

Article

Exploring the Community Cultural Wealth and Science Capital of Parents in a Family STEM Program

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Abstract

While parents and caregivers are seen as an important factor in the development of science identity building, few studies have explored the contextual and capacity-based factors that influence parents' support of their children in STEM. Parental STEM resources can be explored through the community cultural wealth framework which describes the types of knowledge, connections, and capabilities a community possesses. This study explored the impacts of a year-long, museum-based family STEM program on the parents' community cultural wealth and science capital through surveys and interviews. The results suggest that the program was able to have a positive impact on the capital and habitus of the parent participants. Having access to parents who promote career awareness and encourage career exploration has emerged as an important type of cultural capital. By engaging families as a whole, rather than youth as individuals, programs may be able to more effectively support youth science identity and career aspirations. Sustained, engaging, family-based programs out-of-school, and potentially in schools, are one way to approach the need for more youth, particularly women and those from underrepresented groups, to pursue STEM careers.

Keywords: science identity; parents; community cultural wealth; science capital and habitus

1. Introduction

As society continues to grapple with how to address the need for a diverse workforce in science, technology, engineering, and mathematics (STEM), researchers have been exploring the factors that influence the science identity, interests, and aspirations of youth. This research has been grounded in many theoretical frameworks such as social cognitive career theory (Lent et al., 2002), self-determination theory (Chiu, 2024; Deci & Ryan, 2012), communication theory of identity (Hecht, 1993; Stewart, 2022), science capital (Archer & DeWitt, 2016), and expectancy value theory (Wigfield & Eccles, 2000). From these frameworks, several factors have emerged as contributing to the development of the science identity, interests, and aspirations of youth. Some of these include student self-efficacy and self-concept, peers, science experiences, teachers and counselors, and families (e.g., Archer & DeWitt, 2016; Amarnani et al., 2018; Dou et al., 2019; Ennes et al., 2023a, 2023c; Jackson & Suizzo, 2015; Jones et al., 2022; Oh et al., 2022; Simpson & Bouhafa, 2020; Thomas et al., 2020).

Family engagement with youth is emerging as an important factor in promoting STEM identity and career aspirations (e.g., Archer & DeWitt, 2016; Crowley et al., 2001; Dabney et al., 2013; Ennes et al., 2023a, 2023c; Gülhan, 2023; Lee & Luykx, 2006; Maltese & Tai, 2010;



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Nugent et al., 2015; Perera, 2014). Families are often responsible for an individual's first exposure to science (Ennes et al., 2023c; Maltese & Tai, 2010). From early in life, families are a source of knowledge about the environment and shape individuals' understandings of the way things work. Science interests have been found to occur early in development when families are the initial source of science interest (Dabney et al., 2013). Similarly to Dorrance-Hall et al. (2025), we acknowledge that families come in a variety of compositions. In this article we use the term parents and families to describe "those who provide children with nurturance and a sense of belonging rather than strictly focusing on biological ties (e.g., parent figures, extended family members)" (Dorrance-Hall et al., 2025, p. 1).

Parental attitudes toward science can influence student interest in science (Perera, 2014), as well as their levels of self-efficacy related to science (Dotterer, 2022). Parents with positive science attitudes also tend to become more involved in their child's science school work and homework, as well as encourage visits to museums and libraries (Perera, 2014). However, a parent's demographics and cultural perspectives can influence the behaviors they engage in, their beliefs, and the resources to which they have access (Davis-Kean, 2005; Jones et al., 2023; Sedawi et al., 2025; Thomas et al., 2020; Wang & Degol, 2013). Because youth spend most of their time with their family, creating programs for youth that include their family and community may have lifelong, beneficial effects (Dabney et al., 2016; Ennes et al., 2023a; Gülhan, 2023; Thomas et al., 2020). Family-based programming connects students to science in their community, helps them to better understand science and its relevance in their personal life, and increases science interest (Lee & Luykx, 2006). However, research suggests that not all students have access to early parental encouragement toward STEM (Funk & Parker, 2018; Levine & Sutherland, 2013; MacPhee et al., 2013). Students who do not have a parent in a STEM field may not have as many opportunities to learn about careers in STEM fields (Dorrance-Hall et al., 2025). "Parents share information about careers, talk about their own work, give advice based on their experiences, and provide expectations for their children's career paths. . . Parental influence is powerful and children actively interpret, adapt, and apply these messages based on their lived experiences, intersecting identities, and the resources available to them" (Dorrance-Hall et al., 2025, p. 5).

While parents and caregivers are seen as an important factor in the development of science identity building, few studies have explored the contextual and capacity factors that influence parents' support of their children in STEM (e.g., Amarnani et al., 2018; Oh et al., 2022; Šimunović & Babarović, 2021). Deficit-based assumptions and traditional power structures often prevent parents from fully supporting their children's learning, while schools commonly overlook families' strengths and home-based knowledge (Sedawi et al., 2025; Thomas et al., 2020). One way to address this is by exploring the parent resources that can support their children's STEM identity development and interests.

1.1. Community Cultural Wealth

Parental STEM resources can be explored through the lens of community cultural wealth, which describes the types of knowledge, connections, and capabilities a community possesses (Yosso, 2005). Community cultural wealth examines the assets communities possess rather than approaching issues from a deficit perspective. Within this framework described by Yosso (2005), community cultural wealth is made up of several interacting forms, including, but not limited to, social, aspirational, familial, navigational, and linguistic capital (Table 1, Yosso, 2005).

Table 1. Forms of capital as described by community cultural wealth theory (Yosso, 2005) and science capital (Archer & DeWitt, 2016).

Capital	Description	Example
Aspirational	Having goals for the future in spite of real or perceived barriers	Wanting to become a chemist
Familial	Historical and cultural knowledge shared between family or kin	Having a parent who can help a student learn how to pursue a career in chemistry
Linguistic	The ability to speak in more than one language, which can include music, art or forms of code switching	Being able to explain scientific research to one's family
Navigational	The ability to navigate systems that are complex, such as higher education or medical care	Knowing how to search for college scholarships
Resistant	The knowledge, skills, and strategies developed through challenging inequity, discrimination, or oppressive social structures	Pursuing a degree in chemistry despite feeling like the only student of color in one's classes
Social	The individuals and networks one has access to	An after-school science club
Science	The resources, economic, cultural and social, one has related to science	Having a parent with a science career

The system of relationships and resources an individual develops through interactions with other people and communities builds social capital (Bourdieu, 1986; Yosso, 2005). This includes the networks of people an individual knows, such as family, friends, teachers, and other community members. Familial capital is considered an expansion of social capital and is often described interchangeably with family capital or family social capital (Williams & Dawson, 2011). Familial capital includes the forms of cultural knowledge within a family, such as a shared history or memories. It also includes the “emotional, moral, educational, and occupational consciousness” learned from family and kin (Yosso & Solórzano, 2005, p. 131). Family in this context includes extended family and non-relatives (Yosso, 2005). Familial composition and culture vary among different ethnic, socioeconomic, and cultural groups (Dorrance-Hall et al., 2025; Kiyama et al., 2015).

