family photos of brand new activities. They have diverse backgrounds, interests, practices, and perspectives.

This dissertation is about how we can address the deficits in our learning environments and opportunities for kids and families with backgrounds like mine. While technology has an important role to play, the design of activities, facilitation, environment, and ecosystem of opportunities are often overlooked. These contexts and structures play important roles in welcoming people, helping to surface and realize their ideas, and developing relationships that will support and sustain their learning. When we design experiences, how do we invite, welcome, and respect people for who they are, where they are from, and how they are connected? How do we develop opportunities to allow people to create, to share their voice, and to shape their trajectories? This dissertation is my attempt to wrestle with these questions and make visible what kids and families can do when given the spaces to create, connect, and thrive.
Chapter 1 Introduction

In this chapter, I describe the opportunities and challenges for young people as they participate in our computational society—and the role that families and communities can play to support their full participation as computational creators.
In the summer of 2013, I had the opportunity to visit MAKESHOP, a makerspace inside the Children’s Museum of Pittsburgh. It was an inviting and open space, full of activities and materials for kids and their families to play with, such as circuit blocks, a laser cutter, and other interactive design activities. What I found most fascinating about the space was the sewing table area. There were spools of various colored thread, scraps of cloth with interesting patterns, and plenty of needles. I just loved the ways that kids and their families approached the table. Kids eagerly touched the materials and declared all the things they wanted to do. Parents sat down with them, a little hesitant at first, but soon said things to their kids like, “I think I remember how to thread a needle. Let me help you with that.” Sometimes the parents themselves would work on a simple pillow next to their kids. There was a sewing machine nearby and I watched one grandmother create a simple dress for her granddaughter’s doll. Around the sewing table, other kids and parents were at work and sometimes they would share ideas or inspirations with other families. As I watched how families approached this table, I could see all this history, familiarity, and support emerge within their intergenerational interactions.

When kids learn to sew, they can create a variety of artifacts as well as access a rich history and tradition of sewing that spans generations and crosses social groups. Parents and other family members can support their kids in a variety of ways, such as sharing their experiences, collaborating on projects together, or even modeling their own projects. Kids can remix the techniques they learn from others to express themselves in new ways. With sewing, kids can create things that are personally and socially meaningful and connect with others who share similar expertise, interests, or traditions with sewing.

The sewing table and the overall MAKESHOP environment was designed to cultivate these kinds of interactions and experiences for families (Brahms & Werner, 2013). The physical environment was bright, colorful, and welcoming. The table was easy to come around for families. On the table, there were some projects that were left behind, allowing newcomers to see what happened as inspiration. Families were close enough to each other so that they could interact or overhear other families’ conversations. Facilitators walked around helping families get started or making suggestions to take their projects further. The different tools and materials on the table suggested what families could do. There were larger plastic needles for younger kids to play with in addition to traditional metal needles. Scraps of different fabrics could evoke project ideas. There
were other tables around the space. Nearby was a circuit blocks table with other kids and parents busy tinkering with circuits. At the entrance of MAKESHOP, kids and parents were greeted with a hanging sign that asked "What do you want to make today?" The creators of MAKESHOP designed structures to support an experience where families could make what they wanted, meet with other creators, share their projects, and learn from one another – cultivating a culture of creative learning.

*Participating in a Computational Society*

Today, young people are connecting, playing, and growing up with technology. They can easily talk to friends and family from anywhere around the world. They can look up all kinds of content as well as share their own content for others to find. They can play with toys that have small computers embedded in them, which can interact with their movements and voices. At the same time, many parents are figuring out what makes sense for their kids and their families. However, unlike the activity of sewing, kids and their families are still developing their histories, practices, and identities with computing. How would a sewing table experience look like for families in the context of computing? What kinds spaces welcome intergenerational participation and support kids and parents to be creative and collaborative with other families? Community centers have computer rooms that provide easy access to computers and families are increasingly adopting different computing devices at home. However, there were other aspects about the sewing table that supported and engaged families beyond the devices – a welcoming and creative environment, facilitators to invite families and help them get started, activities that engaged them in creating and sharing, and tools that provided multiple entry points and ways of expressing themselves.

In the past decade, there has been a growing movement to engage kids in "computational thinking," or using the concepts and practices of computer science as a way to solve problems and understand the world around them. Jeannette Wing, who popularized the phrase argues that computational thinking "represents a universally applicable attitude and skill set everyone, not just computer scientists, would be eager to learn and use" (Wing, 2006). Many workshops and initiatives have emerged to define computational thinking and how we can integrate it into educational settings (National Research Council, 2010; Grover & Pea, 2013).
I have been interested in engaging young people not just in solving problems with computing, but using computing to create, design, and build things and develop as *computational creators* as well as computational thinkers. Kids who learn to create and express themselves with computing are able to take more active roles and shape their participation in an increasingly digital society. Computer programming, or coding, has been recognized as an important medium to create with computing. When kids learn to code, they can create their own interactive media and apps such as games, stories, animations, and simulations — and share them with people around the world. At the same time, as kids learn to code, they can develop as computational thinkers as they engage with concepts, practices, and perspectives supported by computing (Brennan & Resinck, 2012; Wing, 2006). These abilities to think and create computationally can allow kids to develop as computational creators — people who can create things they care about, develop identities as creators, and imagine the ways they can shape the world. These abilities are important for everyone to become full participants in our increasingly digital society.

However, there are troubling participation gaps in who takes up these opportunities with computational creation. When we look at spaces that have traditionally supported these activities, such as computer science programs, there is an underrepresentation of women and racial minorities. For example, in 2014, 17% of the computer and information science bachelors degree recipients were women (NCWIT, 2016), while in 2015, 13% of the computer and information science bachelors degree recipients were racial minorities (African-American, Hispanic-American, and Native-American) (Zweben & Bizot, 2015). These statistics represent the United States, but the question of who participates in computing has been a global conversation.

I have been preoccupied with this question of "who?" Who can participate and take up the advantages of computing? Who is not participating? What challenges do they face to participate? Seymour Papert asked a question in *Mindstorms* (1980) that helped me think about this question.

> Which people will be attracted to the world of computers, what talents will they bring, and what tastes and ideologies will they impose on the growing computer culture? (p. 29)

I interpreted Papert’s question in two ways. First, that those who participate have the power to shape the kind of computer culture that develops. This includes shaping the everyday interactions we
have with platforms, systems, and tools that mediate our interactions. Uneven participation by groups of people can result in uneven computing innovations that can benefit some and exclude others. In an Op-Ed article for the New York Times titled "Artificial Intelligence’s White Guy Problem" (2016), Kate Crawford described the many ways that algorithms and systems can perpetuate biases. For example, some facial recognition systems have failed in recognizing faces with darker skin colors (Chen, 2009). Pokemon Go, a popular augmented reality game, had fewer locations for players to interact with in poorer neighborhoods (Huffaker, n.d.).

Like all technologies before it, artificial intelligence will reflect the values of its creators. So inclusivity matters – from who designs it to who sits on the company boards and which ethical perspectives are included. Otherwise, we risk constructing machine intelligence that mirrors a narrow and privileged vision of society, with its old, familiar biases and stereotypes.

Crawford’s article and the examples she provided highlights my second takeaway from Papert’s quote. To ensure that the growing computer culture is inclusive and diverse, we need to invite people from many backgrounds to help shape that computing culture together.

Preparatory Privilege

What enables some kids to participate in this computational society? I have had an opportunity to explore this question for the last five years through my research as a part of the MIT Scratch Team. Scratch is a programming language and online community where kids can create and share their own interactive media such as animations, games, and stories – and share it with people around the world (Resnick et al., 2009). As of this writing, there are more than 16 million shared projects with more than 12 million registered members. In my research, I have focused on the Scratch online community to understand who participates, how kids participate in creating and sharing with others, and how the Scratch website and online community support their learning process. In my interviews of Scratch members, I learned how they were creating personally meaningful projects and connecting with others who shared their interests. The Scratch community members I interviewed were computational creators – creating things they cared about, developing identities as creators, and imagining how they might shape the world around them (Roque, Rusk, & Resnick, 2016).
However, during our conversations, I noticed an interesting pattern that struck me and stuck with me: many of the Scratch members had a parent or extended family member who introduced them to Scratch, asked them questions about their work, or pointed them to other learning opportunities that could deepen their interests. Some of their parents or someone in their immediate support network were engineers, hobbyists, or computer science professors. Many of the Scratch members I interviewed also had their own computers (sometimes the computer was in their room), where they could easily access and use Scratch for their own purposes.

For many of the Scratch members I interviewed, they were fortunate enough to have what Jane Margolis and her colleagues have called "preparatory privilege" – that is, the resources, autonomy, and social support to leverage these creative and empowering opportunities with computing (Margolis & Fisher, 2003). This pattern I observed reflects other studies of kids' uses of new media and technologies – many kids are increasingly using and interacting with technologies, but few are taking up opportunities to create and design with technology (Livingstone & Helsper, 2007; Ito et al., 2009). For kids that took up these creative opportunities with computing, they already had the social, economic, and cultural capital to facilitate their engagement. Access to technology is not enough and these studies counter the narrative of a "digital native," where kids can be left alone to take up the many opportunities of technology. The social and cultural context surrounding a kid influences what they can do and how they can pursue their interests with technology.

**Family Learning and Computing**

Parents and other adult caretakers play important roles in providing them with resources, finding learning opportunities, or collaborating on projects together (Barron, Martin, Takeuchi, & Fithian, 2009). For parents with limited backgrounds in computing, figuring out the roles they can play to support their kids and negotiating the mixed messages about the benefits or pitfalls of technology use can be challenging (DiSalvo, Reid, & Roshan, 2014; Tripp, 2011). Assumptions about technology use can sometimes undermine their kids' experiences. For example, some parents might limit kids' uses of technology to school-based assignments, excluding informal opportunities to explore, play, and connect (Tripp, 2011). These challenges are especially pronounced for families in lower socioeconomic com-
munities. While families are increasingly adopting Internet-enabled devices, families remain "under-connected" and struggle with staying connected because of interrupted service, trouble making payments, sharing one connection with multiple people in the family, or hitting the data-limits of their mobile devices (Rideout & Katz, 2016).

At the same time, traditional dynamics and roles are shifting as kids develop their expertise beyond what their parents may be familiar with, leaving parents to wonder what roles they can play to support their kids' development (Correa, Straubhaar, Chen, & Spence, 2015; Roque, 2013). With their growing expertise and excitement around technology, kids often acted as "technology brokers" with their family members (Correa, et al., 2013), teaching their family members how to use email, pay their bills online, or search for information. In a survey of families in the Austin area, Correa and colleagues (2013) found that kids from lower socioeconomic groups more frequently fulfilled the "technology broker" role. However, these kids' expertise critically relied on their schools and their peers. For kids that attend schools that are resource- and curriculum-poor, the potential for their expertise to grow and develop can be very limited (Margolis, Estrella, Goode, Holme, & Nao, 2008).

As new technologies and opportunities emerge, some researchers warn that these gaps may accelerate inequality. In a study of household investments in enrichment activities for their kids, Duncan and Murnane (2011) found that investments were increasing in upper income households while investments in lower income households have remained relatively flat (Figure 1).
Cultivating Communities of Creators

In thinking about how we might engage kids from diverse backgrounds in computing, I have been influenced by the Seymour Papert’s constructionism (Papert, 1980; Kafai & Resnick, 1996) framework. This framework argues that kids learn most effectively when they are designing and building things that are personally and socially meaningful. He built on Jean Piaget’s theory of constructivism, which argues that people learn by actively building knowledge through experience, rather than learning by transmission of ideas (Piaget, 1976). Papert’s framework of constructionism influenced the development of the Logo programming language, which allowed kids to use computing to design, build, and explore powerful ideas. Logo and other related explorations sparked a long legacy of tools that allowed kids to build, design, and create their projects based on their personal interests while allowing kids to explore powerful ideas (Resnick, Bruckman, & Martin, 1996).

One might say the computer is being used to program the child. In my vision, the child programs the computer and, in doing so, both acquires a sense of mastery over a piece of the most modern and powerful technology and establishes an intimate contact with some of the deepest ideas from science, from mathematics, and from the art of intellectual model building. (Papert, 1980, pp. 5)

While many of these tools have spread and allowed kids to build with computing, there has been a tendency to introduce or engage kids by having them follow a series of steps or recipes, which undermines the goal of having kids create personally meaningful projects. As Amy Bruckman pointed out, "tools are not enough... Tools are effectively constructionist only when they are embedded in a constructionist culture." (Bruckman, 1998, pp. 51–52) What does this constructionist culture look like? How does the surrounding social and cultural context support kids to engage in creating and building with these computational tools? Papert shared another vision of a computational samba school, inspired by dance schools in Brazil where community members gather to learn the annual dances from each other (Papert, 1980). Novices and experts learn from one another. Membership is open to anyone, people of all ages, abilities, and status (Zagal & Bruckman, 2005). Samba was part of the popular culture and it was continuous in many aspects of people’s lives outside of the school. He argued that for computer culture to be meaningful, it needed to connect with the popular culture as well.
The obstacle to the growth of popular computer cultures is cultural, for example, the mismatch between the computer culture embedded in the machines of today and the cultures of the homes they will go into. And if the problem is cultural the remedy must be cultural. (pp. 183)

Bruckman extended this idea in the early 90s when she created MOOSE Crossing, a text-based virtual world that allowed kids to create and build things together – learning from each other at the same time (Bruckman, 1998). The Scratch programming environment and online community provided both the creative and social context for kids to build and share their creations with others from around the world (Resnick et al., 2009). For kids in both of these settings, the community of creators were important part of engaging and sustaining their participation (Brennan, Monroy-Hernández, & Resnick, 2010). These settings demonstrate theories of learning that argue that learning is situated in social interaction, shared activities, and everyday practices of communities (Lave & Wenger, 1991; Rogoff, 1994). Learning occurs through increasing participation in these shared activities and supportive relationships with peers and other caring adults.

In addition to building systems that allow people to come together online, other initiatives and programs have leveraged the role of social support to engage the different spheres and people that surround a young person’s life. Programs like the Digital Youth Network took on an ecological approach connecting home, school, and after-school networks to support and sustain youth in developing as critical media producers (Barron, Gomez, Pinkard, & Martin, 2014). They used a social platform called iRemix to connect these different spaces and encouraged youth to share their work and connect with peers and mentors online. Mimi Ito and her colleagues developed the Connected Learning framework to guide designers and researchers of learning experiences in understanding the role of relationships and networks in supporting youth to pursue and connect their interests to academic, career, and civic opportunities (Ito et al., 2013). Such experiences and networks of opportunity can be especially important in enriching and strengthening the social support networks among underrepresented groups in computing.
Unlike the activity of sewing, kids and their families are still developing their histories, practices, and identities with computing. I was inspired by the ways that families approached the sewing table and for the last three years, I have been preoccupied with how we can engage kids and families in creative computing experiences with the rich intergenerational interactions that support learning, creativity, and play. Strengthening this social support can be an important strategy to break perpetuating cycles of inequality as the computational landscape changes. By strengthening, I mean supporting the important people that surround a young person to help them appreciate and understand their kids’ interests in computing. Outreach programs often focus on “skilling up” the individual, leaving it up to the young person to advocate for their interests and activities to their parents, friends, and educators. Forms of family engagement in these outreach programs are typically limited to informational presentations or attending final showcases. Outreach programs miss out on opportunities to engage parents as co-learners and co-creators with their kids. Studies about how families use technology recommend designing learning experiences where parents can develop their expertise and where families can engage in joint activities around computing (Livingstone, Mascheroni, Dreier, Chaudron, & Lagae, 2015; Takeuchi & Stevens, 2011).

In this dissertation, I explore the possibilities of engaging kids and their families as computational creators by designing a learning experience in the spirit of the sewing table. I especially focus on families with limited access to resources and social support around computing – who are still developing their family practices, traditions, and histories with computing. The two primary research questions I explore in this dissertation are:

1. How can we design inclusive and creative learning environments to support kids and their families to engage in computational creation?

2. By engaging in this inclusive and creative learning environment, how do kids and their families develop as computational creators?

I took a two-fold approach to explore these questions. First, I engaged in an iterative and collaborative design process with different community-based organizations to develop a program called Fam-
ily Creative Learning (FCL) (Roque, 2016). Kids and their families participated in a series of workshops to create and learn together using creative technologies. Second, I used a qualitative approach to document the complex and diverse learning experiences of families, focusing on kids’ and parents’ engagement in the creative learning process rather than exclusively on the concepts that they were learning. In documenting families’ experiences, I examined how the Family Creative Learning environment, activities, tools, and facilitation supported families as they engaged in computational creation.

To design Family Creative Learning, I was inspired by participatory approaches such as action research and design-based research (Stringer, 2013; Anderson & Shattuck, 2012), which engage people as collaborators rather than research subjects, embed the research in real-life settings, and experiment with multiple iterations. I worked with various community-based organizations that served families in low-income communities and we designed and implemented eight iterations of the program. In addition to designing this learning experience, I studied families’ experiences to understand how kids and parents were developing as computational creators. I drew from ethnographic and case study methods to examine both individual experiences and emergent social and cultural patterns. I collected qualitative data such as observations and interviews to analyze the ways in which families enacted different design and supportive practices, how they interacted during their collaborations, what kinds of roles they took on, and how they perceived their experiences.

After experimenting with different program models through our design iterations, the current model of Family Creative Learning consisted of five workshops, held once a week in the evening for two hours. Kids and parents learned how to create with the Scratch programming language and the MaKey MaKey invention kit to create digital and physical projects. The program culminated in a community showcase where families shared their projects with other families and friends. Each workshop was split into four parts: Eat, Meet, Make, Share. In Eat, families started with dinner. During Meet, we split up parents and kids to meet and reflect on the experience with their peers. In Make, kids and parents created projects with Scratch and MaKey MaKey. In Share, all the families came back together to share their projects and ask each other questions.

Some might interpret Family Creative Learning as a program that taught families to code, but my collaborators and I learned something more important from our design process and analysis of fam-
ilies' experiences: for families, FCL was as much about building relationships as it was about building projects. Kids and parents had many opportunities to develop connections while they were eating together, meeting with their peers, making projects that built on their interests and ideas, and sharing their projects and giving each other feedback. These opportunities to connect allowed kids and parents to develop new or apply existing roles to support one another as they collaborated. In addition to developing connections within their families, kids and parents connected with other families and became better acquainted with staff in community centers – developing stronger support networks for kids and their families.

At the same time, kids and parents were able to see themselves, each other, and computing in new and empowering ways. Kids saw how they could apply their expertise to support their family members. Parents experienced first-hand the kinds of challenges, breakthroughs, and playfulness that their kids experienced. At the same time, kids and parents saw each other as curious, joyful, and creative inventors of technology. They developed new ideas of computing as something that they could control, connect to the real world, and create anything they imagined. As one mother said, she appreciated how she was "able to build something from nothing." Another kid expressed how "anything is a material. Everything is a tool." While most computing learning environments focus on developing skills and content knowledge, often programs miss opportunities to help participants develop a sense of who they are and how they relate to computing.

These family experiences were embedded in the designed structures of Family Creative Learning. We selected tools like Scratch and MaKey MaKey that could support kids and parents to create almost anything they imagined. We designed activities that allowed kids and parents to connect, learn, and share – activities that allowed them to develop deep connections to the activities and to each other. Our facilitation strategies supported kids and parents to surface and pursue their ideas. The physical and socio-emotional environment were created to support a welcoming and creative space for families to take intellectual and creative risks. All together, these designed structures aimed to cultivate a constructionist culture of learning that was inclusive of the diverse backgrounds and interests of kids and their families – an environment supported by caring relationships where kids and families could create things with computing that were personally and socially meaningful.
Through the design and study of Family Creative Learning in this dissertation, I want to challenge educators, designers, and researchers to expand our visions of what learning experiences can look like in the context of computing. Rather than exclusively focusing on teachers and schools as facilitators of these learning experiences, families and communities are important people and settings that can complement and sustain lifelong experiences with computing. These learning experiences need to be personally and socially meaningful connecting to learners’ interests and providing opportunities for them to connect to other learners. These personal and social aspects of learning helped families to develop perspectives on themselves and each other in the context of computing. At its core, this work is an exploration of connecting the different people and settings in a learners’ life. These connections can build a network of relationships that will support these developing trajectories and diverse identities as computational creators. It is through these caring and supportive relationships that we can build and shape a computational culture where young people can create, grow, and learn, while embracing who they are and where they come from.

**Thesis Organization**

In Chapter 2 *Designing for Family Engagement*, I describe my collaborative and iterative design process with community-based organizations to develop an inclusive and creative learning environment for families through the Family Creative Learning program.

In Chapter 3 *Examining Family Engagement*, I describe my qualitative approach to understand how kids and their parents develop as computational creators.

In Chapter 4 *Building Projects*, I share the experiences of families' participation in the Family Creative Learning workshops, using the story of one family to organize the themes from families' experience.

In Chapter 5 *Building Perspectives*, I discuss the perspectives that kids and parents developed during the workshops, highlighting how kids and parents shifted how they saw themselves, each other, and computing.

In Chapter 6 *Supporting Computational Creators*, I revisit the design of Family Creative Learning discussed in Chapter 2 and the descriptions
of family experiences in Chapter 4 and 5 to discuss design strategies to engage learners in computational creation.

