Children and Parents’ Perceptions of Access to Science Tools at Home and Their Role in Science Self-efficacy

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Abstract
Families play a vital role in the development of the science interests and career aspirations of youth. Of particular interest is how a family’s science capital and science habitus impact how children see themselves in relation to science. One aspect of science capital that has emerged as foundational in children’s levels of science self-efficacy and academic self-concept is their access to science related tools outside of school. To learn more about the role of science tools in building the future science interests of youth, this exploratory study examined reported access to science-related tools and tool experiences for 89 participants (44 parents and 45 children). The results showed that more than half of the children reported a lack of home access to science tools such as a meter stick, compass, or scale. There were significant differences in reported access to science tools for African American and Latino/a youth. The reported access to tools for youth was significantly correlated with their science achievement value score (a measure of self-efficacy and self-concept). When comparing child and parent reported tool access, the parents noted having significantly more tools at home than the child participants. The findings from this study suggest that parents should provide opportunities for their children to explore these common household tools on their own as well as in family contexts. Having prior experiences with science tools outside of school is an important form of science capital that could foster success for children in the science classroom.

Keywords Family · Science capital · Science experiences · Science tools · Self-efficacy
It is increasingly apparent that parents play a foundational role in helping children learn science. The actions of parents in learning and doing science at home have been described as a component of family habitus (Archer et al., 2012). Family science habitus includes the dispositions and behaviors a family holds regarding science. Research suggests these dispositions influence a family’s beliefs about science as well as how and whether they choose to engage with science (Archer et al., 2012). A family’s science habitus has been shown to influence science learning in school (e.g., Boonk et al., 2018) and can lead to lifelong engagement with science outside of school such as science-based hobbies (Jones et al., 2017).

In addition to their habitus, how a family chooses to engage with science is influenced by their access to science capital. Science capital includes tools related to science such as books, microscopes, or rulers (Bourdieu, 1986; Claussen & Osborne, 2013). Families with high levels of science capital often have high levels of science literacy and access to cultural and social resources related to science (Archer et al., 2015). Access to science capital may vary by gender and race (Archer et al., 2015; Jones et al., 2000a, b) and can be tied to socioeconomic resources. These differences have been documented as early as third grade (Kohlhaas et al., 2010). Furthermore, the type and amounts of science capital a family possesses, along with the family’s habitus, have been shown to influence a child’s science career aspirations (Archer et al., 2012).

Children develop ideas about what matters when learning or doing science through their social interactions with others, such as parents, who teach them different ways of speaking about science, what tools are important, and how they are used (Lemke, 2001). However, parents may not be fully aware of the important role that childhood science experiences (such as visiting museums, engaging in science activities at home, or talking about science with their family) play in future success in science (NSTA, 2014). “When family is a primary source of initial interest in science, general interest in science is more likely to occur earlier” (Dabney et al., 2013, p. 406), emphasizing the importance of understanding the access children have to science tools at home. Examining the science capital and access to resources (such as science tools of children) have emerged as particularly salient given the increase in students learning at home during the global pandemic (e.g., Andrew et al., 2020).

To better understand children’s access to resources related to science, this study examined science tools and tool-related science experiences as components of a child’s science capital. We explored the access that children and parents reported having to science-related tools in the home environment to gain insight into the types of resources to which children have access outside of school. Here, tools are defined as physical objects that allow an individual to engage in sense-making in science, technology, engineering, and mathematics (STEM) contexts (Lemke, 2001). Exploring science-related resources to which children perceive they have access can provide insight into how and why some students have higher levels of Science Achievement Value (a measure of self-efficacy and self-concept) and Perceived Family Science Achievement Value—both factors which lead to increased Future Science Task Value (or interest in and value of science for their future; Jones et al., 2021). Furthermore, by examining the perceived access to tools by both parents and children, we can gain insight into tool availability and use. The research questions that guided this study included the following:

1. What access do children have to science tools and tool-related experiences?
2. What access do parents have to science tools and tool-related experiences?
3. What is the relationship between children’s access and parents’ access to science tools and tool-related experiences?
4. What is the relationship between children’s access to science tools and their Science Achievement Value (a measure of self-efficacy and self-concept)?

**Current Research on the Importance of Tool Access**

Recent research has documented that access to science tools plays a role in the development of children’s levels of science self-efficacy and science self-concept (Science Achievement Value) as well as their perceptions of the support they may receive from their family for learning science (Perceptions of Family Science Achievement Value; Jones et al., 2021).

In a recent study, structural equation modeling was used to examine students’ \( N = 1,015 \) responses to a STEM career aspiration survey. The authors found that factors related to science capital (exposure to STEM practitioners, STEM experiences, and tool access) were positively related to students’ Science Achievement Value and their Perceptions of Family Achievement Value (Fig. 1). Furthermore, both Science Achievement Value and Perceptions of Family Science Achievement Value had a direct positive effect on students’ Future Science Task Value (aspirations and interests in science). This model suggests that tool access positively influences children’s self-efficacy, self-concept, and their perceptions of the value of science for their future (Jones et al., 2021). Less is known, however, about the relationship between youth and parent perceptions of access to science related tools and how this might influence the overall model.

**The Value of Tools in Learning Science**

Access to tools at home may lead to a better understanding of science tools in the classroom. Without prior opportunities to engage with tools, children may enter learning contexts that require tool use without the needed previous experience (Carter et al., 1999). Tools, both symbolic and physical, have emerged as foundational for learning science (Jones et al., 2000a; Kirch, 2010). Tools play a fundamental role in making observations, analyzing data, and sharing results. Furthermore, tool use is rooted in culture (Carter et al., 1999).
et al., 1999; Vygotsky, 1978), and is inherently social and contextual (Carter et al., 1999). Research suggests that children need early experiences with tools to be successful later in school settings where tools are necessary for science learning (Carter et al., 1999).