Aspirational capital enables an individual to have aspirations and ambitions for the future despite any barriers they may perceive or experience (Yosso, 2005). This form of capital includes the goals individuals have for themselves, or others, that may appear to lie beyond their current situation and means. To pursue their goals, an individual must use their navigational capital, which allows them to comprehend and negotiate institutions such as schools, universities, hospitals, or even fields such as science or engineering (Yosso, 2005). For example, part of an adolescent's navigational capital would include knowing about careers, how to find information on applying for college, and how to ask adults for letters of recommendation. Resistant capital is the understanding of the “structures of racism and motivation to transform such oppressive structures” (Yosso, 2005, p. 81).

Linguistic capital is a result of learning to communicate in more than one language or style and is associated with a set of intellectual and social skills (Yosso, 2005). Language plays an important role in allowing individuals access to institutionalized capital in areas such as science (Claussen & Osborne, 2013). Linguistic capital is representative of the languages and communication skills that youth from nondominant backgrounds often bring with them (Yosso, 2005). It “refers to these intellectual and social tools attained through communication experiences in more than one language and/or style” (Yosso & Solórzano, 2005, p. 132). Many fields, such as science, have their own language, and that

science language can feel foreign to youth. How youth discuss and interact with science is often developed over time through interactions with their parents and out-of-school science experiences such as science hobbies, engaging with science content online, or visits to museums (Claussen & Osborne, 2013; Cian et al., 2022; Dou et al., 2019, 2025).

It is important to note that forms of capital have overlapping dimensions and are not typically independent constructs “but rather are dynamic processes that build on one another as part of community cultural wealth” (Figure 1, Yosso, 2005, p. 77). For example, Claridge (2022) argues that social capital extends beyond the individual to include social networks, social norms and trust, which are also components of cultural capital. Furthermore, it is likely that familial capital is shared and expressed with linguistic forms of capital, or aspirational capital is likely to have relationships to social capital. Similarly, social and familial capital are necessary to build navigational capital as these networks help an individual navigate social institutions such as schools (Yosso & Solórzano, 2005).

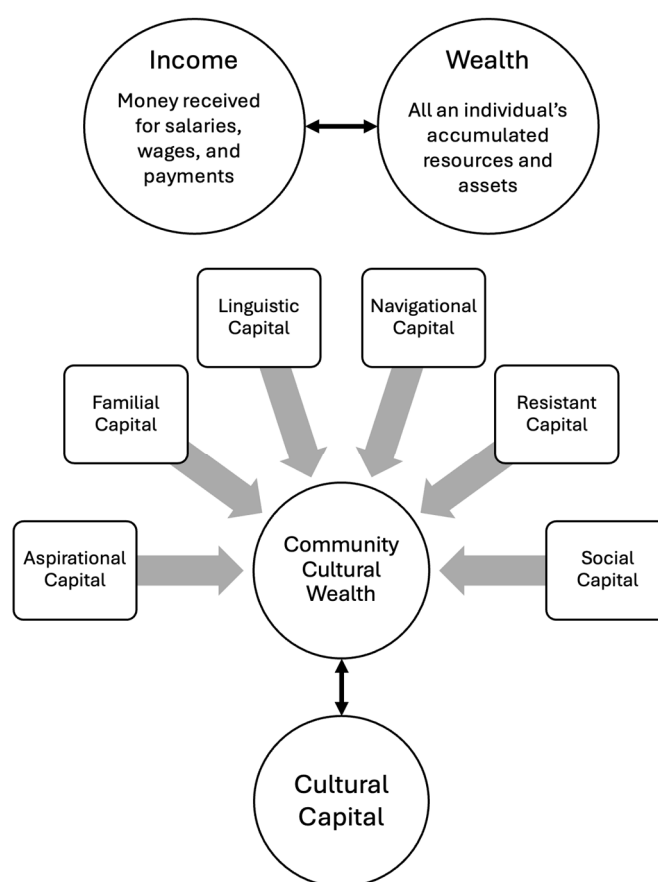


Figure 1. The forms of capital that make up community cultural wealth as modeled by Yosso (2005).

Another form of capital relevant to this work is science capital. Science capital refers to the resources (economic, cultural, and social) one has related to science (Archer et al., 2015). Social capital also plays an important role in science capital. Each individual in one's social network also brings their own capital, which, in turn, increases the capital of the individual. For science capital, this network is important for introducing an individual to people who are scientists or have science hobbies, in order to expose the individual to these experiences (Archer et al., 2015; Jones et al., 2016, 2021a).

Forms of capital are typically dynamic, interact with one another, and play a role in building each other (Yosso, 2005). For example, science identities develop within the familial and social arenas and are therefore influenced by familial and social capital (e.g., Dou et al., 2019). Linguistic and navigational capital provide an individual with the tools needed to

pursue a science career by providing knowledge about the “language” of science and the necessary steps that need to be taken to be successful. Finally, science capital supports individuals with the tools needed to see themselves as someone who is capable of pursuing a science degree (Archer et al., 2015). Because of the interplay between these forms of capital, it is essential to examine them together rather than individually. Understanding the community cultural wealth along with the science capital of parents may offer a new avenue for assessing how parents influence the science identity and career aspirations of their children.

1.2. Study Context

This study examined a program that was specifically designed to allow for us to research the potential impact of a STEM family program that had the goal of building science capital. To be clear, it was not an evaluation of the program, but instead, the program was intentionally designed as part of the study. The research explored theoretically grounded aspects of the program that might contribute to parents and their support for youth and families in STEM. The goal was not only to increase the interest in science and STEM careers of the youth but also to increase parent engagement and interest in science. Including families and parents in the program helped address several issues related to science interests and identity. The study built on research showing that improving parents’ level of education leads to better-educated youth and that a multigenerational intervention is more beneficial than targeting kids alone (Kaushal, 2014). Much of the existing research on out-of-school, family-based science experiences for youth has primarily focused on family science nights in schools (e.g., Harlow, 2012; Ogens & Padilla, 2012; Sorby & Schumaker-Chadde, 2007; Sullivan & Hatton, 2011). This study explored how a year-long, museum-based, family STEM program model implemented across three museums could build parental community cultural wealth and science capital to support STEM career interests and aspirations for their children.