In Chapter 7 Conclusion, I reflect on my experience designing and studying Family Creative Learning. I use the story of one boy who participated in the workshops to frame my reflections and ongoing challenges for future work and research.
Chapter 2 Designing for Family Engagement

In this chapter, I describe my design process with community-based organizations to design an inclusive and creative learning environment for families called the Family Creative Learning program. I provide a detailed description of how we chose tools, developed activities, enacted facilitation, and created an environment to support families in computational creation.
The first time I saw a family create a Scratch project together was an accident. I was hosting a workshop for more experienced Scratch creators in the summer of 2011 when a family of four (two parents and their two kids) approached the registration table and asked to participate. They had not signed up beforehand. We had some space in the workshop so we invited them to participate. Rather than leaving their kids, the parents sat down with them. Other parents were around, but they sat outside the workshop space, working on their laptops or talking on the phone. I was surprised to see these two parents sitting next to their kids, waiting for the workshop to start.

I became fascinated by their dynamic. The mother worked with the youngest who was 7 years old, while the father worked with the oldest who was 10 years old. All four family members were new to Scratch. To help them get started, a facilitator sat between the two pairs. Rather than watch their kids, both parents leaned in and asked the facilitator questions, while both kids had their hands on the laptops. At the end of the workshop, each pair shared their project. They were relatively simple compared to the other projects in the workshop, especially since the other workshop participants already had some experience with Scratch. However, you could see how proud and excited they were to share their projects.

This moment piqued my curiosity and I began a series of design explorations around family workshops that eventually turned into the Family Creative Learning (FCL) program. In FCL, families participated in a series of five workshops, which were held once a week for two hours in a local community center. Kids must be at least 7 years old and families could bring any number of family members as long as a parent was involved. I use "parent" loosely to mean any adult caretaker, such as a grandparent, an older sibling, an extended family member, or a family friend. In the first two workshops, kids and their parents learned how to use the Scratch programming language and the MaKey MaKey invention kit. In the next two workshops, kids and parents worked together on a family project. The final workshop was a community showcase where families shared their projects with their friends, family, and other community members.

In this chapter, I describe the participatory design approach to develop the program in collaboration with staff at community centers. I was inspired by approaches such as action research, critical design ethnography, and design-based research. During my collaboration with a community center, I conducted a series of focus groups to better understand parents' perceptions of technology in their lives, their
kids' lives, and their families' lives. I conclude the chapter by discussing the ways we designed structures in Family Creative Learning to engage families in computational creation, organized through a four-part framework of tools, activities, facilitation, and environment.

In discussions about outreach programs, the first questions are often what skills kids need, focusing on how to fill the "deficits" in the learner rather than focusing on the deficits in the learning environments. Some learning environments have a "technocentric" approach, focusing on how to use tools without attention to activity or facilitation structure (Papert, 1987). Other computing outreach programs operate with a central instructor dictating what to do step-by-step with a pre-determined project. With the design and study of FCL, I wanted to explore how we can design inclusive and creative learning environments that built on participants' interests, backgrounds, and rich histories to helped them create and express themselves with computing.

**Participatory Approach**

From the beginning, I wanted to take a collaborative and iterative approach in developing the program, rather than designing a fully developed program first then finding a community organization that would be willing to implement it - an approach often taken by many computing outreach programs. I also wanted to take a hyperlocal approach, designing a program with and for a particular community, rather than designing a generic program for a larger scale. I wanted to free myself and my collaborators from the pressures of scale and instead focus on the features and challenges of their community. However, I wanted to make sure that we documented our processes as a team as well as families' experiences in the workshops to distill lessons that could inform our design process and that might be helpful for other educators and designers to learn from and adapt into their own settings.

I was inspired by approaches that incorporated these sensibilities into the research and design process, such as action research, design-based research, and critical design ethnography (Stringer, 2013; Anderson & Shattuck, 2012; Collective, 2003; Barab, Thomas, Dodge, Squire, & Newell, 2004). In these approaches, participants are collaborators rather than research subjects, based on the idea that the people who are affected should have a stake in the inquiry process.
Sasha Barab and his colleagues (2004) discussed how his research team and their design process benefited from a collaborative relationship:

The tenor of our relationships prompted us to view these sites more holistically. We learned to listen first and then talk, placing emphasis on establishing trust, respect, and shared intention rather than simply imposing an instructional design. Over time, our focus shifted and our team became committed to understanding the participants and their contexts of participation, with the later goal that lessons learned would allow us to develop a more useful product prototype. In our new way of thinking, design became an outgrowth of healthy relationships, as opposed to our relationships being an outgrowth of good design. (pp. 255)

Similarly, our design collaboration was enriched through a process of listening and direct interaction from different people in the community.

Additionally, these approaches argue for embedding the inquiry process in "real-life" contexts rather than in controlled laboratory settings and considering the complexity of these contexts rather than reducing to simple variables (A. L. Brown, 1992). Iterative cycles of design, implementation, and reflection are an important aspect of the process and contribute to the development of guidelines and strategies that are tied to this context. "These principles are not designed to create decontextualized principles or grand theories that function with equal effect in all contexts. Rather, design principles reflect the conditions in which they operate" (Anderson & Shattuck, 2012).

**Collaborators**

I worked with community-based organizations that primarily served youth and families in low-income communities in the Boston area. I wanted to engage directly with the communities in settings that were already interacting with families. While the MIT Scratch Team sometimes hosted open and free events at MIT, such as Scratch Day, these events often attracted parents and families who were already "plugged in" and actively curating opportunities for their kids to engage in creative experiences with computing. I wanted to work with families who may not be aware of these opportunities or who would have challenges attending these kinds of events at the university.
I worked with a total of five organizations, which included Boys and Girls Clubs, community centers in housing developments, and after-school programs. I did one workshop series with a school and community-based organization in Santa Fe, NM. Within these organizations, I worked with staff, typically the technology director or other program coordinators, who were interested in engaging families in design-based activities with computing. Sometimes I worked with one person in the organization. Other times I worked with a whole team of people from the organization.

Most of my collaborators had already worked with the Lifelong Kindergarten research group, which I am a member of. I had prior relationships with only one of the five organizations, but I was introduced to the other four organizations through people in Lifelong Kindergarten. For example, I hosted three workshop series in a Computer Clubhouse within a Boys and Girls Club. Computer Clubhouses are a network of informal learning spaces where teens in low-income communities learn to explore and create with new technologies; they were founded by Mitchel Resnick and Natalie Rusk of the Lifelong Kindergarten group (Rusk, Resnick, & Cooke, 2009).

I made efforts to reach out to organizations outside of my immediate network of collaborators, but I ran into various challenges. I had many promising interactions with different community-based organizations and their staff at meetings, conferences, or other kinds of gatherings, but excited email exchanges soon went quiet. Some organizations did not have the technical resources and space to engage families. Other organizations wanted a ready-to-use sequence of activities. Some did not have the time or staff to participate in a design and exploration process together. Another lesson that I soon learned from our design iterations was the importance of prior relationships with families. Some organizations with little or limited relationships with families had difficulty recruiting families to participate. Other challenges included a misalignment of expectations around family learning and technology. For example, one organization wanted to focus on computer science education. While there are many ways that computational creation aligns with computer science education, I wanted families to experience computing as a form of expression and empowerment and not tie it to a particular disciplinary domain. By working with organizations who had already worked with Lifelong Kindergarten, it was easier to find educators who had the technical resources from past collaborations and who were interested in applying constructionist approaches to designing learning environments.
As we began to design and implement the family workshops, we observed a range of dynamics between kids and their parents. Often one person, usually the child, would dominate the computer, while the other sat passively watching. Sometimes it was because the parent wanted their child to take the lead and encouraged their kids to drive their project. Other times the parent felt nervous or anxious around the activity and preferred to watch. Sometimes parents were too directed, asking their kid to do things in a certain way. We also saw the opposite dynamic, where the parent was disengaged, either on their phones or talking to other parents. At the start of one workshop activity, one parent immediately stood up and walked over to a wall in the room. I asked her if she wanted to join us and she replied by saying she wasn’t very creative or interested in being creative. However, she wanted to make sure that her daughters developed their creativity. Other parents I spoke with talked about how “illiterate” they were with technology and relied on their kids to know what to do. I realized that there was more we could learn about parents and their perceptions around technology, learning, and creativity.

To understand parents’ perspectives, particularly parents within the communities that we were working in, I worked with a staff person at a community center in the Boston area to design a focus group, or group interview. I used focus groups to interview multiple parents in a familiar setting (their local community center) and to leverage the dynamics of groups to gather shared perceptions or contentious points. We developed this central question:

What are parents’ perceptions of technology in their lives, their kids’ lives, and in their families’ lives?

I used our protocol to conduct a focus group at her community center and another three focus groups at three other community centers in the Boston area which served families from low-income communities. I worked with her and with staff at the other community centers to recruit 3 to 5 parents from their communities to talk for 90 to 120 minutes. I asked questions such as "in what kinds of situations do you interact with different technologies?" and "what are some of the most challenging situations or experiences you have faced with technology?"

I conducted four focus groups each with about three to five parents,
with a total of 16 parents. The conversations lasted about 90 to 120 minutes. I provided parents with a lunch or dinner depending on the timing of the focus group along with childcare or activities for their kids to engage in while I spoke with parents. I defined parents loosely to include other adult caretakers such as grandparents, extended family, and family friends. The participants included parents who had been living in the community for generations and recent immigrants from the Caribbean and China.

In the hour and a half we shared together, parents shared their personal and kids’ uses of technology and its influence on their lives. And at the end of each one, I noticed that parents seemed to enjoy the experience. They thanked me for putting this together. And then they thanked each other. Some suggested doing “this” again. Parents exchanged contact information. There was a feeling that we went through something special. And I only made sense of what that was through iterative readings of the transcripts.

I found that parents connected over their sometimes overwhelming anxiety around computing and how it influenced how they saw themselves, their kids, and their relationships to their kids. For example, they agreed that there were benefits to using computers and mobile devices in their lives, but at the same time, they shared questions about what was being lost or given up with their use. With cell phones, they could get in touch with their kids immediately and at any time. With Facebook, they could keep in touch with relatives still living in the countries they left behind. But when someone grows up with communication done through text-based mediums and interactions mediated through devices, how do they connect with people emotionally and deeply in real life? How do they develop their sense of what is right and wrong? One mother asked about technology: “How - not even how does it benefit him - how does it benefit other people? How does what you do [with technology] help someone else?”

For every question I asked, parents illuminated their responses with stories. One dad shared his disappointment with how technology has complicated reading with his son, and even replaced him as his son’s reading partner.

You hit on a word [on an iPad reading app] and it says the word for you. I was a little offended, I thought I would be a great reader for them, but they preferred to have the, whatever the person who had been paid by the company to read to them, which I’m still bitter about.
Other parents would hear these stories and add their own, sometimes validating their shared experiences by saying they experienced the same thing. "I know how you feel." Another parent shared a story of how homework time has changed in her household.

We were taught that you come home, you sit at the table, your parents - somebody did their homework with you. So you've got that physical doing it, not the computer actually teaching you, or sitting in front of a television, just being raised by the television or the computer.

Parents tried to make sense of their stories together. For example, after noticing how much his son played with GarageBand on his iPad, one dad offered to take him to a class offered at a local community center, involving GarageBand activities on personal computers. However, to his surprise, his son resisted.

I was surprised when I said, "Let's go to a GarageBand class at the tech center." He was like, "I don't really like GarageBand." And I was like, "What are you talking about?" And he was like, "I like GarageBand on my iPad." And I think it's because there's not much reading involved [in the GarageBand iPad app].

This father believed that his son preferred using GarageBand on the iPad over a personal computer because there would be less reading involved in the iPad app's user interface. Earlier in the focus group, he shared that he's been trying to help develop his son's reading abilities. However, another mother in the group offered an alternative perspective on his son's reasoning:

I just think being where everyone is speaking English - like you said he can't read - that's intimidating... He's more comfortable with the iPad. It can't talk back. I mean it can talk back, but you know what I mean? It's not so intense. It's not a human with eyes, expecting a response that's correct or incorrect.

In this exchange, another mother in the focus group was able to extend a father's explanation to include social factors - generating new understandings of his son's reaction.

The focus group became a place to share stories, gain validation about their experiences, and connect with one another at personal and emotional levels. In the time that we shared together, the focus group transformed into support group. This was an unexpected outcome. I dug into focus group research literature to better understand the history of the format. Through their focus groups with Hurricane Katrina survivors and second-generation Muslim-Americans
after 9/11, Peek and Fothergill (2009) found ways in which the focus group format can serve as a form of social support or empowerment for people who have been marginalized or victimized. Feminist researchers like Sue Wilkinson (1998) argue that the focus group format can shift the power from the researcher to the participants, can produce richer, interactive data, and provide opportunities for participants to co-construct meaning.

In these conversations, I found that parents were feeling displaced and isolated in traditionally family-supported activities. They found other parents who validated their experiences, empathized with their anxieties, and supported one another.

In Alone Together, Sherry Turkle (2012) writes:

Technology presents itself as a one-way street; we are likely to dismiss discontents about its direction because we read them as growing out of nostalgia or a Luddite impulse or as simply in vain. But when we ask what we “miss,” we may discover what we care about, what we believe to be worth protecting. We prepare ourselves not necessarily to reject technology but to shape it in ways that honor what we hold dear.

Together these parents were surfacing what they held dear and what they wanted for their kids and their relationships with them. The group began by telling what they saw as isolated, personal stories and ended up seeing the connections across their lives, transforming the personal to collective questions and issues.

What emerged from these focus groups was surprising to me and powerful for the parents who attended. In hearing some parents talk about their anxieties and share their vulnerabilities, other parents felt more comfortable sharing their own experiences. And in doing so, they found a sense of validation and connection among the other parents over their experiences with technology – connections they were not experiencing with their kids, whose tech-savviness often left their parents feeling awestruck and less competent. I came into the focus group wanting to understand parents’ perceptions of computing’s relevance in their lives and their kids’ lives. Surprisingly, parents used the focus group as a support group to make sense of their own relevance in their kids’ lives, as computing devices permeated their family activities.

As we were designing the workshops, this sense of displacement and parents’ desire to understand what roles they can play motivated our design thinking and our perspective on parents. How could the...
workshops be an environment where parents could experience and experiment with different roles to support their kids? Additionally, the focus group becoming a support group for parents was an important finding that we tried to incorporate into the design of the workshops. How could the workshops create a space for parents to support one another as they explored ways to support their kids and learn more about technology? I discuss later in this chapter how we incorporated these insights into the design thinking.

**Designing and Iterating on Family Workshops**

When thinking about constructionist learning environments, people often assume that the environment has little to no structure compared to traditional learning environments, which may be very structured. In fact, well-designed constructionist environments do have structure, but they have different types of structures from traditional environments, and they use structure as a means to enable learner agency (Brennan, 2013). As Mitchel Resnick, Amy Bruckman, and Fred Martin (1996) wrote:

> Developers of design-oriented learning environments need to adopt a relaxed sense of "control." Educational designers cannot (and should not) control exactly what (or when or how) students will learn. The point is not to make a precise blueprint. Rather, practitioners of constructionist design can only create "spaces" of possible activities and experiences.

Our design thinking for Family Creative Learning is grounded in these constructionist traditions of learning. We wanted to design an experience where families were actively building and designing projects that were personally and socially meaningful. To be personally meaningful to families from different backgrounds, FCL invited families to build upon the diverse "repertoires of practice" and "funds of knowledge" that kids and their families bring to the program (Gutiérrez & Rogoff, 2003; Moll, Amanti, Neff, & Gonzalez, 1992). Connecting to interests can be a strong motivator for people to engage more deeply with their learning. To be socially meaningful, FCL leveraged learning theories that emphasize the social aspects of learning (J. Brown, Collins, & Duguid, 1989; Lave & Wenger, 1991). Access to peers and other makers can be valuable to find people with shared interests, get feedback and inspiration, brainstorm ideas, work on projects together, and deepen expertise (Ito et al., 2009). In designing FCL, we aimed to cultivate a socially meaningful experience and to
build a learning community among family members. Families were not only interacting among their family members, but also with other families from the same neighborhood and staff at their community center, who were facilitating the workshops.

When I began exploring family workshops, I had already been designing and implementing Scratch workshops with youth and educators at different community centers and events. Workshops are ephemeral learning environments that "pop-up" onto existing spaces such as a community center. Learners can engage in focused activities that may be out-of-the-ordinary and take on roles and practices that they may not usually encounter in their other learning environments. My early inspirations included other family learning programs like Tech Goes Home (http://www.techgoeshome.org), Family Science from Iridescent (Rivas & Olmsted, 2013), and MAKESHOP from the Children’s Museum of Pittsburgh (Brahms & Werner, 2013). I was also inspired by youth-serving organizations such as the Computer Clubhouse (Rusk et al., 2009) and the Digital Youth Network (Barron et al., 2014). Conversations with leaders from these organizations helped in our early design decisions.

In total, I designed and implemented eight iterations of Family Creative Learning, which were primarily implemented in the Boston-area and one was located in Santa Fe, NM. The first four were most experimental, while the last four remained relatively the same with minor refinements. I used the last four workshops to pilot and conduct qualitative analysis of families experiences, which I describe in Chapters 4 and 5. Table 1 summarizes the first four experimental iterations.

As we moved from one iteration to the next, important sources of feedback and inspiration came from talking to families and reflecting with facilitators. We spoke with families during and after the workshop series to learn more about their experience and to ask what they enjoyed and what they would have liked to see. We reflected weekly with the facilitators at the end of every workshop to discuss what worked well, what they were unsure of, and what could be improved.

For example, in early iterations, some of the features we experimented with were timing and setting. The very first iteration was a single, 3-hour workshop on a Saturday evening in a community center. We provided dinner then introduced families to Scratch. The workshop ended with families sharing their projects. After seeing
how families engaged in a single workshop, we decided to try a series. In the second iteration, I worked with a community-based organization in Santa Fe, NM that worked with schools. We connected with an elementary school where more than 95% of students participated in the school's free/reduced lunch program. We followed a similar format from the previous iteration, creating time for the families to eat dinner, make projects, and share their projects. We used the school gym and transformed it into into a creative workshop space. Using the school gym allowed us to invite many families and accommodate more than sixty people in the space. However, when the workshop series was over, we broke down the workshop space, taking away the laptops, activities, and people who supported the workshops and it returned to being a school gym again. Many families were excited to continue, but in this arrangement, kids and parents were no longer able to access the space and the people that supported their experience.

In the third iteration, we decided to focus on community-based organizations, where kids and parents could continue to access the same space, resources, and staff. I did another series of three workshops in Boston, MA at a Computer Clubhouse within a Boys and Girls

<table>
<thead>
<tr>
<th>Iteration</th>
<th>Location</th>
<th>Organization</th>
<th>Summary of Workshop Design</th>
</tr>
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<tbody>
<tr>
<td>Spring 2012</td>
<td>Boston, MA</td>
<td>Independent community makerspace</td>
<td>1 night, 3-hour workshop on a Saturday, using only Scratch. Workshop was structured in an Eat, Make, Share format.</td>
</tr>
<tr>
<td>Fall 2012</td>
<td>Santa Fe, NM</td>
<td>Community-based program that supported after-school programs hosted in school settings</td>
<td>Series of three workshops for 2 hours each immediately held after school on consecutive days, using Scratch and StarLogo TNG, another programming environment for kids. Workshop was hosted at the school gym with computing equipment provided by an outside organization.</td>
</tr>
<tr>
<td>Fall 2012</td>
<td>Boston, MA</td>
<td>Computer clubhouse in a Boys and Girls Club</td>
<td>Series of three workshops held in the evening once a week on a weeknight for 2 hours each. We used Scratch in the first two workshops and MaKey MaKey at the last.</td>
</tr>
<tr>
<td>Spring 2013</td>
<td>Boston, MA</td>
<td>Community center in housing development</td>
<td>Series of two workshops on Saturday morning, using Scratch and MaKey MaKey. Lunch is served at the end of the workshops.</td>
</tr>
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Table 1: Summary of the four experimental design iterations of Family Creative Learning and the various changes in the model.
Club. In this setting, kids could continue engaging with Scratch in after-school programming and, while Boys and Girls Clubs focused primarily on serving kids, this particular Club hosted monthly family nights where parents were welcome to participate. We continued to host three workshops with each workshop engaging families in different activities. For example, on the first night, they animated the initials of their name and on the second night they made musical instruments. However, families expressed wanting more time to build a larger project of their choice. Based on this feedback, we decided to expand the series to include five workshops with a community showcase at the end, where they can share their projects with other friends and family. In this third iteration, we also noticed how families were connecting. For some of the parents, this was their first time really talking with other parents at the Boys and Girls Club. While we fit fewer people compared to the school setting (approximately 20 to 25 people), families had an opportunity to get to know each other across the workshops, especially since we focused on doing a group-wide share rather than asking families to share among the people sitting at their table. For some of the parents, it was their first time coming into the computer room and getting to know the community center staff. My collaborators and I saw this potential for relationship building in the workshop series and saw the potential for this program to grow beyond family engagement to community development.

From these early iterations, we developed a model that we refined in the later four workshop implementations. I worked closely with a staff member that was also a Computer Clubhouse coordinator and worked across two community-based organizations: a Boys and Girls Club and a community center in a housing development. In this model, we invited families to five workshops, held once a week on a weeknight for two hours. Table 2 provides a brief summary of the workshop implementations and the next section provides more detail about the design of this model.