This manuscript is part of a larger series of studies examining the science capital and career aspirations of youth (see Ennes et al., 2023a, 2023b; Jones et al., 2021a, 2021b, 2022, 2023). The program model, called FAME: Families and Museums Exploring, was developed based on the premise that if we enhance the science capital of families, we can increase the science interests, self-efficacy, and out-of-school STEM experiences of elementary-aged youth. The goal of this line of inquiry is to ultimately lead to an increase in the science identity and lifelong STEM interests and career aspirations of youth. The programmatic model used a systems approach to engage the full family (broadly defined by the families themselves) in order to leverage the familial and social capital of the participants. The program was offered at three museums in a southeastern state of the United States. The museums included an urban children’s museum that focused on play, a state-run natural sciences museum located in the center of an urban area, and a planetarium and science center located on a university campus.

Each of the museums recruited 20 families from underrepresented groups through their existing partnerships with community organizations that host after-school programs. The museums selected elementary-aged children (grades 3–5, aged 8–11) who applied or were nominated due to an interest in STEM but who may have had limited access to science capital. Once the families were selected, the museums each hosted ten events over the course of one academic year, including three joint events with the other museums, one hosted at each museum. The program was intended to be sustained, engaging, and long-term (12 months) and offered at no cost to the families. The individual events over the course of the program included meals, engaging STEM activities, STEM career information,

STEM mentors, embedded technology, and activities for each family to take home to continue learning about the event's topic.

Programs began with the families arriving at their museum to share a communal meal with the goal of building social capital and community. Following the meal, the day's topic was introduced, such as astronomy, mammals, or computer coding. Each museum provided family-appropriate, engaging STEM activities related to the day's topic. For example, during the mammals day, families were introduced to local mammals by viewing wildlife camera photos to identify which photos were captured at the location of the program. Participants were expected to engage in the activities together as a family in order to increase their science experience and familial capital. During the activities, STEM community mentors shared information about their careers related to the topic. Inviting local mentors was intended to increase knowledge about a variety of careers that use science, the importance of high school science courses on college acceptance rates, and other information that might motivate and interest youth (Claussen & Osborne, 2013). In order to support the families' access to science capital, the families received a kit of materials at the end of each event to take home so they could further engage with the day's topics. These included items such as a circuit kit, books, magnifying glasses, or investigative materials such as those necessary to make rock candy.

1.3. Research Question

While several studies, such as the ASIPRES study conducted by Archer and her colleagues (see Archer & DeWitt, 2016; Archer et al., 2020), have examined the access youth have to science capital, few studies have tried to build the science identity and career aspirations of youth by increasing families' access to science capital. Bolstering parents' community cultural wealth along with their family's science capital may strengthen their ability to increase and support the science career aspirations of their children. Examining the effect of the program on the parents who attended with the youth can shed insight into these types of family programs. The following research question guided this study:

How does participation in a museum-based, family STEM program aimed at increasing the science capital of youth influence the community cultural wealth of the parent participants?

2. Methods

As part of the program, each parent completed a pre- and post-program survey. The survey instrument used in this study was developed and validated to measure parent science capital and community cultural wealth as defined in the literature (Jones et al., 2023). The development and validation of this survey is described in Jones et al. (2023). While the program was intentionally designed to support the science capital of families, the instrument itself assesses broader dispositions, resources, and forms of capital rather than program-specific experiences. The survey included a wide range of questions assessing the adult's science self-efficacy and science identity, their experiences with science as a child, the adult's perceptions of the usefulness of science in the future for their kids, how families engage in science together, and more. See Jones et al. (2023) for the full survey as well as information on the development and validation.

Twelve families, four from each museum, were selected to participate as case studies based on the youth participant's score on the pre-program survey. The youth whose surveys indicated low levels of science capital were identified at each museum. The parents of these youth were then invited to volunteer to participate in the case studies. Eleven case study families completed the pre- and post-program surveys and participated in three interviews. One family withdrew midyear due to personal reasons.

The parent interviews (described further in sections that follow) included demographic questions, as well as questions related to science self-efficacy, science self-concept, career and education, future goals for their child, science exposure as a youth or an adult, science stereotypes, capital, interest, perceptions of their child, and perceptions of museums and the program.

2.1. Participants

Initially, 47 parent participants completed the pre-survey. Three of the parents were removed from the study because their child did not complete the program. A total of 44 parents completed the entire program and all of the assessments. One parent had two children in the program. Of the 44 parent participants who took both the pre- and post-program assessments, the majority were female (Table 2). More than half of the parent participants were African American, with the rest identifying as White, Latinx, or identifying as another race. Most of the parents spoke English at home, followed by Spanish, and a few parents spoke other languages, such as Hungarian. When asked to describe the area where they live, the majority of the participants indicated they lived in suburban or urban areas, and a few indicated they lived in a rural area (Table 2).

Table 2. Parent/guardian demographics.

	Frequency	Percent
Gender		
Female	41	93.2
Male	3	6.8
Race		
African American	24	54.5
Latinx	7	15.9
White	9	20.5
Other	4	9.1
Language		
English	36	83.7
Spanish	5	11.6
Other	2	4.7
Home Location		
Urban	18	40.9
Suburban	18	40.9
Rural	8	18.2
Education		
Some high school	3	6.8
Graduated high school	4	9.1
Some college	10	22.7
Two years college	6	13.6
Four or more years college	21	47.7

When asked about their education on the pre-program assessment, most of the parents reported they had attended at least some college, with approximately equal numbers having had some college, a four-year degree, or a graduate degree. When asked about their careers, about a third (32.1%) of the parents said they had a STEM or STEM-related career, and 73.2% of the parents said they use science, technology, engineering, or mathematics in their daily work. (Table 2)

Case study parents. For the families in the case studies, all the parents were female, nine were African American, one was Latina, and one White. Five participants were married, and six of them had two children, four had three children, and two had four children. Four of the women had completed some college, three had a four-year degree,

and two had master's degrees. Five of the case study parents had a STEM or STEM-related career and eight of them said they use science, technology, engineering, or mathematics in their daily work.

2.2. Analyses

Parent survey. Changes from pre- to post-program surveys were analyzed using the Wilcoxon Signed-Rank Test or analyzed using a t-test based on the question type. For the open-ended questions related to careers, the responses were coded using the definitions of STEM careers developed by the [National Science Board \(NSB\) \(2015\)](#). The NSB divided careers into STEM, STEM-Related, Technical STEM, or Non-STEM. STEM, STEM-Related, and Technical STEM careers were collapsed into the category "STEM" (1), whereas all other positions were coded as "NonSTEM" (0).

Case study interviews. For the case study interviews, each interview was transcribed and read for themes. Interview transcripts were first read inductively to support familiarization and identification of salient patterns in participants' narratives. During this initial phase, the research team identified recurring asset-based ways that the parents described resources, relationships, and strategies related to science learning. Community cultural wealth theory ([Yosso, 2005](#)) was subsequently selected as an analytic framework because it provided a conceptual lens that aligned with these emergent patterns. Following this initial read, transcripts were coded using a priori categories developed from community cultural wealth and science capital, consistent with iterative qualitative analysis practices ([Locke et al., 2022](#)). The interviews and open-ended questions on the final survey were independently coded by two researchers. The second coder was provided with a codebook with the code, definition, and an example for each code. The two coders independently coded all three open-ended questions on the final survey to establish inter-rater agreement. The intercoder agreement was 0.907 ([McHugh, 2012](#)). The coders discussed any discrepancies and came to a consensus ([Campbell et al., 2013](#)). The resulting codes were: aspirational capital, familial capital, linguistic capital, navigational capital, science, and social capital (Table 3). Resistant capital did not arise in the interviews.

Table 3. Resulting codes and examples.

Code	Example
Science capital	"This was a great opportunity for my child to grow in the knowledge of science and the many possibilities available"
Social capital	"My son has enjoyed meeting other children that have an interest in science"
Familial capital	"I've learned my child is very knowledgeable on things I never knew"
Aspirational capital	"We are increasing dialogue about science related careers and I feel strongly that he will pursue a career in STEM"
Linguistic capital	"She uses more science vocabulary too"
Navigational capital	"It has made me explore other opportunities to integrate science into my children's routines"

3. Results

In the results below, we discuss the analysis of the parent survey and the case study interviews. The data included quantitative and qualitative survey data from the 44 parents in the program as well as qualitative data from the 11 case study parents. Pseudonyms for all parents are used throughout the results.

Science Capital. Early childhood experiences have been shown to be a key influence on future interests and career choices. When parent participants were asked whether they

had access to science toys and tools as a child, 23.3% of the parents indicated they did not. The parents were also asked if they knew anyone during their childhood who worked in a STEM field. Almost half (46.5%) of the parents reported they did not know anyone in a STEM field as a child. More than a third (38.6%) of the parents said they did not participate in a science fair or club, and 65.9% said they did not participate in scouting or 4-H as a child (Table 4).

Table 4. Frequency of parents' reported access to informal science as a child.

When You Were a Child. . .	<i>n</i>	Yes (%)	No (%)
Did you have access to science toys and tools	43	76.7	23.3
Did you know anyone who worked in STEM	41	53.5	46.5
Were you in a science fair or science club?	44	61.4	38.6
Were you ever in Scouts or 4H?	44	31.4	65.9

The parents were also asked to think back to the career they wanted when they were children. This was compared to their current job they reported on the survey (Table 5).

Table 5. Career aspirations of parents with STEM and non-STEM careers.

	<i>n</i>	STEM Career (%)	Non-STEM Career (%)
What did you want to be when you grew up?	42	57.1	42.9
What is your current job?	42	35.7	64.3

Nearly half (46.5%) of the parents reported that they did not know anyone *as a child* who had a STEM career, yet more than half (57.1%) of the parents indicated they had wanted a STEM career when they grew up. Of the 44 parents, only about a third (35.7%) of the parents reported that they currently work in a STEM or STEM-related career. Case study mother Chloe is a good example of how the people she knew as a child influenced her future choices. In her interview Chloe shared:

I didn't have that much exposure to science. . . I grew up in a rural part of the state. There weren't a lot of resources at my school. There was only one high school, everyone knew each other, and you weren't exposed to a lot. And so, I was really pushed into business because that was my strength (final interview).

In addition to questions about their childhood access to STEM resources, parents were asked several questions about their current STEM access. On the pre-program survey, parents were asked whether they felt their family saw them as a science person. Twenty-five percent of the parents said yes, that they felt their family saw them as a science person. By the end of the year there was a significant increase to 38%, $t(44) = 2.423$, $p = 0.022$. One father, Ron, indicated that the program "gives me the motivation to be accurate on giving an answer [to questions] that my children may ask on science and technology" (final survey). Another mother, Kennedy, said, "I realized I was missing opportunities to teach my child about science. I've corrected that" (final survey).

Several of the parents indicated that they experienced a shift in their beliefs about science. Chloe felt strongly that she was not a science person and did not have an interest in science at the onset of the program. However, by the end of the program she had changed her opinion.

[The program has] definitely given me a 'like' relationship with science and I'm actually open to learning new things about science instead of saying 'I don't like

this subject, so I'm not going to like any of it.' I don't have that attitude anymore about science. . . It definitely opened our world to science. I actually developed a "like" relationship with science. Not quite with the "love" thing yet. But the exposure has really. . . I mean, we have conversations about space. At night, we're looking at the moon to see if we know if it's a full or half moon, stuff like that. To see if we can find the big dipper, the north star. With every activity that we've had, it's really opened our world up to the world around us (final interview).

She was not alone. Another case study mother, Ayanna, who is an elementary school teacher, was asked if she was interested in science and engineering prior to the beginning of the program. She said, "Not so much, I don't think I developed the love I want [my children] to have. It's not a priority. It's interesting but not enough to wonder more" (initial interview). Ayanna said she joined the program because she wanted her daughter to have a chance to develop an interest in science, something she never had. However, at the end of the year, when asked whether the program had changed her interest in science, Ayanna said,

Oh yes, in general, I am [more interested]. I would like to learn more and do some of the STEM activities that we have. And the coding is really cool. . . I signed up [to teach] a coding elective [in my job] because we're starting now in kindergarten, and they needed some volunteers and I signed up for the gardening. So, I'll be teaching both of those electives. But I'll be actually learning myself as I teach the kids. So, it'll be a really cool experience. . . Now I see the importance of doing [science] every day and the impact just from having it every few Saturdays a month, every couple of months, how it changes the way that my daughter thinks, when I know she didn't think of it before, as well as myself. So really, kids starting young and getting them to think about science (final interview).