**Design of Family Creative Learning**

The current model of Family Creative Learning (FCL) consists of five workshops hosted in a community center. Each workshop is held once a week for 2 hours in evening during the week. This current model was built on what we learned from designing the first four iterations. We used this model to conduct the last four iterations, where we focused on studying families' experiences.
<table>
<thead>
<tr>
<th>Iteration</th>
<th>Location</th>
<th>Organization</th>
<th>Summary of Workshop Design</th>
</tr>
</thead>
<tbody>
<tr>
<td>Spring 2013</td>
<td>Boston, MA</td>
<td>Computer Clubhouse in a Boys and Girls Club</td>
<td>Series of five workshops with a community showcase, which used Scratch in the first two workshops and MaKey MaKey with Scratch in the remaining workshops. Parents and kids were separated during the first workshop as they learned to use Scratch. This series of workshops was the first introduction of Eat, Meet, Make, Share format.</td>
</tr>
<tr>
<td>Fall 2013</td>
<td>Boston, MA</td>
<td>Computer Clubhouse in a Boys and Girls Club</td>
<td>Series of five workshops with a community showcase, which used Scratch in the first workshop and MaKey MaKey with Scratch in the remaining workshops. Parents and kids are separated in the first two workshops to give them a chance to work on the tools themselves. Created a &quot;design journal&quot; for parents and kids to use as a reference and as a notebook for their work.</td>
</tr>
<tr>
<td>Fall 2014</td>
<td>Boston, MA</td>
<td>Community center in housing development</td>
<td>No major changes from previous implementation.</td>
</tr>
<tr>
<td>Spring 2015</td>
<td>Boston, MA</td>
<td>Community center in housing development</td>
<td>No major changes from the previous implementation.</td>
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Table 2: Summary of the last four design iterations of Family Creative Learning and refinements to the model.
The workshops have the following sequence:

1. Welcome and introduction to Scratch

2. Introduction to MaKey MaKey

3. Brainstorming family projects

4. Building family projects

5. Community showcase

Each workshop (except the last workshop with the community showcase) has a four part structure that we called Eat, Meet, Make, Share. In Eat, we all had dinner together, provided from a local restaurant. In Meet, we split up the parents and the kids to check-in about their experiences. In Make, families designed and built projects using Scratch and MaKey MaKey. In Share, families shared their projects while others asked questions and provided feedback.

To discuss the design thinking of the model and how we iterated on its structures, I describe FCL along these four dimensions of design: tools, activities, facilitation, and environment. These dimensions of design were inspired by the principles developed by the Tinkering Studio, which described their design thinking along activity, environment, and facilitation design (Petrich, Wilkinson, & Bevan, 2013). While I talk about these four dimensions separately, they interact with one another in many ways.

Tools

We wanted families to use tools that enabled them to easily create and share projects that were personally and socially meaningful to them. Novice programming languages have enabled people to create all kinds of interactive media and apps by providing alternatives to text-based environments by removing hard-to-understand syntax (Kelleher & Pausch, 2005). There has been a proliferation of visual programming languages, especially with open frameworks like Blockly (Fraser et al., 2013) and OpenBlocks (Roque, 2007) which enabled other developers to more easily create visual programming languages.
In early iterations of this program, we used Scratch exclusively to introduce families to creative learning with technology. The Scratch programming language enables learners to program any kind of interactive media such as games, animations, and stories. To enable parents and kids to create anything they imagined, we needed to use a tool that would enable families to express their diverse ideas and interests. Scratch was designed to be more personal, more tinkerable, and more social than traditional programming languages (Resnick et al., 2009).

Scratch uses a visual programming language with puzzle-piece like blocks that can be stacked like LEGO bricks. A sequence of blocks, or a script, can command an object, or a sprite, to move, animate, or transform on the screen. There are ten different categories of blocks such as "Motion", "Looks", and "Control" that group together related blocks. Kids can create or import their own images and sounds to further personalize their projects and create their own sprites, backgrounds, music, and sound effects. Figure 2 shows an image of a Scratch project. The script in the project controls a sprite to repeatedly move forward, play a drum sound, then move backward, followed by another drum sound.

Within the Scratch editor, there is a "Tips Window" where kids can access a set of guided tutorials that help kids get started on different activities such as dance, music, and games. We used the "Animate Your Name" tutorial as a resource to help parents and kids started with Scratch. In addition, Scratch has been translated to more than 50 languages, which was useful to family members whose primary language was not English.

With Scratch, kids can also share their projects with others from around the world in an online community. Kids can interact with others' projects and see how each project was made by clicking on a "See Inside" button next to every project. For the family workshops, we did not include participation in online community as part of the workshop activities, but we encouraged families to participate at home and at other times beyond the workshops.

While early workshops used Scratch exclusively, we decided to introduce a physical component to the workshops. We were interested in how families might engage with doing both digital and physical making. At the time, Jay Silver and Eric Rosenbaum had just introduced MaKey MaKey (Silver, Rosenbaum, & Shaw, 2012). With MaKey MaKey, families could create their own physical in-
interfaces to the computer using everyday conductive materials like aluminum foil, Play-Doh, and steel sponges. MaKey MaKey connects to the computer through USB and can connect to different materials through alligator clips. Figure 3 shows an image of a simple MaKey MaKey setup. The metal spoon is connected to "Space" and the metal sponge is connected to "Earth." When kids create a loop from Earth to "Space" or any of the other spots representing key presses, MaKey MaKey sends a keypress trigger to the computer. In this case, the computer thinks that the Space key was pressed whenever the metal spoon and metal sponge are touching.

With Scratch and MaKey MaKey, families could create projects that combine physical and digital interaction. A Scratch project can be programmed to respond to key presses. For example, some families created different musical instruments, where families touched different conductive materials like aluminum plates which triggered sounds to play from the Scratch project. Figure 4 shows one family's project. A mother and daughter created their own drum set and electric guitar. The daughter connected herself to MaKey MaKey.
with a steel sponge. When she touched any of the foil plates, which were also connected to MaKey MaKey, she completed a circuit and it triggered a sound to play in Scratch.

When we introduced MaKey MaKey to families, we were surprised how much kids and, especially, parents connected to the MaKey MaKey. As one mom said, "I'm having more fun than my kid, is that okay?" As we observed families creating with the tools, we found that engaging families in both physical and digital making enabled multiple entry points to work together – creating opportunities for more inclusive participation among family members. Connecting computation to everyday materials and craft materials especially resonated with families who were already engaged in craft activities together. If one family member was more interested in building with physical materials and crafts, they focused on MaKey MaKey while other family members focused on Scratch. For example in one family, a mother Donna made a physical cardboard piano while her son Alec...
programmed the sounds in Scratch – an arrangement that reflected their own comfort and interest with each medium. However, while they started in one medium, neither worked exclusively in one as their project progressed. When it came time to connect the cardboard piano to sounds, they worked together to connect the aluminum keys and the sounds in Scratch. Because Scratch and MaKey MaKey needed to interface, working in one medium became a gateway to the other, allowing all family members to see how both physical and digital making interact.

Activities

The overarching structure of each workshop is a four-part structure that we called Eat, Meet, Make, Share (see Figure 5). This structure grew out a combination of community organizations’ and my experiences with workshops, conversations with leaders of different family learning programs, and lessons learned from our design iterations. One feature that many organizations, who had experience working with families, emphasized was having dinner for families. As a result, we created times for families to eat together, make projects, and share what they did. After conducting the focus groups, which I described earlier in this chapter, we decided to add another part called "Meet" to produce the current four-part structure of Eat, Meet, Make, Share. This structure facilitated the flow of each workshop and we aimed to create a sense of "ritual" rather than routine, in that each part had different activities, roles, and meaning.

In Eat, we provided dinner from a local restaurant. This time pro-
vided families an opportunity to share a meal together and catch up on their days, which can be challenging for families with hectic schedules. It also gave families an opportunity to start with something that they were familiar with: eating together before jumping into other activities that they were less familiar with. Facilitators also sat down with families during this time, allowing facilitators a better chance to understand how families were doing, how their days went, and if we needed to provide someone with special attention during the workshop.

During Meet, we split up parents and kids into separate groups and rooms. This gave parents and kids an opportunity to interact with their peers and reflect on their experiences with facilitators. We wanted to simulate the social interaction and support that emerged in the parent focus groups. During the first Meet at Workshop 1, parents and kids spent time getting to know each other. One of the facilitators started introductions by sharing something about themselves to model the kind of sharing and interaction that we wanted parents and kids to engage in. For example, a facilitator might share their insecurities around technology and how their interest in learning how to program developed. For the rest of the Meets, facilitators focused on asking parents and kids about their experiences in the workshops. For example, in one Kid Meet, facilitators encouraged kids to share something they learned by demonstrating it on a computer connected to the projector. In another Parent Meet, facilitators asked parents questions about how it was like to work with their kids in Workshop 3.

In Make, parents and kids worked on individual and family projects. During Workshop 1 and 2, when we introduced Scratch and MaKey MaKey, parents and kids worked with their peers (parents worked with parents and kids worked with kids). During these two workshops, we engaged families in animating their names in Scratch and making musical instruments with MaKey MaKey. We did brief introductions and showcased different examples, but spent most of the
time helping families get started and design and personalize their own projects. We found that this gave parents and kids first-hand experience with each of the tools without having to worry about each other. During Workshop 3 and 4, parents and kids worked together on a family project that they would eventually show during the community showcase in Workshop 5. Families worked on brainstorming their projects and we helped families translate these ideas into Scratch and MaKey MaKey.

During Share, families came back together and each family member shared their projects, even the shier participants. Before we shared, we reminded families that this was a time to celebrate what they accomplished, learn from each other, and help one another by asking questions and giving feedback. We encouraged families to talk about what they did and what they would do if they had more time. Whenever someone finished, everyone participated in giving the family member a big round of applause. Through successive Shares, families got practice talking to others about their projects and experience as well as answering questions about their process.

During Workshop 5 at the community showcase, we had a simple Eat and Share format. We encouraged families to invite their friends and families to see their projects. We also invited community staff and other community members such as local educators and school staff. We decorated the room to feel festive with balloons and large signs with each family’s name by each family’s station. A slideshow of photos played in a corner. At the end of the showcase, we gave families photo collages that featured several action shots of their family working (rather than certificates). Facilitators said something to recognize and appreciate each family’s learning and collaborative process. We concluded with a group photo.

_Facilitation_

In _The Having of Wonderful Ideas_ (1996), Eleanor Duckworth asked: "How do people learn and what can anyone do to help? Helping people learn is my definition of teaching" (pg. xiv). Duckworth discussed the role of teachers in creating situations where kids could develop and pursue their "wonderful ideas." In designing the workshops, we wanted facilitators to play an important role in helping to create an environment where families’ felt welcome and whose ideas were taken seriously. Facilitators were there to be co-creators,
co-learners, and cheerleaders for families to pursue their ideas. We wanted to shift away from the central instructor who disseminated knowledge to participants.

When recruiting facilitators, I often framed facilitation as a learning experience rather than a volunteer opportunity, where they are giving their time and resources to those who need it. Rather, facilitating in FCL was an opportunity for facilitators to learn how to design technology-based learning experiences and to learn from and with families during the workshops. I recruited facilitators from MIT and the Harvard Graduate School of Education. In addition to supporting families, these facilitators helped with logistics, documentation, and research activities such as data collection and analysis. At least one staff person from the community organization participated as a facilitator. The staff who participated were usually my collaborators from the community organization. Together, we recruited additional facilitators from the community, some of whom were already volunteering at the community center. We focused on facilitators who had experience working with youth and an interest in learning about how to support people in learning with technology, rather than recruiting facilitators who had technical expertise.

To help facilitators get started, I met weekly with facilitators at least a few weeks before the workshops began. One of the meetings involved examining Scratch and MaKey MaKey projects made by facilitators and reflecting on their process to create it. This reflection helped facilitators build empathy for families' first experiences with Scratch and MaKey MaKey. Facilitators who were university students also made a few visits to the community center to spend time in the space and get to know the staff, kids, and other community members. Right after each workshop, we met for about 30 minutes to debrief, reflect, and think of ways to improve in the next workshop. I facilitated the team reflection using a structure called "Red, Yellow, Green." Green were aspects of the workshop that worked well or any positive observations and interactions facilitators noticed. Yellow were questions or things facilitators were unsure of. Red were aspects of the workshop that did not work well and could be improved or any challenging interactions facilitators noticed. Every facilitator had to contribute a moment or comment for each Red, Yellow, and Green.

In the early iterations of Family Creative Learning, facilitators primarily focused on helping families with their projects, answering questions and helping them develop their ideas. In early workshops, the set of facilitators was not consistent from workshop to workshop.
– instead they were pulled in based on their availability. However, conversations with family members and facilitators revealed the roles that facilitators played beyond helping the families with projects. For example, facilitators were instrumental in helping families feel welcome and connected in the environment. One mother, who spoke little English, shared how anxious she was in English-dominant environments. However, she continued to participate because of two reasons: her son’s interest and feeling like the facilitators cared about her.

During the Meet portions of the workshop, facilitators posed questions to kids and parents to help them reflect on their workshop experiences. When parents expressed anxieties about helping their kids with computing, facilitators shared their observations of how parents were being helpful. For example, a mother expressed that her daughters’ creative process seemed fine without her. A facilitator pushed back and shared our observations of how the mother had encouraged her daughters and gave them feedback – moves that helped her daughters persist through challenges and go deeper with their projects. Similarly, with kids, facilitators used "Meet" to encourage kids to recognize their excitement and expertise around technology as assets they could use to support their other family members. During "Meet," facilitators played an important role by sharing their observations from past workshops to help family members recognize how they were helping each other in activities that were new to their families.

Starting with the Spring 2013 workshops, I worked with facilitation teams that consistently participated throughout a series. I began to see that supporting facilitators meant facilitating facilitators as learners and designers, in contrast to other approaches that focus on training facilitators. We began to observe how we were learning from each other in our team reflections, which we conducted after every workshop. During these reflections, we shared our observations, but we also shared our challenges supporting families. We discussed these challenges and provided each other with suggested facilitation moves to try for the next workshop. For example, one facilitator shared concerns about giving too much guidance during project making. Other facilitators then shared how their guidance varied, tending to give more guidance in the early workshops, then stepping back more and asking questions as families developed their expertise. Through these shared reflections and discussions, facilitation became a practice that we developed over time. In addition to our team meetings, we held discussions about facilitation with members of the Lifelong Kinder-
garten research group and we reviewed writings about facilitation (Petrich et al., 2013). We distilled our common practices as facilitators, which are summarized in Table 3. In later workshop series, I used this table of facilitation practices to start discussions with new facilitators about how we want to support and interact with families.

Environment

The physical arrangement of a space can signal many things about the learning experience to a newcomer. At the outset, we wanted to design a space where learners felt welcome and safe to take creative risks and eventually come to see it as a space where they belonged. Sapna Cheryan and her colleagues (2009) in their study of objects in computer science classrooms demonstrated how simple objects in the room can influence how well someone identifies with and develops an interest in the activity within that environment. For example, by replacing objects stereotypically associated with computer science such as Star Trek posters or video games with unexpected objects such as plants and nature posters, they found a boost in female students' interests in computer science.

Cheryan and her colleagues called this feeling of fitting into an environment "ambient belonging." In designing the workshop space, we added many cues to help families feel welcome and a sense of ownership of the space. Upon entering the workshop room, families encountered a table of name tags they created during Workshop 1. A facilitator was stationed by that table and welcomed families to come in and drop their stuff. In the far wall, families saw large photos of other families from past workshops. Near the entrance was a hot dinner from an Italian restaurant. In other nights, they might have Chinese food, Dominican food, or Southern food. To the left, families and facilitators were already seated and having dinner, talking about what they did this past week. In another wall, a slideshow featured photos taken from the previous workshops. Some of the kids shrieked when they saw photos of themselves and pointed it out to others in the room.

In addition to creating a welcoming environment, we wanted to arrange the space to facilitate creative and collaborative learning. Since one of my early collaborators was a coordinator at a Computer Clubhouse, we drew inspiration from the environmental design to organize the workshop spaces across the different community
<table>
<thead>
<tr>
<th>Principle</th>
<th>Description</th>
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<tbody>
<tr>
<td>Ask questions rather than give answers</td>
<td>It may be tempting to give the answers to questions right away, but if it's possible, ask questions instead so that learners can arrive at their own answers. Even something as simple as &quot;Can you explain what your program does? What do you want it to do?&quot;</td>
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<td>Build trust and relationships</td>
<td>Get to know your learners and help them get to know you. Learning new things requires learners to be open and vulnerable. Being around people that they know and trust can facilitate the learning process.</td>
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<td>Encourage exploration, experimentation, and risk-taking</td>
<td>Learners might feel that there are right answers and the correct ways to do things. They might ask you &quot;Does this look right? Is this how it's supposed to be?&quot; Encourage learners to try things out, to stretch their ideas, and explore new pathways in their projects.</td>
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<tr>
<td>Authentic enthusiasm goes a long way</td>
<td>Sometimes learners, especially beginners, can feel unsure about their projects. Some encouragement or cheerleading can help them feel good about their work and their next steps.</td>
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<tr>
<td>Be a connector</td>
<td>Connect learners with similar interests to each other and to relevant resources in the workshop.</td>
</tr>
<tr>
<td>Use technical words cautiously</td>
<td>Be aware of the words that you use. Avoid technical jargon. If you have to use it, use it as a learning opportunity to explain technical language.</td>
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<tr>
<td>Surface their interests</td>
<td>It can sometimes take time for people to know what they want to do. Create an environment that is open to many interests. Ask questions like &quot;What do you like to do?&quot;</td>
</tr>
<tr>
<td>Put yourself in their unique shoes</td>
<td>Every learner is different. When interacting with learners, try to think about how they may be feeling, what they may be thinking, and how they would want to do things.</td>
</tr>
<tr>
<td>Hold tools as a last resort</td>
<td>It's tempting to grab the mouse, but try describing the steps rather than doing it for learners. If you have to grab the tools, let them try it again for themselves after you show them and guide them along.</td>
</tr>
<tr>
<td>Mistakes and failures are welcome</td>
<td>Rather than avoiding mistakes, encourage learners to be open to them. As you support them through it, help them see what they are learning in the process.</td>
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Table 3: FCL facilitation practices developed through reflection and discussion with facilitation teams across the workshops
spaces. Typical computer rooms are designed with computers on tables facing the same direction (sometimes even bolted down). One chair at each computer might suggest that each computer is for one person. Some computer rooms might even have dividers between each computer to reinforce that individual experience. Computer Clubhouses took a different approach.

In a typical Computer Clubhouse, each table with a computer has two or three chairs to facilitate youth working together. The tables are placed in small clusters around the edges of room, leaving more space for circulating around the room. The chairs in Clubhouses all have rolling wheels, allowing members to interact with others more easily by rolling over to see what is on another computer. In the middle of each Clubhouse is a large green table without any computers on it. This table acts as a type of village common, where people come together to share ideas and to work on plans, drawings, crafts, and building projects—or simply to have a snack and catch up.

The Clubhouse space is designed to have the feel of a creative design studio, a combination of an art studio, music studio, video studio, and robotics lab. Some of the design choices might seem unimportant (or even extravagant), but we have found that the design of the space deeply influences the attitudes and activities of the participants. As soon as youth walk into the Clubhouse, the setup of the space suggests possibilities. They can see tools and examples to spark their interest and imagination. At one new Computer Clubhouse, the director remarked with surprise that the behavior of the young people changed dramatically for the better when track lighting was installed. And many Clubhouse staff members have noted that the rolling chairs, though sometimes a distraction, make it much easier and more likely for Clubhouse members to share and collaborate with one another (Rusk, Resnick, Cooke, p. 5).

While every community space is different, we tried to keep certain elements constant. Like the Computer Clubhouse, we arranged tables to create a "center table" that did not have computers and where we gathered around for meals, did introductions and began activities, and used for additional workspace. We arranged the computer tables either in "pods" or along the walls of the space with two chairs by each computer to make it easy for people to hear and see what others are doing. When it was time for Make, we arranged the materials so that they were inviting and suggested possibilities. The walls had past projects or pictures of people in action in the space.

In addition to the physical arrangement of the space, we learned that we needed to address the socio-emotional environment. We observed the various ways that families communicated and interacted. Some
communicated non-verbally, anticipating what they each needed and wanted. A few families might shout at each other to be heard. Some siblings took some light jabs at each other. After some brainstorming with different facilitators, we decided to engage families in creating a "community code." During Workshop 1 at Kid and Parent Meet, we emphasized that we would be spending a lot of time together in the next five workshops, doing different kinds of activities that ranged from working on a project to sharing ideas and projects as a group. We asked kids and parents to think about what they each needed to feel respected and creative in the space. We shared their community codes at the end of Workshop 1. We regularly cited the community code when we had to address any challenges or issues in the workshop. For example, in one Parent Meet we had simple phrases such as "listening" and "no judging." Another parent added, "One person doesn't know it all. Together we know more." In a Kid Meet, kids added "be honest" and "no teasing." A facilitator added, "talk to a facilitator if you need a moment" in case any of the kids ever felt uncomfortable or needed someone to talk to. After Workshop 1, we revisited the community code again in Workshop 2 in case families had anything to add after experiencing the workshop environment.
Chapter 3 Examining Family Engagement

In this chapter, I describe my qualitative approach to understand how kids and their parents developed as computational creators.
Many studies have detailed how kids and families negotiate technology use, across different demographics. For example, Lynn Schofield Clark in the book *The Parent App* (2013) discussed two ways that families guide their uses of technology: an "ethic of expressive empowerment," which uses technology for education and development, and an "ethic of respectful connectedness," which uses technology to maintain family ties and cultures. Brigid Barron and colleagues (2009) described seven distinct roles (e.g. teacher, collaborator, and resource provider) that parents enacted to encourage and support their kids as creators with computing.