The parents were asked on the pre-program survey if they had knowledge of anyone in their community who worked in a STEM field. Less than a quarter of the parents indicated they knew someone in their family (23.8%) or anyone at all who worked in a STEM field (22.7%). However, on the post-program survey, a Wilcoxon signed-rank test suggested the program enhanced parent participants' knowledge and awareness of STEM fields, with significantly more parents reporting that they knew someone in their community who worked in STEM. Of the 44 parents, 93.2% of them indicated they now knew someone who worked in STEM ($z = -2.65, p = 0.008$) (Table 6). One example of how the program may have shifted the parents' knowledge of people in STEM was shared by Chloe, a case study mother. When asked at the beginning of the year, Chloe did not think she had anyone in her family who worked in STEM outside of a few accountants. At the end of the year, she told the interviewers: "I have a cousin that's a doctor, she's my age. That's why I'm really hoping that [my daughter] wants to go down that route. She's the only cousin that I know of that's in a science-related field. My other cousin is a registered nurse" (final interview). Similarly, Elena explained that she had initially reported that as a child, no one in her family had a STEM job, but later realized that nursing was considered part of the STEM fields. When asked if anyone in her family had a STEM job as a child in the post-program interview she replied,

I will say yes, but as far as knowing what they did, no I didn't know what they did, no one [I was] familiar [with] or had an experience with. My mom was a nurse, but you don't really know what's related to science (final interview).

Table 6. Parents' reported access to STEM pre- and post-program.

	Pre-Test			Post-Test			<i>z</i>	<i>p</i>
	<i>n</i>	Yes	No	<i>n</i>	Yes	No		
Do you know anyone now who works in STEM	44	77.3	22.7	44	93.2	6.8	−2.65	0.008 *
Do you know anyone now with STEM hobbies?	44	68.2	31.8	43	76.7	23.3	−1.00	0.315
Does anyone in your family work in STEM?	42	76.2	23.8	43	86.0	14.0	−1.41	0.157

Note: * $p < 0.01$.

One of the components of science capital is knowledge of science. On the end of year survey, 11 parents indicated they had a greater knowledge of science and its influence on their families. Ten parents said they learned new information about science in general, and five reported they had more awareness of the role science plays in everyday life. Eight parents said they had a greater knowledge of science careers and hobbies. One Latina mother, Sofia, who was part of the larger study, discussed the knowledge she gained to help guide her daughter's career decisions,

This was a great opportunity for my child to grow in the knowledge of science and the many possibilities available. It helped me to have more information to guide my daughter in her interest in animal science as she wants to be a veterinarian (final survey).

Sofia brought her children to the program and said it changed the STEM-related activities that their family did together:

My children now can tell what science is all about and the different types of science. They are more interested in becoming [a scientist]. They want to explore the world, they look for rocks, plants, animals and tried to find more about it. We go to explore at museums, parks, zoos, beach, etc. They ask to buy tools to use that are science related like binoculars, bug catching, etc. (final survey).

Olivia also talked about how she changed their family's engagement with STEM:

I have increased the priority to involve my son in STEM activities as much as we can. He is such an athlete but we have shifted our priorities to have a balance between STEM and sports because he loves both (final survey).

This was similar to the change Claire had when thinking about her sons.

Our other son also loved coming to these events. It was actually really good for him/us because we often think of our other son as being the real science/math kid and him into reading and sports. But he is absolutely just as interested in science. Thanks for helping us see that (final survey).

Ayanna also realized she had shifted the way she thought about her children and their interest in science. She indicated she had not talked with her daughter about science as much as she may have with her son. Ayanna stated that the program had caused her to reflect on whether or not she was treating her children equally in regard to science and science interests. In the final interview, Ayanna said she now makes a conscious effort to give both her children science kits and talks with them both about science and potential careers. She went on to describe the types of conversations she now has with her daughter, such as reflecting on what they learned during the day's program, predicting the weather, making hypotheses, and talking about what constitutes science and science careers. Ayanna also indicated that she had seen changes in the way they talked about science as a family. "Even though [the program] was for [my daughter], the other kids were able to explore and experiment and get the same type of experiences, which is nice. And so that creates more conversations beyond her and I" (final interview).

Some families indicated on the pre-program survey that they struggled to understand what kinds of activities are “science” so they could do them at home. One case study mother, Risa, said, “we don’t know what to do. Not being exposed to these activities, it’s basically not knowing” (initial interview). However, this changed over the course of the program, with Kelly indicating that the resources they received as part of the program “is keeping the learning going” (final survey).

The parents were asked whether they had spoken with their family about science in the last week. Nine parents indicated in the open-ended questions on the post-program survey that they do spend more time talking about science as a family. Camila said, “this program had a huge impact for my family. I have four children ages 12, 8, 6, and 4 years and they learned new things about science and I did too. Now we have new topics of conversation at home” (final survey). Another Latina mother, Luciana, said her “kids like to ask more questions about science and read the news about natural events in the world” (final survey). This was also seen in the comments from Juan about family conversations regarding how science is part of their everyday life:

The program has helped me to bring up things in everyday life that are impacted by science. I now let them measure and mix things to cook so they can see the outcome. I can appreciate the program exposing kids to different aspects of science (final survey).

Ayanna and her family were also doing more science-related activities together outside of the program: “We do nature walks, go to the park, we cook together, make weather predictions definitely, we love doing that- but we need to do more experiments” (final interview). Ayanna also indicated they were visiting more museums and would continue this in the future. Chloe also talked about how they are more likely to talk about science as a family or visit more museums. She said she even changed what she did for her daughter’s birthday based on the program:

Yes. I told them for [her] birthday- and we’ve never done this but I know it’s because of the influence that the program has had- I went online to look at these science experiments that she could do with her friends. We tried them out. We did the lava lamp, that is really cool. I love doing that. And we made snot. I was hoping the girls would get a kick out of that since most of them have brothers. It was more like slime (final interview).

The events hosted by the museum also changed Chloe’s hobbies at home. After participating in a program on bird banding:

We took the bird feeder home and hung it. I did bird watching before now, but now I’m really interested in it, now that we did the whole process of bird banding. I’ve really enjoyed that. To see the birds up close, how beautiful they are (final interview).

3.1. Community Cultural Wealth

Social capital. When examining parent responses for examples of changes in social capital, several patterns emerged. Two of the case study parents indicated they initially enrolled in the program because they wanted their child to have an opportunity to socialize with other children who like science. Additionally, several parents reported on the end-of-year survey that they were glad to have met other families who were interested in science. Chloe shared how she felt:

I like this because it’s a different setting, a different environment. So, we met different people. And it was people who were kind of like minded and seemed

inquisitive and wanted to learn more, had something to contribute so that was fun (final interview).

Similarly, Ayanna discussed the new relationships she was building as part of the program: “A lot of the families are from [the school where I teach] and it has really given me an opportunity to get to know them and talk on a personal level rather than a professional level” (midyear interview).

Four parents said they, or their child, had developed a community of people who liked science. One mother, Kelly, said the program was “an opportunity [for her son] to see that other friends his age are as interested in science as he is” (final survey). This was echoed by Brittany when she reported “my son has enjoyed meeting other children that have an interest in science” (final survey). Chloe said she was already leveraging the social network to navigate and identify new program opportunities for her children.

There might be other activities that we don’t know about through other places. The university offers [a STEM program] we didn’t know about until we were a part of the science club. It was someone at the [program] who told us about it (final interview).

Other mothers indicated they were sharing new information with their social circles. Case study mother Zoe said, “I share a lot of information with my friends and family” (final interview). Ayanna also indicated she had begun sharing her new knowledge about science by gifting science kits and talking with other parents about what they had been doing. She reported that her daughter had shared the take-home materials with her friends, and the parents called Ayanna to find out more about them and where they could get their own sets for their daughters. She indicated that she was pleased to be able to share her knowledge with the other parents. Additionally, the museum educators felt they had become part of the families’ social networks. One African American mother told the educators at her museum that their family referred to them (the white educators) as their “Vanilla Aunties” when discussing the program at home.

Familial capital. Familial capital is considered an extension of social capital (Williams & Dawson, 2011). The parents suggested they had seen changes in their familial capital as noted by one mother, Claire, who felt the program achieved familial and social goals: “it was a wonderful opportunity for all of us to learn together and network with other families.” Another African American mother, Heather, said involvement in the program “helped us bond and learn new things together. I’ve learned my child is very knowledgeable on things I never knew. It exposed us to new things and made learning fun as a family.” For many of the parents, this program was an opportunity to spend more time as a family, as seen by Viola’s comment: “She loves science and it is an extracurricular activity that gives us something to do over the weekend, together.”

Aspirational capital. Changes to the parents’ aspirational capital may have influenced not only their aspirations for their children but also for themselves. Three parents indicated they planned to go back to school to pursue degrees in science after participating in the program. One father had already enrolled in a science program and two mothers were considering going back for a new degree. One of the mothers, Tamika, said the STEM professionals in the program really made her feel she could go to college for a degree in medical ethics or something related to the biomedical field:

It’s made it easier to see if I can try again to go back to school. . . . Seeing the people that were doing the instruction and the people that helped it and giving some background about what they were doing. Listening to them talk about what they do and the types of jobs that they may do, and what they do when they do their

job and, main thing, knowing it was all local. Different parts of the state but it's all still local (final interview).

Two parents explicitly said they knew how to better support their child's interest in science as a result of participating in the program. According to Serena, "my son is a real scientist type and this year was a huge support for him and for us to know new places, opportunities, topics, what we could not have known without the science club" (final survey). An additional two parents said they had a better understanding of what careers were available in science, so they could encourage their child. One African American mother, Olivia, said,

My family has a deeper appreciation for science related experiences and understand the impact these experiences will have on our son's future. We are increasing dialogue about science related careers and I feel strongly that he will pursue a career in STEM (final survey).

Linguistic capital. Linguistic capital represents the languages, including the language related to science, that one possesses. Chloe reported an increase in discussions about science:

This program has exposed us to the world of science in ways we would not have explored ourselves. We talk about earth, how to make the world a better place and have plans to visit zoos, aquariums, and museums more often (final survey).

Other parents reported changing how they spoke with their family about science at home. Claire noted that the program "did help us be even more intentional about how much we talked about science at home." Serena, a mother who recently immigrated to the United States said, "we talk more about science because the [program] was the best [part] of our last year." One Latina mother, Camila, said it even impacted the way her extended family spoke about science. "I invited [my nephews] a couple of times [to the family program] and they were very impressed, excited, knowing more about science. They are now more interested in science books and talk more about this topic." Others described spending more time talking about how science is related to their everyday life.

One parent, Elizabeth, indicated that she noticed a change in how her daughter spoke about science. "I hear my daughter talk to her friends that she goes with to explain what she is doing and how things work. She also explains things to her family upon return after activities. She uses more science vocabulary too." The parents also shared that they changed the way they spoke about science with their family. Chloe was a great example as she admitted she quit saying she hated science to her children as a result of being in the program. The parents reported that they talked more about science with their immediate families as well as with other friends and families.

Navigational capital. When examining the instances where the parents indicated they had changed in their ability to navigate resources surrounding STEM, several parents indicated they were now taking steps to find new experiences and opportunities for their children to continue engaging in STEM. Brittany said, "it has made me explore other opportunities to integrate science into my children's routines." Another parent, Pat, said the program "has encouraged me to continue to find exciting programs to expose my child to science, technology, etc." An increase in navigational capital was also seen in the earlier quote from Serena that she now had a better understanding of new resources to support her son's interest in science as a result of participating in the program. Chloe also spoke of her increase in navigational capital through the network of people she met in the program. While many parents expressed increases in navigational capital, there were also some missed opportunities. Although the ongoing programs talked about careers and provided community mentors related to different careers, the process of financing and

applying for college was not addressed until the end. One parent, Zoe, said she would have liked to have “learned about, for the parents, getting scholarships for older kids for science programs” (final interview).

3.2. Limitations

One of the limitations of this study is the small sample size, which was related to the nature of the program and the number of interviews conducted. While the participants were recruited from underserved communities, the educational background of the parents in this study may not be representative. All of the responses in this study are self-reported, which may be subject to social desirability or recall bias. However, science capital and community cultural wealth are latent constructs that reflect families’ perceptions of resources, relationships, and opportunities, many of which occur outside of program settings and are not directly observable. In museum contexts, self-report is a standard and appropriate method for examining change (DeVellis & Thorpe, 2021; Staus et al., 2021). In fact, Falk and Needham (2011) found that participants engaged in self-reporting in museums are more likely to under-estimate their growth rather than over-estimate their learning. Findings are therefore interpreted as perceived changes in science capital and community cultural wealth rather than objective behavioral measures. Also, as culture plays an important role in cultural and science capital, care should be taken when generalizing these results beyond the scope of these cases.

4. Discussion

This study examined a family STEM program designed to support the community cultural wealth and science capital of the parents. In the sections that follow, the results of the surveys and the perspectives and experiences of the case study participants are discussed. Overall, the results suggest that the program had a positive impact on the capital of the parent participants.