In studying the engagement of kids and parents in FCL, I aimed to contribute to these conversations about families' uses of technology by describing the process by which kids and parents become computational creators - and how the learning environment of FCL plays a role in supporting that development. What values, guiding principles, and family dynamics around technology use do kids and their parents enact within Family Creative Learning? How do families interact with the features of FCL (tools, activities, facilitation, and environment) and what roles do these features play in their development? How do kids' and parents' perspectives of what they can do and how they can support each other shift when they engage in creative experiences with computing?

In this chapter, I describe my process to understand how kids and their families participated in the workshops and developed as computational creators. My methodological approach is qualitative, focusing on iterations of design and study to improve both the design of the program and understanding of family members' learning experiences within the structures of FCL. My qualitative inquiry draws on case study and ethnographic methods. I appreciate how these methods enable me to develop in-depth descriptions of family members' experiences, while also focusing on the emergent social interactions and cultural patterns among families and facilitators within this creative learning environment. These approaches allow me to discover important factors and relevant categories for analysis in families' learning experiences. They also allow me to focus on the process of learning: how kids and their parents negotiate working together on projects, how facilitators step in to help and step out to give learners space to figure things out, and how participants develop relationships with other families in the room - and how these processes contribute to families' development as computational creators.

Just as my process for designing the workshops was iterative, my
process for understanding families was also iterative. Initially, I focused on understanding kids’ learning experiences and how parents supported them. However, after closely observing family interactions, I saw the ways that parents were learning and engaging in the experience, while also trying to support their kids. I decided to expand my research to look at families as a unit of learning, which I found to be complex, dynamic, and diverse. Additionally, based on feedback from past facilitators who shared how much they were learning from the experience, my research team encouraged me to expand my research to include facilitators. In the last iteration of Family Creative Learning, I collected data to understand facilitators’ learning experiences as they were supporting families to participate.

My research team consisted of graduate students from the Harvard Graduate School of Education (HGSE). For each workshop iteration, I had a team of about two to four students helping with facilitation, data collection, and analysis. All together my research team consisted of eleven graduate students from HGSE.

Data Collection

I have been carefully observing families participation in the workshops since we began designing them and I wrote regular reflections across all eight design implementations of Family Creative Learning. In the first four iterations, I experimented with the model of FCL and tried different structures to support families. I used my observations and conversations with families, facilitators, and community staff to inform our design process. In the last four iterations, the design of FCL remained relatively stable with minor changes. In these last four iterations Spring 2013, Fall 2013, Fall 2014, and Spring 2015, I focused on examining family experiences and understanding how families developed as computational creators – and how the design features of FCL supported that development.

These last four workshop series were held in two Boston-based community centers that were located in the same community, one was a Boys and Girls Club and the other was a community center in a housing development – each about 5 minute walking distance from the other. Each organization served predominantly low-income families. At the the Boys and Girls Club, we hosted the family workshops in a Computer Clubhouse, which is part of a network of informal learning spaces for youth to design and build projects with new
technologies in a supportive environment (Rusk et al., 2009). At the community center, we hosted the workshops in a computer room. The Boys and Girls Club primarily served young people whereas the community center provided services for early childhood, parenting support, after-school programming for young people, and other community serving functions. The community center was also across the street from an elementary school. Some of the students from this school participated in one or both of the community organizations. The area around the organizations is experiencing some gentrification and increasing income inequality. For the housing development, at the time of these workshops, the median income was about $12,000 while the median income for the rest of the area was about $90,000. The community has felt the effects of drug abuse and addiction, like in many other New England communities, with some kids having lost one or more family members to drug addiction or overdoses.

I focused on qualitative data collection during and after the workshops. I was unable to speak with families before the workshops began. Even though we had a registration process, many families showed up and registered on the first workshop day. While we could have added forms for families to fill out, we did not want to add additional friction for families to sign up for the workshops. Instead we asked families questions about their prior backgrounds and interests in conversations during and after the workshops.

I collected multiple forms of data to triangulate what we were finding. My personal field notes of workshops and team meetings spanned across eight workshops implemented from 2012-2015 which included more than 60 families. These field notes were supplemented by photo and video documentation. These field notes and documentation were useful to reflect and improve upon the workshop design. I collected even more qualitative data in the last four workshop implementations (Spring 2013, Fall 2013, Fall 2014, Spring 2015) when the Family Creative Learning model was more stable. This data included 24 families. Table 4, 5, and 6 summarizes information about the families and individuals that participated in the four workshop series. I involved facilitators in writing field notes, which included their observations of family interactions and their personal reflections on their facilitation. I recorded team debrief sessions after each workshop, that spanned 30 - 45 minutes. In these debrief sessions, we discussed what happened, what went well, what questions we had, and what could be improved. I also I collected projects made by families in the workshops.
**Family Information**

Five families participated. There were 10 kids and 5 parents all together. The largest family size was four people, with a median size of 2. The kids' ages ranged from 4 to 13 years old, while the parents' ages ranged from 30 to 58 years old. Four of the five parents were women, with three parents who immigrated from countries in Latin America. Two mothers were single parents. 100% of the families were able to create and share a project at the community showcase.

**Fall 2013**

Six families initially participated, but one had to drop out because of a family emergency part way through the workshop. There were 11 kids and 9 parents. The kids' ages ranged from 7 to 12 years old, while parents' ages ranged from 37 to 54 years old. Five of the parents were women. Two of the parents immigrated from countries in Latin America. Two of the mothers were single parents. 67% of the families were able to create and share a project at the community showcase.

**Fall 2014**

Eight families participated. There were 14 kids and 8 parents all together. The largest family size was four people, with a median size of two. The kids' ages ranged from 7 to 12 years old, while the parents' ages ranged from 27 to 60 years old. All parents were women, with three parents who immigrated from countries in Latin America. All kids qualified for free/reduced lunch in school. 75% of the families were able to create and share a project at the community showcase.

**Spring 2015**

Six families participated. There were 7 kids and 6 parents all together. The largest family size was three people, with a median size of two people. The kids' ages ranged from 7 to 13 years old, while the parents' ages ranged from 36 to 82 years old. Five of the six parents were women. All parents are immigrants from countries in Latin America. All kids qualified for free/reduced lunch in school. 100% of the families were able to create and share a project at the community showcase.

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Table 4: Information and demographics of families that participated in the four workshop series: Spring 2013, Fall 2013, Fall 2014, Spring 2015
Observations through field notes and documentation can be helpful in understanding what was happening in the workshops, but interviews can be helpful in understanding how families perceived their experiences. During the workshops, the Meet sessions were treated as groups interviews that were about 15 to 20 minutes each. At these sessions, we asked kids and parents to reflect on and share their workshop experiences with their peers. After the workshops, I followed up with families within a month from the last workshop to conduct 60 - 90 minute interviews with individual family members. In these interviews, I asked questions about their background and interests, their experiences in the workshops, and what they have done since the workshops. I was able to interview 38 family members (15 parents, 23 kids), which spanned 15 of 24 families that participated. These interviews were conducted in-person. Except for one family who preferred to do the follow-up interview at home, all interviews were conducted at the community center where the workshops were held. It was not possible to interview all family members for a variety of reasons, which included losing contact with families or conflicting schedules.

We continued to follow-up with families 3 months and 6 months after the workshops through reunion night workshops. These reunion night workshops had the four-part structure Eat, Meet, Make, Share from the original workshops. During Meet, we followed up with families to ask them about any projects they have done recently or continuing impressions of their past experience. Family participation at these reunion nights was much less than in the original workshops and ranged from 50% to 75% of the families from prior workshops. For families that did not attend, we encountered similar challenges in contacting families like we did for follow-up interviews.

In addition to family interviews, we decided to interview six facilitators from Spring 2015 to understand their experiences supporting families in the workshops. The interviews lasted for 60 to 90 minutes and we asked questions such as "What kinds of experiences did you have working with youth and/or families before FCL?" and "Tell us about three memorable or important moments for you throughout your experience facilitating in FCL." In addition to the interviews, facilitators wore mics to record their interactions with families. Unfortunately, the audio quality from these recordings were very poor because the workshop spaces were very loud.
<table>
<thead>
<tr>
<th>Workshop</th>
<th>Name</th>
<th>Relationship</th>
<th>Age</th>
<th>Occupation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Spring 2013</td>
<td>Alana</td>
<td>Mother of Emmanuel</td>
<td>53</td>
<td>Stay-at-home</td>
</tr>
<tr>
<td></td>
<td>Donna</td>
<td>Mother of Alec</td>
<td>50</td>
<td>Self-employed lawyer</td>
</tr>
<tr>
<td></td>
<td>Hector</td>
<td>Father of Felipe, Julio, Nina</td>
<td>58</td>
<td>Retired</td>
</tr>
<tr>
<td></td>
<td>Jess</td>
<td>Mother of Vince, Paula, Britney</td>
<td>30</td>
<td>Student</td>
</tr>
<tr>
<td></td>
<td>Rosa</td>
<td>Mother of Clara and Sonia</td>
<td>49</td>
<td>Physical therapist assistant</td>
</tr>
<tr>
<td></td>
<td>Carla</td>
<td>Mother of Steven</td>
<td>N/A</td>
<td>Nurse</td>
</tr>
<tr>
<td></td>
<td>Cesar</td>
<td>Father of Chris</td>
<td>N/A</td>
<td>Custodian</td>
</tr>
<tr>
<td></td>
<td>Dina</td>
<td>Mother of Chris</td>
<td>N/A</td>
<td>Stay-at-home</td>
</tr>
<tr>
<td>Fall 2013</td>
<td>Frank</td>
<td>Grandfather of Charles</td>
<td>54</td>
<td>Retired</td>
</tr>
<tr>
<td></td>
<td>Keisha</td>
<td>Mother of Charles</td>
<td>N/A</td>
<td>Social worker</td>
</tr>
<tr>
<td></td>
<td>Sandy</td>
<td>Mother of James</td>
<td>42</td>
<td>Hair stylist</td>
</tr>
<tr>
<td></td>
<td>Tim</td>
<td>Father of Ethan and Stacey</td>
<td>38</td>
<td>Develops maps for city</td>
</tr>
<tr>
<td></td>
<td>Heather</td>
<td>Mother of Ethan and Stacey</td>
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<tr>
<td></td>
<td>Alicia</td>
<td>Mother of Patrick</td>
<td>59</td>
<td>N/A</td>
</tr>
<tr>
<td></td>
<td>Casey</td>
<td>Grandmother of Jasmine</td>
<td>60</td>
<td>Retired</td>
</tr>
<tr>
<td></td>
<td>Felicia</td>
<td>Mother of Lennie</td>
<td>38</td>
<td>Receptionist</td>
</tr>
<tr>
<td>Fall 2014</td>
<td>Massie</td>
<td>Mother of Teddy, Lisa, Alexa</td>
<td>31</td>
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</tr>
<tr>
<td></td>
<td>Pattie</td>
<td>Mother of Shay</td>
<td>29</td>
<td>Preschool teacher</td>
</tr>
<tr>
<td></td>
<td>Shanaya</td>
<td>Mother of Andy and Kobe</td>
<td>26</td>
<td>Preschool teacher</td>
</tr>
<tr>
<td></td>
<td>Teresa</td>
<td>Mother of Deacon and Isabella</td>
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<td>Assistant at community center</td>
</tr>
<tr>
<td></td>
<td>Whitney</td>
<td>Mother of Rihanna, Sasha, Regina</td>
<td>33</td>
<td>Stay-at-home</td>
</tr>
<tr>
<td>Spring 2015</td>
<td>Angel</td>
<td>Uncle of Jaime</td>
<td>35</td>
<td>Mechanic</td>
</tr>
<tr>
<td></td>
<td>Diane</td>
<td>Mother of David and Vanessa</td>
<td>35</td>
<td>Student</td>
</tr>
<tr>
<td></td>
<td>Estella</td>
<td>Mother of Carlos</td>
<td>42</td>
<td>Stay-at-home</td>
</tr>
<tr>
<td></td>
<td>Julia</td>
<td>Mother of Eric</td>
<td>39</td>
<td>Stay-at-home</td>
</tr>
<tr>
<td></td>
<td>Kelsey</td>
<td>Mother of Lucy</td>
<td>36</td>
<td>Coordinator at community center</td>
</tr>
<tr>
<td></td>
<td>Sarah</td>
<td>Great-Grandmother of Mariah</td>
<td>82</td>
<td>Retired</td>
</tr>
</tbody>
</table>

Table 5: Summary of demographic information of parents who participated in workshops Spring 2013, Fall 2013, Fall 2014, Spring 2015. For parents who did not indicate their age or occupation, I entered "N/A." To determine parents' occupation, we asked parents what they did when their kids were at school.
<table>
<thead>
<tr>
<th>Workshop</th>
<th>Name</th>
<th>Relationship</th>
<th>Age</th>
</tr>
</thead>
<tbody>
<tr>
<td>Spring 2013</td>
<td>Alec</td>
<td>Son of Donna</td>
<td>9</td>
</tr>
<tr>
<td></td>
<td>Britney</td>
<td>Daughter of Jess</td>
<td>4</td>
</tr>
<tr>
<td></td>
<td>Clara</td>
<td>Daughter of Rosa</td>
<td>13</td>
</tr>
<tr>
<td></td>
<td>Emmanuel</td>
<td>Son of Alana</td>
<td>10</td>
</tr>
<tr>
<td></td>
<td>Felipe</td>
<td>Son of Hector</td>
<td>12</td>
</tr>
<tr>
<td></td>
<td>Julio</td>
<td>Son of Hector</td>
<td>9</td>
</tr>
<tr>
<td></td>
<td>Nina</td>
<td>Daughter of Hector</td>
<td>7</td>
</tr>
<tr>
<td></td>
<td>Paula</td>
<td>Daughter of Jess</td>
<td>7</td>
</tr>
<tr>
<td></td>
<td>Sonia</td>
<td>Daughter of Rosa</td>
<td>9</td>
</tr>
<tr>
<td></td>
<td>Vince</td>
<td>Son of Jess</td>
<td>11</td>
</tr>
<tr>
<td></td>
<td>Chris</td>
<td>Son of Cesar and Dina</td>
<td>N/A</td>
</tr>
<tr>
<td></td>
<td>Charles</td>
<td>Grandson of Frank</td>
<td>10</td>
</tr>
<tr>
<td>Fall 2013</td>
<td>Ethan</td>
<td>Son of Tim</td>
<td>10</td>
</tr>
<tr>
<td></td>
<td>James</td>
<td>Son of Sandy</td>
<td>10</td>
</tr>
<tr>
<td></td>
<td>Stacey</td>
<td>Daughter of Tim</td>
<td>8</td>
</tr>
<tr>
<td></td>
<td>Steven</td>
<td>Son of Carla</td>
<td>10</td>
</tr>
<tr>
<td></td>
<td>Alexa</td>
<td>Daughter of Massie</td>
<td>7</td>
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<tr>
<td></td>
<td>Andy</td>
<td>Son of Shanaya</td>
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</tr>
<tr>
<td></td>
<td>Deacon</td>
<td>Son of Teresa</td>
<td>11</td>
</tr>
<tr>
<td></td>
<td>Isabella</td>
<td>Daughter of Teresa</td>
<td>10</td>
</tr>
<tr>
<td></td>
<td>Jasmine</td>
<td>Grand-daughter of Casey</td>
<td>7</td>
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<tr>
<td></td>
<td>Kobe</td>
<td>Son of Shanaya</td>
<td>8</td>
</tr>
<tr>
<td></td>
<td>Lennie</td>
<td>Son of Felicia</td>
<td>9</td>
</tr>
<tr>
<td>Fall 2014</td>
<td>Lisa</td>
<td>Daughter of Massie</td>
<td>9</td>
</tr>
<tr>
<td></td>
<td>Patrick</td>
<td>Son of Alicia</td>
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</tr>
<tr>
<td></td>
<td>Regina</td>
<td>Daughter of Whitney</td>
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<tr>
<td></td>
<td>Rihanna</td>
<td>Daughter of Whitney</td>
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<tr>
<td></td>
<td>Sasha</td>
<td>Daughter of Whitney</td>
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</tr>
<tr>
<td></td>
<td>Shay</td>
<td>Daughter of Pattie</td>
<td>9</td>
</tr>
<tr>
<td></td>
<td>Teddy</td>
<td>Son of Massie</td>
<td>10</td>
</tr>
<tr>
<td></td>
<td>Carlos</td>
<td>Son of Estella</td>
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</tr>
<tr>
<td></td>
<td>David</td>
<td>Son of Diane</td>
<td>13</td>
</tr>
<tr>
<td></td>
<td>Eric</td>
<td>Son of Julia</td>
<td>10</td>
</tr>
<tr>
<td>Spring 2015</td>
<td>Jaime</td>
<td>Nephew of Angel</td>
<td>9</td>
</tr>
<tr>
<td></td>
<td>Lucy</td>
<td>Daughter of Kelsey</td>
<td>10</td>
</tr>
<tr>
<td></td>
<td>Mariah</td>
<td>Great-granddaughter of Sarah</td>
<td>11</td>
</tr>
<tr>
<td></td>
<td>Vanessa</td>
<td>Daughter of Diane</td>
<td>7</td>
</tr>
</tbody>
</table>

Table 6: Summary of demographic information of kids who participated in workshops Spring 2013, Fall 2013, Fall 2014, Spring 2015. For kids who did not indicate their age, I entered "N/A."
Analyzing Data

Interviews and group interviews were transcribed verbatim by the research team, which consisted of graduate students from the Harvard Graduate School of Education, or a professional transcription service called Scribie.com. My research team and I reviewed the transcriptions by Scribie. We initially coded the data using the qualitative analysis tool called Dedoose but shifted to using MAXQDA. My research team and I iteratively read and coded the data to develop categories or themes about families experiences. We met weekly to discuss the process of our analysis. These discussions served as our inter-coder reliability checks, making sure that each analysis was approved by all team members.

I took an emic approach, allowing themes to emerge from the collected data to describe families development in their experiences within Family Creative Learning. From initial analysis of Spring 2013 and Fall 2013 data, four large categories about their experience emerged that we continued to evolve as we analyzed Fall 2014 and Spring 2015 data: practices, interactions, roles, and perspectives. Families used different kinds of practices or ways of designing their projects and supporting one another. Families had different kinds of interactions throughout the workshops, within and between families and among facilitators. Kids and parents took on different roles to support each other and create projects, such as teacher, facilitator, learner, and collaborator. They also developed new and emerging perspectives about themselves, each other, and computing.

Additionally, I categorized and analyzed moments when families encountered or interacted with structures of the workshops. These categories included tools, activities, facilitation, and environment. Families learned to use and create with new tools, which included Scratch and MaKey MaKey. They engaged in activities, where they ate shared meals, met other parents and kids, made projects together, and shared their progress. They were supported by facilitation from community staff and research team members. Families entered and interacted a physical and socio-emotional environment, where we co-created a space where they could feel safe and respected.

I took a similar emic approach in analyzing facilitators experiences from Spring 2015. I focused on initially what facilitators were learning about the practice of facilitation and how they supported families' learning experiences. As I continued my analysis and discussed
with other researchers for feedback, I decided to focus my analysis on facilitator and family interactions to remain within the scope of this dissertation, using the collected facilitator interview data to better understand families' development and how facilitators supported them in that process. In reflecting on the design of FCL, I also used this data to reflect on my process of designing and supporting facilitators in FCL.

In the next two chapters, I describe the results of my analysis. In Chapter 4 Building Projects, I describe families' experiences throughout the FCL workshops, sharing what motivated families to attend, how they initially experienced the workshop, and how they encountered and overcame challenges during their project making process. In Chapter 5 Building Perspectives, I discuss the perspectives that families shared about themselves, each other, and computing – and how these perspectives contributed to their development as computational creators.
Chapter 4 Building Projects

In this chapter, I share the experiences of families' participation in the Family Creative Learning workshops, using the story of one family to organize the themes from their experience.
Since I began experimenting and designing the family workshops, I've had the pleasure of interacting with more than 60 families. They came in many different configurations. Most of the time they came as a pair, one parent and one child, usually the parent who had time and the child who was most interested. Others came in larger groups, including all the kids — so that no one felt left out or because no one was at home to watch the other kids. Some families were multi-generational, spanning as much as four generations. Our oldest participant was in her 80s, a great-grandmother who accompanied her great-granddaughter. A few included the older siblings as the "parents," a role the older siblings were used to filling as their parent or parents were often managing more than one job.