Science Capital. According to results from the survey, many of the parents indicated they had an interest in a STEM career as a youth but lacked role models to encourage them to pursue them. Nearly half (46.5%) of the parents reported that they did not know anyone who had a STEM career as a child. This lack of role models may have led to fewer of the participants pursuing careers in STEM despite their interest (Clark Blickenstaff, 2005; Sonnert, 2009). This aligns with other studies that found youth who do not have a parent STEM role model may not have as many opportunities to learn about careers in STEM fields (Dorrance-Hall et al., 2025; Funk & Parker, 2018; Levine & Sutherland, 2013; MacPhee et al., 2013), and that talking about science with family is important in childhood (e.g., Dorrance-Hall et al., 2025; Dou et al., 2019).

Even as adults, more than a fifth of the parents initially said they did not know anyone with a career in a STEM field. However, that changed significantly from the pre-program survey to the post-program survey. This may be a result of a better understanding of what constitutes STEM fields, as several parents initially expressed confusion about what is considered a STEM job. Additionally, the increase in knowing people in STEM may be due to the opportunities to meet STEM professionals during the program. This can be seen in Tamika’s comments about the importance of meeting local STEM professionals.

Although the program focused on introducing community members with formal STEM-related careers, community members with informal STEM interests could also serve an important role in building science capital for families. A study of adult science hobbyists found that knowing someone with STEM hobbies is important for building early science interest (Jones et al., 2016). In the present study, almost a third of the parents initially said they did not know anyone who engaged in science hobbies, and yet research suggests

providing access to adults in STEM careers is one way to help build family science capital (Jones et al., 2016). Access to role models was seen by the parents as being an important part of science career interests, as Ayanna indicated when she discussed how knowing more people in science may have changed her career path. Role models can help individuals feel like careers are possible, that they are relevant, and help create a sense of connectedness to the career (Deci & Ryan, 2012; Dorrance-Hall et al., 2025). The importance of STEM role models has been highlighted in research on STEM identity, career aspirations, and engagement (e.g., Aish et al., 2018; Gibson, 2004; Gladstone & Cimpian, 2021; Shin et al., 2016). Further research might explore how introducing parents to STEM role models may support their own science identity and capital so that they can engage more effectively with their children.

The role families play in helping youth develop ideas of what they are capable of and interested in regarding science and science careers is complex but vital (Archer et al., 2012). Several of the parents reported that they had greater knowledge of ways to support their child's interest in STEM and STEM careers after participating in the program. They indicated they had learned new information about their children, such as the mothers who saw their sons as "sports kids" but realized they were also "science kids." They also indicated they had greater knowledge of how to support their child's career aspirations through engaging in activities within the community.

These experiences with a community of like-minded families and access to role models were a few of the ways the program attempted to increase the family science capital of its participants. The results of the study suggest an increase in two of the science-based activities in which participants reported participating. By the end of the year, parents indicated a significant increase in the number of times they visited a zoo, aquarium, museum, or planetarium. This is an important part of family science capital as these places offer opportunities for youth to develop greater science literacy, the desire to continue learning about science topics, and knowledge that science was important to their family (Crowley et al., 2001). Parents are able to support the development of science identity and career interest through taking their children to informal science centers (Crowley et al., 2001), and these experiences increase the likelihood that the youth will choose STEM fields in college (Dabney et al., 2012).

The participants also indicated that they changed how they prioritized their children's activities after having participated in the program. The two mothers who learned they needed to balance sports with STEM are a good example, as well as the parents who began finding new ways for their children to engage in STEM outside of school. Another example is the two case study mothers who realized they had previously believed their sons to be more interested in science than their daughters. It is important that parents encourage science interest by giving their children opportunities to grow their interests through out-of-school science experiences, such as trips to science museums or giving them science kits, and by avoiding gender stereotypes related to STEM (Wang & Degol, 2013). The ways parents talk about science with their children has been shown to influence their interests and aspirations (Dorrance-Hall et al., 2025), and there are opportunities to further explore the conversations that take place during museum-based family programs to better understand how parents are engaging with their children in these programs.

How parents feel about science has a major impact on their family science capital as well as their child's science interests (Gülhan, 2023; Perera, 2014; Thomas et al., 2020). While many parents indicated they were initially interested in science when beginning the program, several of the case study mothers who were not indicated they had found a new interest during the program. This change in interest may have influenced how the parents believed their family viewed them as a science person. There was a significant increase in

the number of participants who felt their families saw them as a science person at the end of the program. This may have a beneficial effect on their children in the long term, and this finding is worth further investigation.

4.1. Community Cultural Wealth

Social capital. Several parents in this study described their desire to build a network of families that also enjoyed science, part of their social capital (Bourdieu, 1986; Yosso, 2005), for themselves as well as for their children. This form of capital is important to help parents understand and negotiate the field of science, which may be unfamiliar to them (Yosso, 2005). Several parents within the study felt they had achieved this goal. There was also evidence that parents extended their social network to include museum educators who were referred to as the “Vanilla Aunties”.

Familial capital. Participants shared in the interviews that the program helped them spend more time together engaging in science activities, as Heather described when she discussed family bonding and learning new things about one another. Other researchers have shown that parents are early sources of science interests and often act as gatekeepers for out-of-school science activities (Dabney et al., 2013; Gülhan, 2023; Thomas et al., 2020). Increasing the opportunities for families to engage with one another in pursuit of science experiences and opportunities can potentially build science and familial capital and ultimately career aspirations for youth.

Aspirational capital. The results of this study suggest that the aspirations of the parents changed both for themselves and for their children, exemplifying enhanced aspirational capital. Three parents indicated that, as a result of their participation in this program, they were either currently pursuing a STEM degree or had plans to do so in the future. Participation in the program helped them to see that they were capable of doing so. For Ayanna (the teacher who is learning computer coding to teach her students), this new interest was due to meeting local STEM professionals who were representative of something she could achieve. This suggests that in addition to being important for youth career aspirations (Clark Blickenstaff, 2005; Sonnert, 2009), role models may be instrumental in helping more adults pursue STEM degrees or hobbies.

Additionally, the parents reported they gained new knowledge about their children’s interests as well as how to support them in those interests. These included the parents who found that their children had a greater interest than expected, such as the “sports kids.” This also included parents like Olivia, who reported increasing her conversations about STEM careers with her son. This type of support is very important in increasing the STEM career aspirations of youth, particularly for underrepresented groups (Cian et al., 2022; Dou et al., 2019, 2025; Hernandez et al., 2016; Moore, 2006). It is important to note that not all youth or parents may want to enter a STEM career or to pursue STEM leisure interests, but building capacity for those who are interested may be valuable.