The dynamics across families varied. Having worked with young people in many workshops and after-school programs, I knew that we would have diverse learners with different interests, perspectives, and ways of interacting. During the workshops, I met families that each had their own microcosm of diverse interests, perspectives, and ways of interacting. These family dynamics were shaped by their members, who were each trying to balance their own agency with their responsibilities to each other. These families, in turn, collectively shaped the dynamics of each workshop and the kind of culture that emerged within the workshop environment. Whenever someone decided to visit the family workshops, I often gave a little warning to set their expectations: "It's a little bit of wonderful and a little bit of crazy, much like big family gatherings." Or, as another young participant said about the workshops: "It's crazy, but not bad crazy."

In studying families' participation in the workshops, I wanted to understand their experience from their perspective and what they gained from their participation, particularly how they developed as computational creators. What kinds of goals did each family member have prior to the workshops? How did kids and parents perceive their experiences in the first two workshops, when they were being introduced to these creative technologies? How did they work together on their family project? What challenges did they encounter and how did they overcome them? What kinds of roles did they take on to create their projects and support each other? How did their experiences as a family interact and intersect with the experiences of other families in the workshop environment and what emerged from these interactions?

As I observed and talked to family members, I learned that this experience was as much about building relationships as it was about
building projects. Families came into the workshops interested in learning more about technology and what they can do with it, but they were also interested in opportunities to be together. Lynn Schofield-Clark in her book The Parent App (2013) talked about two motivations for families to use technology: an "ethic of expressive empowerment," or uses of technology for educational and enrichment purposes, primarily among middle to upper income families; and an "ethic of respectful connectedness," or uses of technology to maintain family connections, primarily among lower-income families. However, for families that participated in the Family Creative Learning workshops, their experience with technology was a means for both respectful connectedness and expressive empowerment – rather than one or the other.

In this chapter, I describe the experiences of families as they worked on individual and family projects throughout the workshops. I use the trajectory of one family Julia and Eric to illustrate how one family experienced the workshop, from their perspective. Within their story, I interweave the stories and perspectives of other families to illustrate the varying experiences and responses to the workshops.

Making Decisions to Attend

Julia is a stay-at-home mom. She immigrated from Panama when she was 17 years old. She came to the workshops with her 10-year-old son Eric, who is an only child. Eric is in 5th grade and goes to the school across the street from the community center. Julia and Eric are both soft-spoken, especially Eric who is very shy. Sometimes you have to lean in to hear him speak. Julia had just taken some computer classes at the community center through a program called Tech Goes Home, where she learned how to sign up for an email account, look up information, and create a PowerPoint presentation. At the end of the program, she got a subsidized computer, which she took home to share with her family. Eric loves to create things, especially with his LEGO bricks and any other materials he can find. He has been playing with the computer that his mother got from Tech Goes Home. He just discovered Google SketchUp and has been making his own 3D models.

They both heard about the workshop through Jose, a staff member at the community center who had facilitated the Tech Goes Home classes. He had encouraged Julia and his other students to attend the family workshops. With Julia, he especially emphasized that "Family Scratch Nights" (the name we used to call Family Creative Learning at the community center)
would connect to Eric's growing interest in engineering, which Eric had learned about in school. Julia wanted to be supportive so she signed up, and she thought that maybe she might learn new things about computers.

Connecting Through a Trusted Community Member

Like Julia and Eric, an important factor in families' participation was encouragement from a trusted community member, particularly someone from the community center staff. Sometimes these same staff members participated as facilitators in the workshops. The kinds of relationships that families had with community center members or educators varied. Many of the families that participated had at least one family member already engaging in the community center in some way, either through parenting services, family wellness programs, or after-school programs for kids that provided homework help and other enrichment activities.

Most of the time, kids had the pre-existing relationship with community center staff because they were participating in after-school programming at the community center. Ben, one of my collaborators who was a Computer Clubhouse coordinator, had approached many of the kids that participated at the Clubhouse. Their parents had heard of Ben through their kids, but had hardly interacted with him. Rosa, a mother of two, first heard about the workshops through her eldest daughter Clara who came home with a flyer describing the workshops. Tim, a father of three, heard about the workshops through his youngest son Ethan, who was an active participant in the Computer Clubhouse.

Other times, it was the parent or both the child and the parent who had pre-existing relationships with the community center through different activities. Another parent Donna, who knew Ben and her son Alec's positive relationship with him, shared:

He [my son Alec] loves Ben. Ben showed it [the program handout] to me... I really thought if Ben is showing me this, he wants me to go, there is no way I am not going to go. He's been so good to my kid.

Donna

Jose, who worked at the community center, had gotten to know Julia and Eric individually – Julia through the Tech Goes Home program and Eric through the after-school programming at the community center. Other parents learned about the workshops during their par-
enting support group when one of the community staff members gave a short demonstration of the kinds of projects that families would be working on.

**Persuaded by Another Family Member**

The family member who learned about the program through a trusted community member would then try to advocate for the program to the rest of their family. Most of the time, it was a child trying to get the rest of the family to come to the program. During our recruitment, we decided to focus on talking to kids first, if it was possible. We wanted to make sure that kids wanted to be at the workshops rather than being "dragged" to the workshops by their parents. (And if any dragging happened, we preferred kids to be the ones pushing their parents to attend.) In addition to speaking with kids directly, we would send kids with flyers to give to their parents to help kids talk about the program.

Kids who were eager to participate repeatedly reminded their parents to attend. As one mother admitted during Workshop 1 at Parent Meet, she was "threatened" by her son to attend.

I am here because I was threatened to be here. He called me every 10 minutes. "Pleeease please please," [he said]. So when I didn’t show up at 6 he was like, "Where are you?" "Traffic! Traffic! I’m coming." So then when I came downstairs [to the Computer Clubhouse], he was like "You were supposed to be here at 6," and I said, "I’m going, I’m going." Yeah, he is excited over Scratch because he wants to do some kind of project with the Play Doh and all that stuff. So I got to buy Play Doh.

Carla

Sometimes important information would be lost as one family member tried to describe the program to their other family members. One kid, who was brought by his mother, shared, "She told me it was awesome and she said that we can make bananas into a piano." Some parents and other family members came into the workshops confused and uncertain. One grandmother who was asked to come by her grandson assumed "Scratch" referred to scratch lottery tickets. This confusion, sometimes, led to misaligned expectations or affected parents’ participation. One mother came to the workshops assuming it was a one-night pizza party and not a set of 5 workshops once a week. Another parent, who thought it was a one workshop program,
had trouble attending consistently because he was not able to plan ahead with his work schedule.

Attracted by Family Time Through Learning Together

Kids and parents alike were attracted by the opportunity to learn something about computers and to spend time together as a family. When discussing the program with trusted community center staff, parents explained that they were attracted to the family time, free food, and the chance to learn more about technology together with their kids.

Many programs that I know wouldn't do it that way [with parents and kids participating]. They [the programs] just have the child come... they come and they do and then maybe when the program is over you [the parent] get to see the work – the finished work. But this [FCL] is a good way of having the families together so they can work together and challenge themselves together.

Julia

Some young people, who were already familiar with Scratch, became excited at the opportunity to learn more, but were also excited to teach their parents and other family members how to use Scratch. For example, Ethan had already been using Scratch for a few months at the Computer Clubhouse. At the family workshops, he wanted to teach his family how to use Scratch. He hoped to learn from them – they might discover things about Scratch he didn’t know or create things he didn’t know were possible.

Another mother Whitney became attracted to the workshops after she saw a demonstration of Scratch and MaKey MaKey during a parent support group.

He [a community center staff member] came to [the parent support group], and he did a demonstration about Family Scratch Night and the MaKey MaKey and I was just like, "Wait a minute! When are you starting that because I want to go! I want to learn how to do that." So that was something new for me that I really wanted to get to know how to make it. I think the spoon, and him plugging the spoon, clipping the spoon to the MaKey MaKey and then the Brillo pad, and I was just like, "Wait a minute!" And the banana, he plugged the banana to it, I was like, "Wait, that's a fruit! How can you plug the fruit up and then make it do that?" I wanted to experience that, I wanted to do it for myself, because I thought that was just so cool.

Whitney
These three aspects of families' motivations for attending were intermingled and for many families they came because of all three. Families felt encouraged by trusted community center staff as well as at least one member of their family who was enthusiastic about participating. The opportunity to spend time together as a family while learning new things were also important and appealing aspects that motivated them to attend.

**Introductions: Workshop 1 and 2**

At the first workshop, both Julia and Eric were very nervous. They spoke very quietly and stayed together. Julia had just learned how to type, how to email her family in Panama, and how to create a simple PowerPoint presentation, and now they were going to create things with computer programming, which she had never heard of. Eric had heard about programming but he wasn't sure if he would be able to understand it. As they were eating dinner, other families came in. Julia recognized a mom Estella who she had met at the community center's parent support group. Estella brought her son Carlos, who immediately introduced himself to them. Eric recognized another kid from his school Jaime, who brought his uncle Angel. Everyone went around the room and introduced themselves along with something they were interested in. He heard someone say “dance” and another say “drawing.” When it came to Eric, he quietly said, “Engineering.”

After dinner, parents and kids were separated into different rooms. They were each introduced to Scratch very briefly and then asked to animate the letters of their name. Julia felt overwhelmed trying to get started. Her computer was having a lot of issues and a facilitator was helping her with it, but the other parents seemed to be moving along with their projects. Meanwhile, Jose was getting started in the other room with the help of another facilitator. Carlos sat next to Jose and they kept looking at each other's project, pointing out anything that seemed cool.

At the end of the night, they shared their projects with parents going first. Julia was nervous to share her project; she had just animated two letters of her name and had wanted to do more. Everyone was standing behind her, watching her as she shared her project. Jose along with the other kids in the room were standing very close, leaning into her computer. Eric was impressed that his mom made something with Scratch. He knew what it took to get started and was impressed that she made something. When the whole group came around to Eric's project, Julia was also very impressed. She knew he would do something great. When he showed his project, though,
she found herself being “blown away.” His project was so personalized. He had imported an image from Minecraft, a video game he was just telling her about, to use as a background in his project.

During the second workshop the following week, they were both still pretty nervous, but this time, Eric was “nervous excited.” They were introduced to MaKey MaKey and they both had never seen anything like it before. Eric didn’t know you could connect the computer to the real world. Julia felt really nervous. She heard something about electricity and conductivity and worried that she might get electrocuted.

Like the first night, kids and parents worked separately, but tonight they worked in the same room. Julia was paired with a parent named Angel who recently immigrated from Puerto Rico, and they spoke Spanish as they worked together. He teased her when she shared her concern about being electrocuted. He playfully poked her hands with the alligator clips, which were connected to the MaKey MaKey. Every time he did that, she shrieked and laughed. She laughed so loud that other participants turned their heads to see what was going on. Meanwhile, Eric was working with Carlos and they experimented with different materials, connecting different ones to the MaKey MaKey and seeing what would happen. Carlos was more outspoken and energetic than Eric and sometimes took over the computer. A facilitator helped them get started and sometimes asked Carlos to let Eric try the materials and the MaKey MaKey.

Surprising Themselves and Each Other

Many family members shared a mix of nervous and excited emotions when they first entered the workshops, like Julia and Eric. Some family members were worried if they would be able to use Scratch and shared how "scared" they felt. Other family members, especially those enthusiastic about the possibilities of technology, were excited to dive in.

In Workshops 1 and 2, parents and kids worked separately or worked with their peers. This arrangement allowed parents and kids to each have the opportunity to have first-hand experience working with tools. At the end of these workshops and every workshop, parents and kids came back together and shared their projects – giving them the opportunity to see what they were able to do. It was during these shares that kids and parents often surprised each other.
I just couldn’t believe how creative what the kids – you know, like this dry computer class, it’s going to be so you know technical. And then downstairs it was so interesting that they turned it into this really creative medium. Every single kid did something different.

Donna

It was so interesting to see everybody’s project. But everybody had different ideas. There was no same idea. No kid or no parent wanted the same things. This is so unexpected.

Kelsey

One mother got a touching surprise from her two daughters during the Share session of Workshop 1. During that workshop, we asked participants to animate the letters of their name. Instead of animating their own names, her daughters worked together and animated their mother’s surname. Mother’s Day was coming the following weekend and they decided to use this project to surprise her. She kept her last name but her daughters have their father’s last name. At the end of the animation, the girls recorded their voices saying, “We love you mommy.” She was touched and surprised that they could express this sentiment with Scratch.

Encountering Challenges With Participation

At these workshops, facilitators and I saw the kinds of challenges that kids and parents have with using and learning with technology. For example, some parents and kids were still developing their basic computer literacy and had trouble working with the mouse. Some parents had limited English and relied on our bilingual facilitators and translated resources to support them in the workshops. Others talked about feeling unsure or overwhelmed by the new experience. One kid Carlos tried to explain how he felt through a metaphor:

I: What did you feel like when you were stuck?

Carlos: I feel like a sausage.

I: A sausage?

Carlos: I felt like a sausage.

I: Can you explain?

Carlos: It felt like I didn’t have any legs, or hands.
I: Aww. That sounds sad.

Carlos: Or I was just frozen.

Family members overcame these challenges in a number ways. For some, it was a matter of trying things out and persisting through their challenges with the support of the activities and facilitators.

If you don’t know it, it’s scary, but you practice... It’s not bad, but is good because... What makes it good because it’s fun, to me. It’s kind of a game.

Diane

Because you said, "Go to this and do that, do that." I’m like, "Huh?" So at first I was nervous like, "What?" But after you showed us step by step and we followed through, it made more sense.

Kelsey

As the workshops progressed, some families tried to learn how to use Scratch at home between the workshops. Some parents asked for resources they could take home. One mother Estella used our reminder calls between workshops to ask questions about their family project, which they were working on at home. During the Spring 2015 workshop series, parents insisted on taking home the Design Journal, a booklet of resources and handouts that we provided for kids and parents to use during the workshops.

The experiences of families in these first two workshops were full of new and surprising experiences. For some, it was their first time encountering something like Scratch and MaKey MaKey, where they could make both physical and digital projects. These first encounters were full of mixed emotions and came with challenges, but many families continued to participate and worked through these challenges together.

Creating and Sharing Together: Workshops 3, 4, and 5

At the third workshop, Julia and Eric began working together on a family project. They spent the first part of the workshop brainstorming a project related to the theme of "Carnival" – a theme that the rest of the families were also brainstorming projects for. Julia and Eric thought about doing something with a roller coaster. They were recently at the beach and they saw a small roller coaster there. They kept talking about their project and
eventually their roller coaster got more and more ambitious – something they would see in a larger theme park.

They decided to attend an optional workshop between Workshop 3 and 4 so that they could keep working on their project. A facilitator Sam came by to help them translate their project idea to something they could do with Scratch and MaKey MaKey. He asked questions about what they wanted to do next or made suggestions for what materials they might use with MaKey MaKey or what blocks to use in Scratch. Eric took the lead while Julia acted more like a "project supervisor" making sure they were on time, asking for help whenever they needed it, and helping troubleshoot when the project wasn’t working. At Workshop 4, which was the last workshop before the community showcase, they continued to work with Sam to build their roller coaster project. They kept playing with different conductive materials for their roller coaster while making adjustments to their Scratch project.

On the night of the showcase, Julia and Eric arrived on time and immediately set up their project. They had made a roller coaster project using aluminum plates, cardboard, aluminum tape, plastic cups, and googly eyes (see Figure 6). Whenever the aluminum plates, which were the roller coaster cars, moved and touched the aluminum tape on the cardboard, the project in Scratch would animate a roller coaster car across the screen and play the sound of someone screaming. For one of the roller coaster cars, they had recorded Carlos screaming as a sound effect.

As people arrived, they shared their project with different people from the community: staff from the community center, other kids who participated in after-school programming, and some people they had never seen before. People were very curious and asked them questions about their projects. Eric was shy, and so Julia introduced the project whenever someone approached them. She then asked Eric to explain how it worked. His school principal also came by their project and he expressed how surprised he was to see Eric talking.

Encountering Collaboration Challenges

In Workshops 3 and 4, kids and their parents worked together on a family project to share at the community showcase (the final workshop). In addition to these workshops, most families typically attended an optional workshop that we provided for families to continue working on their projects. How families worked together varied. Some families worked very seamlessly, building on dynamics
they had already developed through other activities such as school work or family craft projects. Others encountered challenges – some of which were anticipated based on past experience in other family projects and others were surprising. For example, for their family project, Alec and Donna split up their project, which was going to be a cardboard piano. Alec programmed the sounds to play in Scratch when someone pressed certain keys on the keyboard. In the meantime, Donna created a cardboard piano with aluminum keys. There were frustrations along the way. Alec sometimes advanced the project without explaining his thinking to his mother, and Donna sometimes tried to steer the process.

Among bilingual families, sometimes the parent could only speak Spanish and the child would have to try to translate or could not speak their parent’s language. Facilitators who were bilingual played important roles to support their participation. Other times one person would dominate, typically whoever had more experience with computers. Kids would often have more experience than their parents so they tended to dominate the tools. In some cases, facilitators needed to step in to help families work together. Sometimes facilitators would help parents and kids think aloud their ideas and encourage them to try out each idea in their project or help them find a compromise.

These challenges were compounded within families with multiple kids participating. Parents had to manage their participation and at-
tention across their kids. It was challenging enough for parents and kids to share one computer. In cases where families had more than two people, facilitators suggested splitting up across two or more computers. Rosa and her two daughters Clara and Sonia were one such family. When it came time to work on their family project Rosa worked with Clara while Sonia worked by herself. Facilitators suggested these groupings after sensing Sonia’s independent personality. Rosa and Clara worked pretty seamlessly and were aware of each other’s abilities and interests. They collaborated on two musical instruments: a cardboard guitar and foil drum set. Meanwhile, Sonia got started with the help of another facilitator. Rosa checked in with Sonia occasionally, expressing enthusiasm about her emerging drum project. During the Share session of Workshop 3, Sonia had difficulty getting hers to work, insisting that it worked before. She felt discouraged when she was unable to fix it. Rosa gave Sonia a hug, reassuring her that she did a great job and that her project just needed to be fixed.

In the following week during Workshop 4, Rosa made sure to situate herself between her two girls so she could also check on Sonia. While Rosa tried to be more involved in Sonia’s project, Sonia already had a clear vision and wanted more control over the process, trying to program the project and build the MaKey MaKey connections herself. Rosa decided to step back and watched Sonia, providing support when Sonia asked her for help. However, as Sonia continued to struggle, Rosa became more involved, helping to figure out issues with facilitators and making suggestions when Sonia seemed unsure. For example, knowing Sonia’s sense of style, Rosa suggested decorating the cardboard with pink leopard print duct tape, which Sonia happily incorporated. As Sonia finished her project, Rosa made sure to give her positive comments on what she had accomplished.

**Trying Out or Applying Existing Practices and Roles**

For many family members, it was an opportunity to apply existing or develop new roles in this context. Some kids and parents had experience working on projects together either for school-related homework or craft projects at home. Rosa was used to stepping in and out to help her kids—balancing careful observation and more explicit intervention. Some parents were surprised how practices they had already developed to support their kids in other contexts were relevant in the workshops. For example, one mother Sandy, who enjoyed crafts, ap-
preciated how her interests in crafts and self-expression were needed to work on a project with her son Pete. She especially connected with MaKey MaKey because she could connect conductive and craft materials to the project. She could be a collaborator with her son, who was more tech-savvy than her, rather than a passive observer.

For other families, being collaborators were new roles for both parents and kids and they had to develop new strategies together. One mother Kelsey described how she and her daughter Sarah were both used to being "bosses." "Both got to have it our way," she said. As they started working together, both tried to drive the project direction. Eventually, they started to "give and take" by building on each other's ideas rather than trying to advocate for their own.

It [the workshops] allowed us to put aside our differences, put aside me being a mom, her being the daughter, and just decide we want to work together.

Kelsey

Some parents tried to act as a project managers, while their child took on a creative lead role like Julia and Eric. As their kids developed ideas, parents helped them break down their ideas into smaller tasks, find material resources, ask facilitators for help, or make compromises depending on their time.

For kids, it was an opportunity to take on a role as "teacher" as they supported their parents. One kid David decided to let his mom Diane have more input in their project because she was new and excited about their project.

Just like my grandpa, he likes to see people having fun. That's also a thing for me. When people are having fun and I'm also having fun, it makes me have more fun because I see that they're enjoying themselves.

David

He enjoyed helping her and related his feelings to how he saw his grandfather, who enjoyed seeing people have fun. Other kids took on similar "teacher" roles helping their parents, siblings, and even other families in the workshops.

Some parents welcomed this role from their kids as they got much needed support on something parents were unfamiliar with. Donna shared how her son often got her "out of jam" as he explained how to use different blocks in Scratch. Another parent Hector talked about
how much he needed his kids help because he kept forgetting how to
do things. He also secretly enjoyed asking for their help because he
could spend time with them.

Despite these efforts, some families needed facilitation to help resolve
their different issues. For example, some facilitators helped fami-
lies think aloud their ideas and made suggestions for how to break
down tasks between family members. During Parent and Kid Meet
sessions, we reminded family members that they were working on
a family project. At times, we took a kid aside, who was dominat-
ing the tools, to encourage them to ask their parents for ideas about
their project. For some families who had great difficulty working to-
gether, we suggested working on separate computers, but sitting by
each other. In these cases, families still had opportunities to see each
other's progress and play with each other's projects.