Linguistic capital. Understanding science requires a degree of linguistic capital (Yosso, 2005) because science has its own language and vocabulary (Claussen & Osborne, 2013). One parent within this study reported that her child had changed the way she talked about science and was beginning to use more science-related vocabulary with her friends. Other parents discussed the way they changed the way and amount they spoke about science with their child and as a family. Command of the language of science is necessary to pursue science careers (Claussen & Osborne, 2013), and this is one area that is not typically explicitly addressed with this type of program. However, it would greatly support the science capital of families and may lead to greater science career aspirations (Cian et al., 2022; Dou et al., 2019, 2025). Helping families be more comfortable talking about science could be one way family programs can help increase support for youth science interests

and increase the relevance youth see in STEM (Lee & Luykx, 2006). How parents talk about science and science careers can influence their children's beliefs about it as well (Cian et al., 2022; Dou et al., 2019, 2025; Gülhan, 2023; Keller & Whiston, 2008; Perera, 2014; Thomas et al., 2020). Having staff and community mentors model how we all experience terminology that we do not know and express epistemic humility could empower youth and parents to feel more efficacious with the language of science.

Navigational capital. Navigational capital allows an individual to successfully negotiate institutions such as school, applying for jobs or college, and others (Yosso, 2005). While information on applying for scholarships and how to prepare their children for college was addressed at the end of the program, including it throughout the year may have done more to build navigational capital. So, there was a need for more of that type of intervention, as this is another type of capital that may form a barrier to pursuing STEM careers (Hernandez et al., 2016). However, several parents made comments suggesting they had an increase in their navigational capital, as they were already finding, or in the process of finding, new resources to support their child's interest in science. These parents felt encouraged to look for resources that they did not know existed prior to the program, such as summer camps or scholarships. Knowledge of resources is an important part of navigational capital.

Navigational capital can also enable students to negotiate unsupportive or hostile institutions and environments (Yosso, 2005). There is a need for a long-term examination of how these youth fare in the future after leaving this "science-rich" environment for environments that may be focused differently. One could speculate that by building family capital, youth and parents may have developed a more positive perception of their abilities and support, but further research is needed to explore whether or not the program built navigational skills.

4.2. Future Areas for Research

Future areas of research may include examining how programs most effectively serve families from different backgrounds and cultures. As the programs described here took place in science and children's museums, future work could examine the impacts of this program model in other types of institutions or within school systems. Research is needed to better understand how linguistic and navigational capital can be addressed within family STEM programs. Additionally, there are opportunities to examine the impact of role models on the parent participants as well as how families talk with one another during these programs.

5. Conclusions

In spite of decades of targeted programs, there remains a need for youth to have more experiences that will support lifelong STEM identities, interests, and aspirations (e.g., Chen, 2013; Musu-Gillette et al., 2017; Snyder & Dillow, 2010). One factor that these programs fail to take into consideration is the vital role parents play in the education and the career aspirations of their children (i.e., Archer & DeWitt, 2016; Crowley et al., 2001; Dabney et al., 2013; Ennes et al., 2023c; Lee & Luykx, 2006; Maltese & Tai, 2010; Nugent et al., 2015; Perera, 2014). In order to increase the science identities and career aspirations of youth, some families may need help creating a support structure (e.g., Archer et al., 2012; Dabney et al., 2016; Lee & Luykx, 2006; Perera, 2014). Research has shown that a multigenerational intervention may be more beneficial than targeting kids alone (Kaushal, 2014). Not only is it beneficial for the youth participants (Ennes et al., 2023a, 2023b), but this study found that a multigenerational intervention is beneficial for the parents as well.

This study sought to build upon the cultural resources parents bring with them in order to help them better support the science identities and career aspirations of their children.

While previous programs have examined the level of capital individuals possess, this study used a family-based program to support the community cultural wealth, including social, familial, aspirational, and family science capital of the participants. The results suggest that this program model was successful for increasing the forms of capital that are foundational for supporting the science interests and career aspirations of youth. The words of one of the parents powerfully illustrates this perspective:

I can speak to the importance of being inclusive the people who haven't historically- who haven't chosen science or math or stem as an option for various reasons whether lack of confidence, or not being targeted, or not feeling comfortable, but I think this is a great opportunity to kind of bridge that gap and do it in a fun way. It's powerful. It's meaningful. It has really changed us and our lives. It is all about exposure. Exposure is big. So as much as we can expose children, especially those who are not represented in this field to it, I think that's great. The earlier the better (Deja, final interview).

Implications. The findings suggest that organizations seeking to develop similar programs may benefit from engaging role models that best reflect the local community, to help build the social capital of the families through communal meals and other group-building activities, and offer engaging hands-on science experiences. When discussing careers, it is important to help the families understand what types of careers are considered STEM and what STEM activities look like.

Based on these findings, it is important that family STEM programs specifically address linguistic capital. As the language of science is a barrier to participation in STEM (Claussen & Osborne, 2013), museums and other organizations hosting STEM programs can greatly increase the capital of their families by addressing and utilizing scientific language. Explicitly teaching parents how to probe their children's ideas about the world, teaching them how to support science self-efficacy, and supporting questioning and developing a sense of wonder could go far as supports for developing aspirational and navigational capital. Additionally, to best support the types of capital needed to pursue STEM careers, these programs should also include information to support the navigational capital of families. Understanding how to prepare for STEM careers in school, how to apply for school and scholarships, and other aspects of navigational capital are barriers for many underrepresented families (Hernandez et al., 2016). Finding ways to support the linguistic and navigational capital of these families is one way museums and other STEM organizations can help support the science career aspirations of youth.

While school-based programs may reach more individuals, there may be tensions between the school and parents (e.g., Morgan, 2010; Murray et al., 2014; Tezcan-Akmehmet & Luke, 2013), which may lead to fewer underrepresented families participating. The benefit of engaging in these programs in out-of-school settings is that the learning is seen as free choice and tends to come with fewer stressful constraints (Tezcan-Akmehmet & Luke, 2013). However, it is worth investigating how well this type of program works in school settings in order to further support the science interest and career aspirations of youth.

Having access to parents who promote career awareness and encourage career exploration has emerged as an important type of capital (e.g., Ceglie & Settlage, 2016; Moore, 2006; Sonnert, 2009; Workman, 2015). By engaging families as a whole, rather than youth as individuals, programs may be able to more effectively support youth science identity and career aspirations. Sustained, engaging, family-based programs out-of-school, and potentially in schools, are one way to approach the need for more youth, particularly women and those from underrepresented groups, to pursue STEM careers.

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