Building Roles and Relationships

In observing families build projects, I have been fascinated by the
kinds of roles that parents and kids take on to support each other as
well as how they develop these roles (Roque, Lin, & Liuzzi, 2016).
Technologies play an interesting role in complicating traditional roles
between parents and kids. Kids generally have more computer ex-
pertise than their parents. At times, kids act as "technology brokers"
at home helping parents navigate emerging technologies and me-
dia to engage in everyday practices (Correa et al., 2015), which can
have mixed outcomes for kids who can at times benefit from helping
their families while sometimes coming at expense of a kid's own time
and learning (Katz, 2014). As Correa and colleagues (2015) found,
kids' expertise with computing was influenced by their immediate
network of family members, peers, and educators. However, kids in
resource- and curriculum-poor schools and communities had limited
opportunities to further develop their expertise.

Compared to these studies of kids acting as technology brokers at
home, FCL workshops created a space and time where kids and
parents are positioned as learners and they are introduced to tech-
nologies that they are generally both novices to and in a learning
environment that feels different from the traditional environments
they have been in. Parents and kids generally come in at a simi-
lar "level" when approaching Scratch programming; however, kids
still have an advantage of being more comfortable with computers.
MaKey MaKey, on the other hand, is very new to both parents and kids. These leveling effects and complicated roles with technology created an interesting opportunity in the workshops to observe the kinds of roles that kids and parents take on to support each other as they work on their individual and family projects.

Brigid Barron and her colleagues identified roles that parents play to support their kids in the development of technological fluency, which included learner, teacher, collaborator, and resource provider (Barron et al., 2009). In these workshops where families were working together, we got to see how some of these roles were developed and how they were negotiated between parents and kids. Most parents were not in one role continuously, but responded to what their kids needed. Other parents took on roles they didn’t take on before with their kids, while others found ways to apply existing roles into this new context. Kids took on new roles or applied existing roles as well. They became teachers or collaborators, responding to the activity and to what their family needed. Kids and parents recognized these roles in each other and pulled on each other as resources in the experience.

The ways in which families built relationships as they were building projects is also significant. From my conversations with family members during and after the workshops, the relationships between parents and kids in the context of computing were often fraught and in a continual state of negotiation as the technological landscape changed. Parents were balancing feelings of anxiety and excitement as they saw the risks and opportunities with computing for their children. While the computer and other devices were important sites for access to information, to distant family members, and to future opportunity, it was a place of contention as rules of use were negotiated. Sometimes it became a place of punishment as privileges are taken away.

For families that participated in the FCL workshops, their interest in spending time together was both a motivator to initially attend and to continue participating. As they made their projects together, they had opportunities to build relationships. As one mother said about her experience working with her kids:

When you make something together with your kids... you become a little bit more close.
Diane
Chapter 5 Building Perspectives

In this chapter, I discuss the shifting perspectives that kids and parents developed during their workshop experience, highlighting how kids and parents saw themselves, each other, and computing.
During workshop Meet sessions with kids and parents, I had opportunities to learn about their experiences from their perspective. Facilitators asked parents and kids how they were doing and what they thought about the previous workshop's activities. At Workshop 1 Meet, we asked them how they thought and felt about technology in their lives. At Workshop 2 Meet, we asked them what it was like to program and share their first Scratch project. We asked similar questions about their first experience with MaKey MaKey in Workshop 3 Meet. At Workshop 4 Meet, we asked them what it was like to work together on a family project. What surprised them? What was challenging? As the workshops progressed, I saw perspectives emerge and shift and I became fascinated with the ways that they talked about themselves, each other, and computing in new and empowering ways.

In the last chapter, I shared Julia’s and Eric’s experiences through each workshop to illustrate how families worked together. In interviews after the workshops, I asked Julia and Eric what they took away from the experience. Julia said,

The experience to come in and learn with other people, to build something from nothing and create something out of nothing, that I'm going to keep for myself as an experience forever.

For Julia, she had initially entered the workshops wanting to support Eric. In addition to doing that, she was able to see how she could "create something out of nothing." She was able to create projects and share them with others and have the first-hand experience of doing something creative herself.

For Eric, when I asked him what he took away, he shared: "I was able to express what I did without having to keep it to myself." Eric is shy and he knows that about himself. When I asked him what enabled him to express himself, he said, "When everyone else was presenting what they did. It made me want to feel the same way." Every night the workshops ended with a Share, with each family member talking about what they did and asking each other questions about their work. Eric also participated in these Shares. While shy and soft-spoken, he felt comfortable sharing his work, especially after seeing other people share their ideas.

In my interviews with Julia and Eric, I also asked them what it was like to work together. For many of the families, working on projects together around the computer was a novel activity. For some families,
working on a project together, regardless of being on the computer or not, was a whole new endeavor. Julia shared,

I know that he knows a lot of things, but he's very quiet and he wouldn't say a lot of things. But in this experience, in this environment, he was able to open up and show what he knows. That was the thing that blew me away.

Julia

Julia also recognized how shy Eric can be, but in this particular environment, she was able to see sides of him she hasn't been able to see. Julia could see his ideas through the kinds of projects he created. Additionally, Eric explicitly talked about his ideas and thinking during the Share sessions at the end of every workshop. When they started working together, she could see the process he went through to put them together and experience first-hand what it was like to work with him on computer-related projects. She knew how capable and talented he could be and she was moved by what he was able to show in this environment, in front of other people.

When I asked Eric about what surprised him about his mom in this experience, he said, "That she invented things." Eric's use of the word "invented" is meaningful to him. He used it a lot during our interview. He talked about how he liked inventing things, how he made inventions, and how he wanted to become an inventor. In this interview, he used the same word that he used about himself to talk about his mom. This workshop enabled Eric to see his mom in a new way that he hadn't seen before: as an inventor with technology.

In this chapter, I focus on how kids and parents developed new ways of thinking about themselves, each other, and their relationship with computing. In my conversations with kids and parents during Meets and follow-up interviews, I was surprised and excited by the ways they were talking about themselves, each other, and computing. The interviews became a space for me to understand how they described their experience, but they also became a space for families to engage in a process of reflection. Through conversation and questioning, families made sense of their experience and formed their ideas, weaving and constructing the story of their individual and collective experience.

Family members shared what they were able to do, how they surprised themselves and each other with their projects, and what they might do next. Parents, who had previously described how overwhelmed they were with computers, were now saying that they were
happy to have learned something and were open to new learning opportunities with computing. Kids were surprised at how capable and playful their parents were around computers. Both kids and parents talked about how computing became something they could use to create and express their ideas. In the following sections, I describe the kinds of perspectives that family members shared about themselves, about each other, and about computing.

Perspectives on Themselves

During the Kids Meet at Workshop 1, kids excitedly shared the different ways that they used technology. Some were already using creative technologies like Photoshop, Google Sketchup, and Scratch, especially kids who participated in the Computer Clubhouse. (We held the Spring 2013 and Fall 2013 workshops at a Computer Clubhouse.) Many shared how they played different games that spanned different genres which included makeover games, math games, and Minecraft. Some kids claimed to be "self-learners" with computers, experimenting and trying things out.

Parent Meet during Workshop 1 had a slightly different tone than the kids. While there were some parents who were excited about the possibilities of technology and interested in learning more, most parents shared some hesitation or mixed feelings about technology. Some parents described themselves as "illiterate" or not very knowledgeable with technology, feelings that were compounded especially when they compared themselves to their kids. "I don't know nothing at all," said Hector during his first parent Meet. Others added that they were not very interested in technology or hadn't put in the time and effort to learn more.

I don't learn [technology] quick. I am not a quick learner when it comes to [technology]. I tried to update myself with the phones and things... I am not interested in trying too much and I don't set the time aside to sit down for four hours or just to use it all the time... [My kids] pick it up easier.
Rosa

While there were some parents who did have very limited uses of computing devices, which we came to understand as they started using the computer during the first workshop, many parents were more knowledgeable than they claimed to be as they shared stories of how they used computers at home and at work, such as interacting with
family on social media, watching videos, and using word processing. Other parents joked about their obsession with Candy Crush. Some parents talked about how they supported their kids by looking up information together or monitoring what their kids did on computers. Estella shared how she and Carlos would often look at online deals together before they made a purchase in the store. Parents exchanged tips with each other as well. One mother Jess shared how to install Netflix on an XBox so that her family could watch movies right on her television rather than on a computer screen. At the beginning of Workshop 1, parents expressed a lack of confidence with computers, even when they were using digital technology in a variety of ways.

In the following sections, I describe the kinds of perspectives that kids and parents shared in follow-up conversations during and after their participation in the workshops. Parents were surprised that they could learn how to program a computer and shared how they became open to learning even more. Kids who came to the workshops to grow their capacities with computing found themselves also helping their parents develop their capacities.

**Seeing Themselves as Someone Who Can Create and Learn**

As parents began to experience the workshops, I started to hear different stories about themselves during the parent Meet sessions and in post-workshop interviews. Donna, who had initially said, "I don't know anything about technology," shared during the parent Meet session in workshop 2 how she was beginning to understand what we meant when we talked about programming.

I would never have even thought about how you program a computer well you just tell it to do stuff... How could somebody have ever explained that to me in a way that I could understand it? ... For me to even understand how you would go about how to direct a computer, it's kind of thrilling.

Donna

In her post-workshop interview, Julia shared her ability to "create something from nothing."

That I can do a lot of things that I might have thought I can't do. This experience, it shows you that, there is a lot of things that you might think that you can't, but your mind is able to do it. If you push yourself and you challenge yourself a little bit more harder, you will be able to get it done.
Julia

Another mom Kelsey shared "I don't have to call someone to help me. I can just learn to do it myself. I could do that now." She also shared how open she became to the learning experience.

I was friendlier, more comfortable. I didn't shut down or tune things out, and I was willing to collaborate with other people. 'Cause sometimes I just tune things out. Even though I'm still there, I'm not there mentally. But in this thing, I felt so comfortable and so open. It really felt like we were part of a family, not like really doing something to just do it.

Kelsey

Seeing Themselves as Someone Who Can Teach

As I mentioned in Chapter 4, kids took on "teacher" roles to help their parents use the computer and learn how to use Scratch and MaKey MaKey. Some kids helped parents and younger kids from other families. Teddy regularly helped his younger siblings and other kids in the workshop. He also liked giving suggestions on other projects during Share. Pete showed his mom Sandy how to play her Scratch project make drum sounds whenever she pressed certain keys. When facilitators later asked Pete about helping his mom in the workshops, he shared, "we can be their Scratch parents." Later, when his mom shared her project, he shared how "proud" he was to see how much she progressed. Clara who helped her mom get started shared how she could tell how it made her mom Rosa happy.

Clara: She was happy that she could learn something new from me. Especially because I'm like younger than her. So it was kind of weird.

I: Oh yeah? What was weird about it?

Clara: Because she's older than me. She should probably know, but she didn't because I had more experience than her. She didn't know much about computers.

Perspectives on Each Other

One of my favorite moments in the Family Creative Learning workshops happens at the end of Workshop 1. For many family members,
this was their first time with Scratch and with programming. Beforehand, we had separated kids and parents for Meet and Make. Kids and parents felt a bit anxious as we moved them to different rooms. During Meet, some parents, like Julia, shared how they were still getting used to the computer basics, like sending email, looking up information, and using word processing. During Make, parents and kids did the same Scratch activity, which was animating the letters of their name.

My favorite moment occurred when parents and kids have came back together in the same room for Share. The parents were nervous and the kids were curious. We started Share by reminding everyone that what was shared were works-in-progress and we knew that many people did not get to "finish" their projects. We asked the parents to share first, but before anyone started we asked everyone to get up and crowd around the person who was about to share. Kids were physically on top of their parents, trying to get the best view of what their parents made. Some parents started by apologizing because they didn’t get far. However, the kids were surprised that their parents made something and asked questions. How did you do that? Where did you find that? After each parent finished, they got big applause. When each kid presented, we also surrounded them and some kids were physically on top of other kids. Parents were surprised at what the kids were able to accomplish – more than they were able to. The parents and kids asked questions. Where did you get those ideas? How did you do that?

In the previous section, I described the ways that parents and kids were seeing themselves. In this section, I describe the ways that parents and kids were mirroring those perspectives in how they saw each other. Parents described how they could visibly see and hear their kids’ amazement and surprise when they shared their projects. At the same time, kids shared their surprise at how engaged and capable their parent could be. Parents shared how they could better understand their kids’ interests and what supported it.

Seeing Parents as Engaged and Capable With Computing

Throughout the workshops, kids were able to see (and be surprised at) how much their parents could do and how much fun their parents were having with Scratch and MaKey MaKey. Ethan looked forward to sharing everything he knew about Scratch with his family and he
was surprised to see that his father Tim was beginning to do things with Scratch that Ethan didn’t know of before. Carlos described how at home his mom Estella is usually a "zombie" in front of the television. However, at the workshops, Carlos physically mimicked his mom hunched over and looking intently at the computer. Another child Alec shared how he mostly saw his mom Donna working with word processing software. He called her a "Word girl." During the workshops, he was impressed that she was able to create projects using Scratch. While she needed his and other facilitators’ help to get started with Scratch, he eventually could see how she was getting better and was able to understand what they were doing with their family project.

Others talked about how proud they were to see their parents trying rather than sitting back. As one child Mariah said,

I was surprised, because the adults – not to be rude, but adults were like old school... I was surprised on how they did the project because it was a good project to me.

Mariah

Parents noted how surprised their kids were. Jess remembered a moment where she called her son over to show her Scratch project.

He [Vince] was surprised I could do it. He thought I couldn’t do anything on the computer. When he saw that I made something, he was surprised that I made something. And even though it was just a little bit, he said, “How did you do that? You made that?” He was amazed. He probably thought that he would come over and I would be lost. But I was like, “Oh I got it together. I did it.”

Jess

Sandy shared how the workshops allowed her son to see that she’s "not just a mom."

I like when I surprise him a little bit. ‘Cause when I’m the mom, I’m at home, I’m doing this, I’m doing that. But then when I’m taken out of that [and put] in a different environment, I think sometimes I surprise him. He’s like, "How did you know that?" or like, "I’m supposed to be the fancy one!" You know? I like that... cause then I’ll say when I’m at home, "I was a kid, I’m a person, I’m not just a mom, you know?"

Sandy
For parents, they were able to similarly see how creative their kids can be — beyond other visions of their kids being addicted to games or to the screen. Sandy shared how important it was for her to see her son James in action during the workshops. "I got to see that he was actually learning and he wasn’t just sitting there playing games." Julia said that she didn’t know that Eric’s "imagination could go so far." For some parents, it was also an opportunity to see their more shy kids open up and share their ideas, not just with their parents, but with the larger audience of the workshop.

Another dad Tim said how he appreciated the opportunity to see what his son Ethan was "into." He knew that his oldest son was into hockey and his younger daughter was into dancing, but he wasn’t sure what Ethan enjoyed doing. He knew that Ethan enjoyed playing on the computer, but so did his other kids. He was becoming wary of Ethan’s growing interest in computers, and monitored the amount of time Ethan and the rest of his kids spent on the computer, even referring to his role as "the guardian, to kind of regulate." In my follow-up interview with Tim, he shared how his son tried to explain Scratch to him in the past and how he initially did not believe his son until the family workshops.

He did [try to explain Scratch] and he did a poor job of explaining or I did a poor job of listening because I had no clue what he was talking about. He’d be home and he’d be like, "I’m going on Scratch" and I’d be like, "Oh! You’re on the computer." And he’d be like, "No! It’s educational!" and I’m like, "Yeah, sure it is."
Tim

Through his participation in the workshops, he had an opportunity to understand first-hand what Ethan was “into.” During Tim’s experience working with Scratch, he created a project that played his recorded voice saying different things to his kids when you pressed certain keys. After the first workshop, he continued to play around with Scratch, even creating his own account to save his projects.

Parents could also see the social context in which their kids’ interests were being fostered. Many of the parents had spent little time in the actual Computer Clubhouse or computer room. Others hardly even entered the Boys and Girls Club, choosing to wait outside or in the lobby as they waited for their kids to finish up their after-school activities. For some parents, this was their first time visiting
the Computer Clubhouse, meeting the staff, or using the computing resources at the community center.

And so when parents spent time at the workshops, it was an opportunity to see the entire context around their kids' participation with computing in the community organization. As Donna said about her experience:

Well, it's nice to be with people that are important to your kid and you get to see a slice of your kid's life and all the things that are really important to him. And that I think was the most interesting thing. Because I mean, he just loved it all and those are the kids he hangs around with all day long and those are the kids he talks about and that's what he thinks about and those are the teachers he talks about... That was really interesting for me to spend so much time dealing with things that my son likes with people that he does it with all the time.

Donna

Parents got a chance to see how these interests connected with others, to see the ways these people supported that interest, and to participate in that same social context as well.

_Perspectives on Computing_

When talking to kids and parents, I often used the word "technology." It was a useful shorthand because it can encompass devices (e.g. computers, smart phones, tablets), the Internet and access to the Internet, and their variety of uses such as social media, gaming, and information-seeking. However, technology also became too general. We became at risk for making sweeping statements without much depth and context, such as: "I don’t know anything about technology" or "technology is the future." There was also the risk of talking past each other or making assumptions about what we were each thinking about. For example, I could be thinking and talking about using computers, but family members might be thinking in terms of their phones. In our conversations, we would often have to ask each other questions for more clarification. Even the ways that families defined Scratch varied.

In my conversations with kids and parents, I was interested in the ways that they were already talking about technology. For some parents, the computer and other devices like the tablet or phone were special objects that could answer your every question and access any
kind of information at any time.

Anything you need to know is in the computer. You just have to look for it and you can find it. Before you had to go to the library, borrow a book, or something.

Angel

One mom Whitney loved how she could look up anything she wanted, particularly using Google and Siri, the personal assistant in every iPhone. "Siri is my girl," she shared, as the other parents burst out laughing during a Parent Meet in Workshop 1.

Parents shared how technology was an inevitable and intertwined aspect of their kids’ futures, but they were constantly figuring out what it meant for their kids. For example, Julia shared how she understood that computers were necessary for schoolwork.

I see it as a tool that will help him in a lot of things that he’s going to do for his school work and in the future, whatever path of learning, education-wise, that he’s going to go... I know that as time goes on... that the computer will always be something that is going to be helpful for him.

Julia

In the following sections, I describe the ways that kids and parents talked about computing after they began to experience the workshop activities. For kids and parents, the computer shifted from an information-access machine to something that they could also control to create and express themselves. All they had to do was "tell it to do stuff." Kids and parents began to have an expanded view of computing, to see even more possibilities to connect it to the world beyond the machine. With these perspectives, families shared a feeling of doing whatever they imagined with computing.

Seeing Computing Demystified

Parents talked about how the workshop experience demystified computer programming and how computer programs underlie much of what they used today. "You just tell it to do stuff," Donna said.

To get the computer to do these different things by creating these different blocks of directions and then adding those as needed. So I thought it was kind of interesting because it was a completely different kind of process than what I would do ever in my regular life.
Donna

Other parents drew on what they already used or understood to explain their developing understandings. Angel compared programming with his interests in drawing. With drawing he could create whatever was on his mind. All he needed was a paper and pencil. He saw similarities between pencils and paper and Scratch and MaKey MaKey in the workshops – with either tools he could create what he wanted. However, he recognized that he needed more time and practice with Scratch and MaKey MaKey to develop the same fluency he had with drawing.

Kids sometimes used other forms of media such as games and video to describe their projects, rather than calling it simply a "Scratch project." For example, Ethan called his projects "Scratch videos" and James called his projects "animations." For kids, the most meaningful project description was the kind of project they were creating rather than the technology that it was made with. Mariah, who first encountered Scratch in school, thought that Scratch was a "random program." After the family workshops, she later came to call Scratch an "art game" because she could create art with it.

**Seeing the World in New Ways**

Kids and parents discussed their affinity with MaKey MaKey and how the tool expanded their idea of what you can do with computers. A parent Diane shared, "[You are] making stuff that you will never think was possible." Ethan talked about connecting the computer to the "open world." Other family members were fascinated by how Scratch and MaKey MaKey connected to the other materials and tools in their everyday life. One parent Rosa appreciated the ability to connect the MaKey MaKey with craft and kitchen materials. One kid Jaime saw that almost everything around him could be used as a material in his project and could be brought to life with MaKey MaKey.

I: What was cool [about MaKey MaKey]?

Jaime: Everything. It brought life to this.

I: To the computer?

Jaime: Yes.
I: What did you mean you put "life to this?"

Jaime: I don’t know. You press your own buttons instead of pressing these. (Points to the keyboard)

I: Your own buttons?

Jaime: You make your own button anyways, I mean.

I: You’re making your own buttons to this, that’s cool.

Jaime: Anything is your material, everything is a tool. Except fire.

Similarly, a parent Jess also began to see the materials around her differently and what they meant to her and her kids.

I: How would you describe MaKey MaKey or Scratch to a friend?

Jess: MaKey MaKey you can make things, or make them, instead of going outside to buy stuff for the kids that are expensive. You can kind of make something for someone 6 and under. You can make stuff for them and they can get real amazed. But going to the store and getting something almost similar to MaKey MaKey, it would cost hundreds of dollars. You can make something off of MaKey MaKey and you would enjoy it more and the computer is at home. And you probably wouldn’t break the MaKey MaKey because the parent is there, controlling the toy.

I: Cool, yeah. It’s quite practical.

Jess: And you learn at the same time. So they get to play. They think they’re playing, but they’re learning. And it’s kind of – And you don’t have to pay. Well, except for the MaKey MaKey. The $50 kit or something. You don’t have to keep on buying batteries. They get to learn and play together. And other kids get interested.

She realized that she could make toys for her kids – continue making different kinds toys with the same tools – without having to buy pre-made ones from the store. Additionally, her kids could learn as they played together with the toys she made.

Seeing Computing as a Way to Express Their Ideas

Kids and parents talked about the ability to be creative with computing. Sonia, one of the kids, shared, "you could make anything that
you want.” Many family members were immediately struck by this idea during the first workshop. When everyone shared their projects, families were surprised at how everyone made something different, even though they were working on the same activity (animating their names in Scratch).

Every project was different. And I was thinking, even though my project is different from the others... it was still good, it was good.

Diane

Another parent, Sarah, discussed how kids can express themselves:

They learn how to communicate with others. They also learn how to let another person know how they feel. And they do things, and sometimes they do it just to be funny.

Sarah

Kids also shared this sentiment of freedom to create. Alec shared how he feels like he can do anything with programming. Another kid David talked about how with these tools, he could express his thoughts and feelings.

Programming, let’s see. It’s just a kind of thing. I feel free. I’m just able to do whatever I want to do. There’s really no boundaries or blockade. There’s nothing separating me from what I want to do.

David

And as family members created projects, they felt themselves being pushed and challenged in new and interesting ways. As one kid Mariah said,

Because you keep on using your brain on many different things that you can put into your project to make it perfect. And your brain can work then because you keep on thinking and thinking and thinking until I get goosebumps.

Mariah

Developing as Computational Creators

Towards the end of my follow-up interviews with kids, I asked each of them what they wanted to do next or perhaps what they wanted to do when they grew up. For a few kids, mostly boys, they professed their continuing aspirations to become an engineer. Eric, whose story I shared in Chapter 4 along with his mother Julia, was one of them.
He and another boy Teddy from Fall 2014 shared their interest in engineering during Workshop 1 introductions. For kids like Eric and Teddy, the workshop reinforced trajectories of their identity that they were invested in developing. Eric’s mother Julia was also looking for opportunities to reinforce this interest. For example, she signed Eric up for a rigorous academic summer program that would prepare Eric for middle school and eventually college.

For other kids, their aspirations varied but included creative endeavors. Carlos shared how he always wanted to be a "creator":

I: What does a creator do?

Carlos: Create stuff, and put them into animation or something like that. Or I could just be an animator.

For Sonia, she shared her interests in being a fashion designer along with her sister Clara. They both wanted to run their own company designing clothes together. Her mother Rosa echoed these thoughts when I asked her about her daughters’ interests. She appreciated how the workshops allowed her daughters to see how technology was connected to their interests in art and design.

Other kids shared their more immediate steps. For example, Lucy and Jaime shared how they were planning to introduce their cousins to Scratch. Clara shared how she had recently made three more Scratch projects. Alec shared his latest “choose your own adventure” game that he made in Scratch. He also used part of the follow-up interview to ask me how to use the “make your own blocks” feature in Scratch. Pete had aspirations to become an animator and saw how he could use Scratch as a tool to make his own animations. He also enjoyed helping people in the Computer Clubhouse and had recently joined the Tech Team, a youth group that offers tech support at the Club.

For many kids, their experience creating and sharing in FCL reinforced their existing interests or added onto their current interests. Interests in creating images in Photoshop developed into making images that could move based on a sequence of commands they programmed. Interests in gaming were directed towards making their own games that their family members could play too. Interests in dance connected to importing images of themselves dancing and then programming those images to move along to music.
Many of the kids in FCL workshops didn’t aspire to become computer scientists and engineers. When we designed the workshops, we didn’t have that goal. We wanted families to develop as computational creators – people who could create things they cared about, develop identities as creators, and see the ways they can shape the world. These identities as computational creators are grounded in what they care about and driven by the ways they want to shape the world.

In his book chapter "Consequential Transitions: A Sociocultural Expedition Beyond Transfer in Education," King Beach (1999) argues that rather than focusing on questions of transfer in educational outcomes that instead we focus on "consequential transitions" which focus on experiences that allow learners to see themselves in new ways and see how they relate to the world in new ways.

Experiences such as learning algebra after years of studying arithmetic, becoming a machinist, founding a community organization, teaching one’s firstborn to walk, an elementary school class writing a letter to a local newspaper, collaborating with NASA scientists on a classroom project via the Internet, making the transition from student to teacher, and negotiating one’s identity as an African American between home and the school are all potential examples of the sort of generalization we are concerned with. Each of these experiences can involve transformation, the construction of new knowledge, identities, ways of knowing, and new positionings of oneself in the world. They are consequential for the individual and are developmental in nature, located in the changing relations between individuals and social activities. The relations involve the genesis and maintenance of systems of artifacts and all that is embodied through them, including knowledge, skill, and identity. (pp. 113)

For many kids and parents in the workshops, they had an opportunity to develop their skills and expertise in creating with computing. But more importantly, they had opportunities to experience change in how they see themselves within this activity. Parents who were unsure about what they can do with computing were seeing the ways they could "create something from nothing." Kids could see the world around them in new ways, seeing "anything as a tool. Everything is a material." Parents saw how creative their kids could be. Kids saw how their parents use computing in new ways. Kids and parents applied roles in a new context or developed new roles. Often learning environments focus on the skills and content knowledge as outcomes and studying how these skills and content knowledge transfer in other settings, but what is even more powerful is how learners can develop their identities and their perspectives on these activities. For
many of these kids and parents, the FCL experience allowed them to develop as computational creators. These developing identities could have implications for how they decide to pursue and persist in future opportunities. For parents, these developing understandings and appreciations of what their kids are doing and learning could influence how they decide to support and broker opportunities for their kids.

These emerging trajectories of identification are not definite but part of a continual process of negotiation. Their developing sense of themselves as computational creators will continue to interact with the other settings and people in their lives. How well families, especially the kids, are able to enact this developing identity will depend upon how well supported these identities are across time, across the other settings in lives (e.g. school, home, after-school programs), and among the people (e.g. family members, peers, educators) in their lives.
Chapter 6 Supporting Computational Creators

In this chapter, I revisit the design of Family Creative Learning discussed in Chapter 2 and the descriptions of family experiences in Chapter 4 and 5 to distill strategies from FCL that may be useful for other designers and educators interested in supporting computational creators.
In Chapter 2, I described my design process with my community collaborators and how we iterated on the design of Family Creative Learning to design a series of workshops for families. I discussed the design along four design dimensions of tools, activities, facilitation, and environment. That chapter focused on answering my first question: *How can we design an inclusive and creative learning environment for families to engage in computational creation?* I presented the design of Family Creative Learning as a possible experience for families to create and learn together with computing.

In Chapter 4 and 5, I described how kids and their parents built individual and family projects in the Family Creative Learning workshops as well as their emerging and changing perspectives about themselves, each other, and computing. Chapter 4 and 5 focused on answering my second question: *In engaging in this inclusive and creative learning environment, how did kids and parents develop as computational creators?*

In this chapter, I revisit the designed structures of FCL (e.g. tools, activities, facilitation, and environment) to discuss how these structures supported families' development as computational creators. These strategies are not exhaustive nor are they independent of each other. We designed and iterated across four structures of FCL: tools, activities, facilitation, and environment. While each of these design reflections are embedded in the design of FCL, I believe that these reflections can be useful for other settings that are interested in supporting people to develop as computational creators.

**Tools**

*Make It Easy to Personalize Projects*

We wanted to make it easy for kids and parents to build what they cared about and whatever they imagined. An important aspect of the tools was how easy it was for families to personalize their projects. Both Scratch and MaKey MaKey were designed for "wide walls" to support a wide range of interests, possibilities, and explorations (Resnick & Silverman, 2005). With Scratch, families could create all kinds of interactive media that included games, animations, stories, and art. Families imported or created images and sounds for their projects. For one kid Mariah, for example, being able to import a
song by Beyoncé into her project turned her project into a dance party. Sandy and Pete recorded Pete playing the violin to make the sounds for their cardboard violin, rather than using built-in sounds in Scratch.

Everyday materials that could connect to the MaKey MaKey allowed kids and parents to personalize their projects in the physical world. Conductive materials like aluminum foil and Play-doh and non-conductive materials like craft materials and cardboard could be shaped, cut, and glued together in whatever forms parents and kids desired. They created balls, foot pads, animals, guitar strings, and roller coaster cars. Paired with the Scratch programming environment, parents and kids created different interactions with the computer. For example, they created sounds that responded to the space key or they had a character move across the screen.

Not all tools that enable people to create with technology allow for easy personalization. For example, some programming environments have a pre-determined set of media assets and creators are unable to import their own sounds and images. Other programming environments and invention kits might be more expressive and allow people to create their own projects, but they might be limited in genre. Recent "Hour of Code" activities from code.org introduced simple activities to get started, but they were often in the context of solving a simple puzzle or a challenge. When selecting tools and materials, an important question to ask is how do they enable people easily to create and express their ideas? What range of explorations and outcomes are possible?

Support Multiple Styles and Pathways

In their paper "Epistemological Pluralism and the Revaluation of the Concrete," Sherry Turkle and Seymour Papert (1992) discussed the ways that women and many others were being excluded from computing because of the ways of thinking that were dominating the field.

Our central thesis is that equal access to even the most basic elements of computation requires an epistemological pluralism, accepting the validity of multiple ways of knowing and thinking.

In selecting the tools for families to create with, we used tools that allowed for multiple ways of knowing and doing to engage in cre-
ation (Resnick & Silverman, 2005). In their article, Turkle and Papert (1992) argued that computing education environments, "hard" styles, focusing on abstract and planning approaches to solving problems often dominated and excluded "soft" styles, which focused on more concrete and tinkering approaches. These dominant approaches permeated the kinds of tools, activities, and environments of computing education. Scratch and MaKey MaKey, however, were both designed to be more tinkerable (Resnick & Rosenbaum, 2013). Their different features were designed to provide immediate feedback, to encourage experimentation, and allow for open exploration. For example, with Scratch, families could click on individual blocks to see what each block does. MaKey MaKey had LED lights on the board that signaled if a key press was triggered. Both had features to help people get started. Scratch had a cat sprite that was immediately visible and ready to be programmed. MaKey MaKey was designed to be plug-and-play, without any other software installation.

Additionally, combining digital and physical tools created multiple entry points into project creation. Whoever was interested in working with whatever medium, could work in that while the other worked with the other medium. Even though they started working with a particular medium, they still had to talk about their contributions to integrate the Scratch parts and the MaKey MaKey parts. These different entry points helped different family members create and contribute to the overall project.

Create Across Physical and Digital

In a compilation of photos of different New Yorkers on the street, Humans of New York photographer Brandon Stanton found a young woman sitting on a bench. He often asked people to share something about themselves, such as what they liked to do. This young woman talked about an app she was developing to create visualizations of how British politicians vote on certain bills. "I feel like programming is the closest thing we have to magic. It allows you to create things with words".

For kids and parents, the ability to program across digital and physical materials was an important opportunity to stretch their perceptions about computing. Even kids who already had been excitedly exploring computers were surprised when they first started interacting with MaKey MaKey. Many kids and parents shared how they
had never seen anything like it. Others shared how MaKey MaKey together with Scratch "brought life" to the computer. One kid Ethan shared how he didn't know that he could program the "open world."

In addition to programming the physical world, the ability to access, incorporate, and express with everyday materials was important in helping them see the materials around them in new ways. Whitney was fascinated when she first saw a demonstration of a Scratch and MaKey MaKey musical project, especially noting the use of Brillo pads. She typically used Brillo pads to clean things in her kitchen, but in this demonstration, it was being used as a drum. Later on, she would use it as a bracelet that grounded her and allowed her to touch other conductive objects to make sounds. For many family members, everyday objects and materials were transformed to have new properties and purposes.

Activities

Create Opportunities for Creating and Sharing

To help families use computing to create things they cared about, the activity design provided opportunities to create projects and to share with others for feedback and inspiration. Make sessions in Workshop 1 and Workshop 2, which aimed to get families familiar with Scratch and MaKey MaKey, had semi-structured activities that had plenty of opportunities for personalization. For example, in Workshop 1, everyone was asked to animate the letters of their name in Scratch. Kids and parents took lots of liberties with what each letter did, such as making letters spin forever, respond to key presses, play a recorded sound, or change color. Additionally, during Workshop 1 and 2, kids and parents each worked on a project, giving them a chance to focus on individual projects before working on family projects in Workshop 3 and 4. For their family projects, every family had the freedom to create whatever project they imagined. Families were encouraged to brainstorm and facilitators supported families in translating their ideas into Scratch and MaKey MaKey projects.

Share sessions at the end of each workshop provided opportunities for kids and parents to have their ideas recognized and appreciated by others in the room. These sessions also allowed kids and parents to practice talking about their projects and their process in their own
words. As they shared their projects, other family members might give suggestions to deepen their ideas. As they watched other families share their projects, they might get inspiration or ask questions about how they made particular aspects of their projects. These opportunities to share and interact with others around projects fed back into families’ creative process as they incorporated techniques, suggestions, and new ideas.

Create Opportunities for People to Build Relationships

In their study of track team members and their deep engagement with track, Nasir and Hand (2008) shared how developing connections and relationships supported individuals in developing identities:

As individuals connected to others in the practice, it strengthened their sense of connection to the practice itself, because they came to define themselves as a member of a community that participated in track. (pp. 48)

Track provided many opportunities for members to connect with one another, including track meets, practice, and informal interactions around meals and other gatherings. Similarly, the activity design of FCL provided many opportunities for kids and parents to informally and formally connect with other kids, parents, and facilitators. As their connections deepened with other participants so did their connections to the overall FCL experience. At the start of every workshop, during Eat, families and facilitators caught up on what happened since they last saw each other. When families first came to Workshop 1, they typically sat together with their families. As the workshops progressed, they shifted their physical arrangements. Some kids sought each other out and sat together over dinner, while their parents sat together and caught up on the week. Some parents helped other kids get their food. Facilitators, especially in the early workshops, played a role in helping people across families talk to one another by connecting topics of conversation during dinner. The food itself was a point of connection for some families. For example, during one workshop where we served fried chicken, mac and cheese, and cornbread, some mothers talked about how they cooked their fried chicken at home. Kelsey shared how coming to the workshops was like "coming home."

You feel like you’re coming home from a long rushing day, and then
you don’t have to prepare something ’cause you have something already made, and it’s expected this time for everybody to be sitting down at home eating, so everybody felt comfortable enough to be eating with each other. They weren’t feeling like they were being rushed... So I thought it felt more like a family. It didn’t feel like we were in a school learning. It felt like we were home, sitting and learning and interacting with each other. That’s what it felt like.

Kelsey

After Eat sessions, Kid and Parent Meet sessions were important times where they could continue to connect with their peers. Donna shared how Parent Meet felt like a “fellowship.” She and other parents shared their questions, anxieties, and strategies. Other parents related to each other as they shared stories about their kids. Julia and Estella traded stories about academic prep programs that they wanted their kids to participate in. Whitney, who participated in other parent support groups at the community center, shared how the Parent Meets felt more authentic because she felt like they cared about each other. Make sessions also provided opportunities to connect, getting to know each other as they worked on projects together. During Workshop 1 and 2, parents worked with other parents and kids worked with other kids, facilitating cross-family relationships. At the end of the workshop, everyone came back together during Share, which was a valuable resource in helping families connect to one another’s experiences. As parents and kids talked about what they each did, other parents and kids could relate their experience to others.

These different opportunities to connect provided kids and families with multiple ways to develop their sense of belonging as they developed relationships with other participants who were part of the activity. These relationships, in turn, helped families to engage in every activity and contributed to one another’s learning as they provided different forms of social support such as assistance, ideas, collaboration, and feedback. Their developing sense of belonging and their developing fluency in the activity together helped to strengthen their developing identities in FCL.

Create Opportunities to Reflect

The separate Meets for kids and parents were important times and spaces for facilitators to help family members reflect on their developing perspectives about themselves, their family members, and
computing. For example, Meet sessions allowed family members to reflect on the kinds of roles that they were taking on to support one another. In the Meet session before parents and kids worked on their family projects, facilitators asked questions about their experiences working together with their family members on other projects like homework help or craft projects. Then, facilitators asked kids and parents how they wanted to work together on their Scratch and MaKey MaKey projects. In one Kid Meet session, Pete and Ethan shared how they were going to be "Scratch parents." Facilitators followed up by asking Pete and Ethan what that looked like and what they would do. In another Parent Meet session in Workshop 4, facilitators followed up with parents and kids about working together. At times, parents shared how they didn't feel like they were contributing. Facilitators used those moments to share their observations of the parents - how they were taking on different roles and strategies to support their kids. For example, Rosa shared how she didn't know much about Scratch and MaKey MaKey to help her kids. Another facilitator Lisa countered and shared how she observed Rosa stepping in and out to help her kids, by asking them questions about what they were doing and giving suggestions and encouragement occasionally.

Parents often used these Meet sessions to make sense of how they saw computing and how this experience related to other aspects of their lives. Donna had wondered if she would understand programming, but by Workshop 2 Meet, she shared her developing understanding during the Parent Meet in Workshop 2. "[I] just tell it to do stuff," she shared. Other parents agreed with simple "Yeahs" and nods of their heads. Facilitators in that Meet jumped in and reinforced Donna's developing understanding, sharing how that was a great and simple explanation. In another Parent Meet, Sandy shared how much she enjoyed using MaKey MaKey because it allowed her to be creative and to bring in her interests in arts and crafts. Another parent Tim added his perspective and shared how he felt insecure about his creativity, but was glad to be working with his kids who brought their creativity to their family project.

Other outreach programs might provide a worldview at the beginning of the experience and support families to develop that worldview themselves. A common narrative that parents and kids might hear about computing is the narrative of jobs. This is an important and compelling motivation for many families, especially for families who want to change the economic circumstances of their lives. However, our conversations in Meet sessions with parents also included
other topics such as what they were learning with computing, how their and their family’s interests related to computing, and what it meant for their kids to grow up surrounded by computing. For kids, many topics included their aspirations for what they wanted to do, some of which included computing jobs, but also included other creative endeavors such as fashion design, making stories, and dancing. In FCL, we wanted to create a learning experience where kids and parents could create their own meaningful connections and craft their own narrative of what computing means for themselves and their lives.

Facilitation

Help Learners Surface and Pursue their Goals

Facilitation played key roles in helping kids and parents create things that were personally meaningful by helping them to surface and pursue their goals. For example, facilitators sometimes responded to questions by asking questions like “what do you think?” or “what would you like to do?” rather than responding with an answer. In follow-up interviews with family members, many families recognized these facilitation moves. As Julia said about working with facilitator Sam:

He [Sam] let us work and see our mistakes and then he gave us ideas how to correct it, but he sat in there guiding us, not doing it for us. And that’s much better for me I think because that’s the way you’ll learn. If somebody do your work, you wouldn’t learn anything. You have no experience to look forward to or feel happy about the work that you did. But with him it was different. He did explain to us and then he left... He’ll go out and help other people, and then he come back and say, “Oh, see, you figure it out now.” [laughter] And that’s good that he let us work at it until we got it.

Julia

Facilitators also helped families help themselves – for example, by helping families understand and utilize the material resources that were available to them. Upon being called by two kids in the workshop, facilitator Ana showed them how they could use the instructions included in the MaKey MaKey box to accomplish their goal. For families who had collaboration challenges, facilitators helped them resolve conflicts to move toward shared goals. For example, during times of disagreement, facilitators helped family members
talk out their ideas and helped find ways to combine them. For other families, facilitators helped families by building on their ideas and made suggestions to take their ideas and projects further.

**Position Families as Creators**

In exploring the role of learning experience design and families' developing identities as creators, I found the concept of "positioning" to be helpful in my reflection on the FCL design (Polman & Miller, 2010; Holland & Leander, 2004). Researchers have used positioning to highlight moments where learners have opportunities to take on particular roles or stances. For example, during Share, a parent might show other families how she recorded a sound and incorporated the recording into her Scratch project—positioning herself as someone who can create with sound. Positioning also happens in the reciprocal direction when learners are positioned, perceived, or recognized by others within an activity. In other words, if others are treating and talking to someone like a creator, that person may more likely believe and start to see themselves as a creator. For example, facilitators asked some kids who were more familiar with Scratch to help other family members in the workshop—positioning these kids as experts within the workshop activities. Facilitators also repeatedly positioned family members as creators. Facilitators asked individual family members to share their design thinking, asking questions like, "what are you planning to make?" or "where did you get the inspiration for your project?" During Share, facilitators often asked family members to share how they made something with the rest of the group.

Parents and kids were helpful in positioning other family members as creators and contributors in the FCL experience. During Share, parents and kids picked up on the kinds of questions that facilitators were asking families and asked each other similar questions, wanting to learn how they made certain things happen in their projects. Some parents helped bring others into the conversation, sometimes literally by helping to translate or by asking what the quieter parents thought during the Parent Meets. Jose, a facilitator and community center staff member, shared the many ways that facilitators and other family members included and encouraged Eric, who was generally shy.

The facilitators were encouraging him to speak up, to have a voice. In a normal classroom, some kids just may keep quiet because they don't want to look like the super smart one, or maybe they're just very shy.
and they just don’t want to speak up, and we’re talking about a large classroom here. So, this is a different type of learning environment where it’s smaller, and obviously, you have somebody like your mother or your father with you that can support you emotionally there. But the thing is, the encouragement of everybody getting a word in and everybody inputting their ideas was great, and I think that’s what opened up, opened him up to say, “Okay, well, they’re asking me to say something, so I want to say something, and whatever I say doesn’t have to be wrong, and it’s actually a great idea.” Obviously, some of the kids said, “Oh yeah, that’s a great idea,” or “Good job,” or “Let’s do this,” or piggyback his idea. So, that was cool, and I think that helped him out a lot.

Jose

These small vignettes highlighted the ways that facilitators positioned and visibly recognized kids and parents as creators and contributors in the space. These different moves ranged from inviting them to share their ideas to helping them reflect on their roles. These same moves were also helpful in kids’ and parents’ learning experiences as they learned to use different resources to support themselves, to help others in the activity, and to express their ideas. By recognizing kids and parents are creators and contributors and engaging them in the activities, facilitators helped kids and parents recognize these identities in themselves.

Environment

Co-create a Welcoming and Respectful Environment

A welcoming and respectful environment was an important aspect in supporting families to be creative and share their ideas. From the moment that families stepped into the workshops, especially in the early workshops, a facilitator greeted every family and helped them get settled into the space. Families could immediately see hot food, ready for them to pick up and eat with their family. We posted large photos on the wall of kids and parents in their community who had participated in the family workshops. In particular, these photos were of families in action, engaged in the different activities of the workshop. We hosted the workshops in a community center space that some of the kids and/or the parents had already spent some time in through after school programming, parent support groups, or other technology-based programs like Tech Goes Home.
While we made these moves in the environmental design, it was also important to include families in the process of creating a welcoming and respectful environment. Early in Workshop 1, kids and parents created a community code to make explicit the kind of environment they needed to be creative. Facilitators invited each kid and parent to share an aspect that they wanted in this community code. To make each code concrete, facilitators asked family members to specify or give an example. In one Parent Meet, when a facilitator Maria first asked parents what they wanted in the community code two parents said "Respect" right away while others nodded. Maria asked them to elaborate on what respect looks like, especially since it might look different across cultures. Maria added that she recently came from Colombia. Kelsey added:

You wait for someone to finish talking and then you speak. You don’t interrupt people and you don’t judge people and say rude things against them. Everything in this room is confidential. You don’t go out and say, "I saw you and blah, blah" and tell you stuff.

Kelsey

For some family members, an explicit code that was visible helped them feel comfortable in their creative process. Eric shared his feelings about how the community code and our acceptance of it helped him to focus in the workshops.

Eric: I think the Community Code worked out for me because it was easy to follow and I could do more things in the classes when we had a code.

I: Oh, that’s interesting. What do you mean by that? That you can do more things when there’s a code?

Eric: Well when there isn’t a code, everything would be out of control and it would be harder to concentrate and do the work.

Creating the community code together was only one step. Throughout the workshops, facilitators revisited the code with families, especially after observing any challenging interactions in the space.

These strategies and the ways we implemented them in FCL are meant to be starting points for other educators and designers to consider as they develop creative learning experiences with computing. It is not just about choosing the right technologies, but also deciding on the kinds of activities, facilitation, and space to include in the experience. As Amy Bruckman noted, "tools are not enough... Tools are effectively constructionist only when they are embedded in a con-
structionist culture." (Bruckman, 1998, pp. 51–52) These strategies are not independent, but work together to cultivate a community of creative learners.

In addition to these designed structures, the kinds of people we engaged were an important design strategy. Embedded within these structures were people and relationships. The development of Family Creative Learning required experimentation, iteration, and collaboration with community partners, who were familiar with their community members’ backgrounds and needs. Families’ feedback and our careful study of their experiences enriched and complicated our design thinking. In the summer of 2014, Saskia Leggett and I summarized our design thinking and documentation for other educators to create the Family Creative Learning Facilitator Guide (http://family.media.mit.edu/guide). It has since been downloaded more than 2000 times and featured in curated collections of materials for educators such as the MakerEd Resource Library. Educators from many other settings, communities, and organizations have since adapted the model and have become an important source of feedback to the project – continuing to enrich our iterations and design thinking to support kids and parents as computational creators.
Chapter 7 Conclusion

In this chapter, I reflect on designing and studying structures to engage kids and parents as computational creators. I use the story of one boy who participated in the workshops to frame reflections and ongoing challenges for future work and research.
Family Creative Learning was my exploration of the role of social context in supporting engagement with computational creation. FCL brought together the important people and organizations in a kid's life and engaged them in a creative learning experience with computing. Some people might interpret this work as "teaching families how to code," but my design process with staff at community centers and research findings highlight how much this work was about building relationships — relationships between families and technologies, between kids and parents, between families in the same neighborhood, and between families and their community-based organizations. As they worked on projects together, parents were able to develop different roles to support their kids in the experience — some of which built on existing roles and practices that they were already using in other contexts like homework help or craft projects. Similarly, kids developed roles to help their family members. For many parents and kids, FCL created a context that allowed families to build projects and relationships. They learned more about what they could do with computing while learning more about each other and how they can support one another. At the same time, the workshops were supported by community center staff and facilitators from university contexts that interacted, supported, and developed relationships with families.

Additionally, kids and parents expressed shifting perspectives about themselves, each other, and computing. Parents could see themselves as someone who could create and learn with computing. Kids saw themselves as someone who could teach and support their family members. Parents could see how creative their kids could be and kids could see how capable their parents could be. Both kids and parents experienced new possibilities with computing, demystifying computing as something they can use to create and express themselves. FCL provided a space for kids and parents to develop their perspectives and identities in computing. These "consequential transitions" (Beach, 1999) are important and valuable learning outcomes. Computing education program often focus on building skills and delivering content. These approaches miss out on opportunities to enable learners to develop a sense of who they are and how they see themselves in computing.

These experiences were fostered in an intentionally designed learning experience to support kids and parents to develop as computational creators. An important aspect of their development was being able to create things they cared about. In FCL, we provided tools that made it easy to personalize their projects and we engaged families
in activities that prompted and encouraged them to create and share personally meaningful projects. Additionally, our facilitators supported families in surfacing and pursuing their goals. To support their developing identities as creators, we created a welcoming and inviting environment coupled with activities to encourage families to feel connected to one another in the experience—aspects that were helpful to develop a sense of belonging. Once families could feel safe to incorporate themselves into the experience, facilitators played important roles to position, recognize, and encourage kids and parents to see themselves as creators—capable of building things they cared about and shaping the world around them. While these strategies were developed in FCL, I believe they can be useful strategies in the growing movement to engage people in creating, expressing, and building with technology.

In this concluding chapter, I reflect on the experience of one kid David and his experience after the workshops. I use his story to challenge educators, designers, and researchers who are developing and studying learning experiences within the growing computing movement. We need to expand who we engage to include the broader network of supporters in a kid’s life, which includes parents and communities. We need to move beyond activities with narrow and pre-determined outcomes to instead design experiences that are personally and socially meaningful. As we engage a broader network of people in these kinds of experiences with computing, we need to consider the ongoing network of people, activities, and opportunities that support participation rather than lock-step “pipelines” of participation.

David and Returning to the “Old, Old Me”

During one of my follow-up interviews with David, a 12-year old who participated with his mother and little sister, I asked him if he had continued to use Scratch at home. He said, “No, not really.” I was surprised. Earlier in the interview, he had talked about how he was interested in programming and enjoyed doing it at school where he was learning other programming languages like Pencil Code and doing activities with Code.org. He and his family enjoyed participating in the workshops and were usually the first family to arrive and the last family to leave. He was surprised as well and thought they would pick it up on the weekends, but instead they went back to their old routines. As he described, “I went back to the
old, old me, playing video games, going on the tablet, and things like that." I asked him why, and he blamed habit. It's just not what he was used to doing on the weekends, he shared. He added that school took up a lot of his time during the weekdays.

I continued with the interview and when I reached the end, I asked him if he had any questions for me. He immediately asked, "When is the next Family Scratch Night?" I was surprised and I asked him, "Why are you asking me when the next workshop is, but you don't do Scratch at home?" He said, "Scratch at home is just not the same." He continued to explain that, at the workshops, he had someone like me and the other facilitators. We introduced them to different activities and examples that were exciting and motivating to him. He later added that he appreciated the other families – meeting new people, getting new ideas from them, and experiencing new interactions. At the end of each night, he could share his projects and see all the different kinds projects that people made.

I asked him if there was anything we could do to help his family bring the spirit of the workshops home, to be able to simulate what they experienced in the workshops and in their interactions with us. He responded by pointing out that at home it would be boring and less interesting because they knew each other well. I assured him that we were planning "reunion nights" to gather past families and to engage new activities. We continued to talk about other moments from his experience. Before we ended our conversation, he suggested doing a potluck at the next workshop. He and his mom discussed it and they wanted to share their food as well as taste dishes from the other families.

I was struck by many of the things David said in this conversation: how he went back to the "old, old me", how he asked when the next family workshop was, how much he appreciated the workshop experience with us and the other families, and how he and his mom wanted to contribute to the workshops by bringing their own food – and looked forward to the kinds of foods other families would share.

In David’s reflection on his experience, I saw some indicators from his reflections that highlighted how meaningful the experience was for him. The activities were exciting to him. He was inspired by the ideas that other families shared and enjoyed sharing his own. The people were important to him: the facilitators, the other families, and, of course, his own family. David was one of the kids who helped his mom learn Scratch and he found it meaningful to see his mom grow.
and become excited about seeing her ideas realized in their project. He recognized the importance of food in the experience, and he and his mom wanted to contribute through a potluck. Even though David went back to the "old, old me," he recognized that he was someone during the FCL workshops who engaged in these kinds of activities with these people. He saw a "possible self" in the world of FCL, like many of the kids and parents that participated who developed shifting perspectives about themselves and each other in the context of creative computing.

His reflections and experiences also highlight a challenge for many kids and families, especially from lower-income and underrepresented groups: access to ongoing spaces, people, and opportunities that can invite, engage, and sustain his interests. While FCL allowed him to develop his identity as a computational creator, it was dependent on the spaces, people, and opportunities he would engage in next. As he said, "Scratch at home is not the same." In school, David participated in programming activities through a teacher who introduced them to PencilCode and code.org. However, I wondered how his experiences in school compared to his experiences with FCL. When I asked David to compare, he mentioned that Scratch was like a "free for all" allowing him to make whatever he wanted, whereas code.org was a like a game, programming to go from one level to the next. For many kids who participated in FCL, even if they find continuing opportunities to engage in computer programming, they might be missing the kind of creative learning environment that was fostered in FCL.

Similarly, David’s experiences highlight challenges for designers, program staff, and educators who are interested in engaging people as computational creators. Even as we design creative learning experiences for participants, what continued supports are available to them after the experience? What connections and bridges can we build to the ongoing spaces and relationships they have in their lives? Through my collaborations with staff from community-based organizations and my team of university students from MIT and Harvard, FCL did an initial step by connecting across peers, families, and community resources to help the families develop an appreciation and understanding of kids' interests and activities. Through studies of families' experiences during the workshops and follow-up interviews with family members, we found varying levels of continued engagement. Some families continued to use Scratch and MaKey MaKey at home. Others could not because of a lack of resources or time, but their kids continued to participate in the community center’s after
school activities, which included similar computing activities. For other families, they continued with their old routines. However, what many families had in common were these new and empowering perspectives about themselves, each other, and computing. How these perspectives endured and how they influenced their exploration and engagement of future opportunities are questions I plan to continue exploring.

Revisiting the Sewing Table

At the beginning of this dissertation, I shared a story of families approaching a sewing table in a makerspace. I was inspired by the ways that kids and their parents interacted and supported one another in this activity as well as the history, practice, and learning that emerged within their intergenerational interactions. Seeing these interactions provided me with a vision for the kinds of interactions we wanted to cultivate in FCL. However, there is a larger challenge to achieving what I saw at the sewing table that is related to David's challenges. The activity of sewing was not limited to the sewing table. Families have histories and cultural practices around sewing that spanned generations. These rich practices and histories were supported by other activities beyond the sewing table that connected to settings such as their home or other people such as friends and family. Families could access communities - online or in-person - to learn from others or to share their interests. Kids and families could access television shows, magazines, and other media to enrich their practices. There are events in kids' and families' lives that might have engaged them in sewing, such as creating costumes for a school play or getting a suit tailored for a wedding.

There have been many efforts in the past decade to broaden participation in computing supported by government, industry, and grassroots efforts that have included creating new tools, spaces, and activities. How are these efforts developing into a network of spaces, people, and opportunities that are accessible and inclusive to kids like David? How open are they to engaging families and communities in addition to schools? As the movement grows, I wanted to conclude with three challenges for educators, designers, and communities interested in supporting broader pathways to computational creation.

First, we need to expand our vision of the role that parents and com-
Communities can play in kids' participation in computing. While schools have broad reach and can support ongoing engagement through academic periods, families and communities play an important role in sustaining, supporting, and deepening a young person's lifelong learning experience with computing. Parents are interested in learning with computing, not just about it (Livingstone et al., 2015). They are interested in learning with their kids as much as they are interested in learning from their kids (Takeuchi & Stevens, 2011). Being a learner, teacher, collaborator, and cheerleader are just some of the roles that parents can play to support their kids (Barron et al., 2009), but some parents need a little support to figure what those roles look like and what makes sense for their families. Unlike sewing, parents and families are currently developing their histories and traditions around computing.

Community centers and schools can be important spaces to engage parents and their kids as learners and creators with technology. First-hand experiences can be important ways for parents to develop an appreciation and understanding of what they are capable of, what their kids are interested in, and the growing role of computing in their lives. Some organizations like Tech Goes Home (http://www.techgoeshome.org) are already taking steps to invite families to build their expertise and comfort with technology, but we need to go beyond engaging them in uses with technology to creating, expressing, and building with technology. Family Creative Learning was my exploration of a possible design. FCL leveraged the family and community support infrastructures, which already rally around youth in other activities such as school and sports, and engaged them in exploring what rallying around looks like in the context of computing. It takes a village, and those with the "preparatory privilege" (Margolis et al., 2008) to participate in computing already have a village of people and resources rallying behind their participation in computing.

Second, we need to ensure that these learning experiences with computing are personally and socially meaningful. Often learners are introduced to coding in a rote manner, following a series of steps from a video or solving a narrow challenge with a single outcome. What experiences allow learners to express their ideas and build things they care about? We aimed to design an experience that built on kids' and parents' interests and helped kids and parents develop relationships with one another and with other families. These personal and social aspects of the experience played important roles in helping kids and parents build the kinds of perspectives on them-
selves, each other, and computing that developed their identities as computational creators. As Seymour Papert argued: "Education has very little to do with explanation. It's about engagement. It's about falling in love with the material" (Seymour Papert 1983, n.d.).

To create these personally and socially meaningful environments, we need to expand our design thinking beyond providing access to creative technologies to thinking about the kinds of activities, facilitation, and environments that support experiences that are personally and socially meaningful. That includes activities that allow them to create things that they care about and to share these projects with other learners, instead of engaging learners in narrow activities with pre-determined goals. Facilitators play important roles, not as central instructors who share expertise, but as guides, co-creators, and co-learners who support kids to surface and pursue their goals. The physical and socio-emotional space should be welcoming and respectful to many backgrounds and styles to promote an environment that is creative, playful, and risk-taking. By incorporating their ideas, interests, and identities into the learning experience, kids can develop perspectives about themselves as creators and how they see themselves in the world. Developing these perspectives can help them see the ways they can shape our computational culture. I want to highlight that these developing perspectives on themselves and the world are not uniform. Instead these perspectives build on their diverse backgrounds, histories, and identities. Our learning environments must be designed to have the "wide walls" to accommodate these diverse perspectives and identities (Resnick & Silverman, 2005).

Finally, as we invite diverse groups into computing, we need to expand our focus from funnelling them into "pipelines" and instead focus on building networks of opportunities, people, and spaces to support computational creators. These networks need to provide diverse opportunities and pathways to engage and invite the diverse identities, backgrounds, and interests of learners. In many of the conversations around broadening participation, the "pipeline" is often used as a metaphor to provide a vision of how learners will participate in computing and what kinds of outcomes are available. However, this metaphor has problematic implications in how we think about computing education and outreach. It creates an image of lock-step participation from one form of engagement into another, with predetermined and narrow outcomes. A "leaky pipeline" also creates a sense that when someone leaves these recognized forms of participation, their participation with computing has become less legitimate.
In Family Creative Learning, we brought together families, community center staff, local volunteers from professional settings, and university students. Through their interactions in FCL workshops, these different groups developed into a network of relationships that engaged families in creative computing. How these network of relationships continue beyond the workshops is a question I would like to explore. David’s story and returning to the "old, old me" highlight the challenges with maintaining those relationships. There are exciting efforts by different groups who are building networks of learning opportunities and studying the conditions that support youth to access those networks of opportunities. For example, many designers and researchers are building on the Connected Learning framework by Mimi Ito and her colleagues (Ito et al., 2013) to design learning experiences that connect across the different spheres of people, places, and interests in a learner’s life to academic, career, and civic opportunities. Nichole Pinkard and her colleagues are expanding the Digital Youth Network effort to include new settings, such as the YOUmedia spaces in libraries, and new ecologies, such as Chicago’s City of Learning collaboration. Researchers are also studying ways that youth take up these networked opportunities, identifying different roles that educators can play as brokers and curators of opportunities for learners (Ching, Santo, Hoadley, & Peppler, 2015).

As these networks of learning opportunities in computing are studied and designed, my hope is that they enable learners to build and determine their own pathways that are personally and socially meaningful to them. When I reflect on David’s story, I also think of my lived experience as a first-generation immigrant and woman in computing. I had a rocky, serendipitous, and circuitous pathway through computing – and I wonder if he and other kids in FCL will run into the similar challenges and opportunities that I did. In his interview, David shared how with programming he felt "free." "There's nothing separating me from what I wanna do," he shared. Like David, I also saw how empowering it was to do almost anything I imagined and how exciting it was to meet others with similar interests. And as he bounced back to his "old, old me," I was also reminded of my constant negotiation between who I was and how I presented myself as I moved across spaces and interacted with different people. Betsy DiSalvo documented the ways that young Black men tried to negotiate their growing interests in computing while trying to "save face" among the different networks of people in their lives (DiSalvo, Guzdial, Bruckman, & McKlin, 2014). In bringing their families and friends into their computing experiences in FCL, we aimed to help kids’ networks of support appreciate and understand their develop-
ing interests. Additionally, we wanted to create a space for kids and their families to experiment and explore what made sense to them and connect to their existing interests, backgrounds, and histories. I learned early that I didn’t have to choose between being someone interested in art, being someone who wanted to contribute to society, and being someone interested in technology. I could be a mix of all these parts of myself and build things that were personally and socially meaningful. I was fortunate to have networks of support throughout the different parts of my computing experience. My hope is that kids and families continue to see themselves as creators – without having to compromise who they are – and see they ways they can shape their world.
References


Brown, A. L. (1992). Design experiments: Theoretical and methodo-
logical challenges in creating complex interventions in class-
culture of learning. Educational researcher, 18(1), 32–42.
Bruckman, A. (1998). Community support for constructionist learn-
ing. Computer Supported Cooperative Work (CSCW), 7(1-2), 47–86.
Chen, B. X. (2009, December). HP Investigates Claims of 'Racist' Com-
12/hp-notebooks-racist/
Cheryan, S., Plaut, V. C., Davies, P. G., & Steele, C. M. (2009). Am-
bient belonging: how stereotypical cues impact gender par-
ticipation in computer science. Journal of personality and social
psychology, 97(6), 1045.
lane changes, detours and destinations: Building connected learning
pathways in hive nyc through brokering future learning opportunities
kyliepeppler.com/Docs/2015_Peppler_Hive-WhitePaper
_OnRampsLaneChanges.pdf
Clark, L. S. (2013). The parent app: Understanding families in the digital
age. Oxford University Press.
paradigm for educational inquiry. Educational Researcher, 5-8.
new technologies: The role of children in their parents' usage of
the internet. New Media & Society, 17(4), 483–500.
http://www.nytimes.com/2016/06/26/opinion/sunday/
artificial-intelligences-white-guy-problem.html
face while geeking out: Video game testing as a justification for
learning computer science. Journal of the Learning Sciences, 23(3),
272–315.
DiSalvo, B., Reid, C., & Roshan, P. K. (2014). They can't find us: the
search for informal CS education. In Proceedings of the 45th ACM
technical symposium on Computer science education (pp. 487–492).
ACM.
Duckworth, E. (1996). The having of wonderful ideas and other essays on
teaching and learning. Teachers College Press.
Duncan, G. J., & Murnane, R. J. (2011). Whither opportunity?: Rising
inequality, schools, and children's life chances. Russell Sage
Foundation.


Tripp, L. M. (2011). 'The computer is not for you to be looking around, it is for schoolwork': Challenges for digital inclusion as latino immigrant families negotiate children’s access to the internet. *New Media & Society*, 13(4), 552–567.

Turkle, S. (2012). *Alone together: Why we expect more from technology and less from each other*. Basic books.