Science standards, such as the Next Generation Science Standards (NGSS Lead States, 2013), National Curriculum in England: Science Programmes of Study (Department for Education, 2015), and the Science Education: Key Learning Area Curriculum Guide of Hong Kong (The Curriculum Development Council, 2017), have highlighted that learning has roots in the use of tools. For example, in the NGSS Standards, tools, such as rulers, are featured in the development of the cross-cutting concept of scale, proportion, and quantity (NGSS Lead States, 2013). Similarly, the science standards for years 1–2 in Australia state students should be able to “use informal measurements to collect and record observations… using units that are familiar to students from home and school, such as cups (cooking)” (Australian Curriculum, Assessment and Reporting Authority, n.d., para 6). Having access at home to tools, such as measuring cups, rulers, and scales, provides children with the opportunity to develop these critical science practices and may build a foundation for placing value on these tools, scientific practices, and experiences related to tool use—all factors that contribute to science capital and habitus.

Additionally, as shown in Fig. 1, access to tools is positively correlated with a student’s sense of self-efficacy and confidence when engaging in scientific inquiry. “Self-efficacy is a judgment of personal capability” (Bandura, 2012, p. 357–358). It plays an important role in motivation, affect, and action (Bandura, 1982; Bandura et al., 2001). Performance accomplishments, one of the four factors influencing self-efficacy, occur as a result of past experiences (Bandura, 1978). An individual with high science self-efficacy has a strong belief that they will succeed in tasks and activities related to science. This can lead to a student being more likely to select science tasks, such as inquiry activities, when given choices and more likely to work harder to successfully complete them (Britner & Pajares, 2006). The study described above reveals an emerging model where experiences with materials and tools, at home and in school, support the development of scientific practices as well as perceptions of oneself as a science learner (academic self-concept), and confidence in engaging in science (self-efficacy). Much of the previous research examining science tool use took place more than two decades ago (e.g., Carter et al., 1999; Freedman, 2002; Jones et al., 2000a, b; Jones & Wheatley, 1989, 1990), and this study builds upon that research by including the perceptions of the parents and adding a more contemporary perspective. This manuscript aims to contribute to the literature by assessing what science tools children perceive they have access to, how tool access is related to their levels of self-efficacy and self-concept, and the role parents can play in supporting children’s access to science tools and experiences at home.

Methods

In this study, which was part of a larger dissertation study (Ennes, 2019), we examined the perceived tool access and out-of-school science experiences of the youth and adult participants in a museum-based family STEM program aimed at increasing the science interests of the youth participants. The program occurred over one academic year at three museums in a southeastern state in the USA. The purpose of the larger program was to support the science capital and family science habitus of the participating families in order to enhance the science interests and career aspirations of the youth participants. This manuscript
reports the results of perceived tool access and science experiences of the children and parents prior to participating in the year-long program.

**Participants**

Families were recruited by the museums through their existing partnerships with community organizations serving low socioeconomic communities and Title 1 schools (schools with a high number of students from low socioeconomic status receiving free or reduced cost lunch). Priority was given in the selection process to children who were members of groups underrepresented in STEM and from low wealth communities. Many of the participants were new visitors to their respective museums.

The participating children \((n=45)\) were in grades 3–5, ages 8–11, and just over half identified as female. Approximately two-thirds of the children identified as African American, a quarter as Latino/a, and the remaining identified as White or another race/ethnicity (Table 1).

The 44 adult participants (one parent had two children in the program) were primarily female and over half identified as African American (Table 2). The parents mostly spoke English at home \((n=83.7\%)\) and most reported that they lived in urban \((n=40.9\%)\) or suburban areas \((n=40.9\%)\). Over half \((52.2\%)\) of the parents reported they had completed two years or less of college (Table 2).

**Data Collection**

Participating children and at least one parent or caregiver completed a survey at their host museum during the first program at the beginning of the year. The *NextGen Scientist Survey* used in this study was developed to examine the science capital and family science habitus of children and their parents (Jones et al., 2020, 2021, 2022).

The survey was offered to the participants in both English and Spanish. The survey was used as it allowed us to examine tool access across a wide spectrum of science tools. Among other questions that were part of the larger study (Ennes, 2019), respondents were asked whether they had access to 20 common tools related to science or mathematics at home. These tools were identified from a previous study examining the science capital of children as it relates to understanding size and scale (Chesnutt et al., 2018). Additionally, the participants were asked how much time they spent engaging in six tool-based activities. This included reading a map, using a thermometer, using a ruler, using binoculars, going online to learn about science, and building or taking things apart. The parent version of the survey had the same items as the youth version but was slightly modified to ask whether they engaged in these activities at home rather than outside of school. We recognized that parents and children may have different knowledge or access to science resources, so both groups were asked to complete the survey.

**Survey Validation** The survey used in this study has been found to be valid and reliable (Jones et al., 2020). It measures four factors that contribute to future science aspirations with the factors having good internal consistency \((\alpha=0.85–0.93)\) and partial scalar

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1 While the targeted population was families from low wealth communities, information about socioeconomic status was not gathered on the survey.
invariance and metric invariance for both gender and ethnicity (Jones et al., 2020). Of particular interest in this study is the factor science achievement value which is a measure of an individual’s levels of self-efficacy and self-concept ($\alpha = 0.93$). Additionally, the four factor model had an adequate fit: $\chi^2(318) = 1182.497$, $p < 0.001$; $\text{CFI} = 0.94$; $\text{TLI} = 0.93$; $\text{RMSEA} = 0.05$, [CI = 0.049, 0.0455]; $\text{SRMR} = 0.048$ (Jones et al., 2021).

### Table 1  Child demographics

|                          | Frequency | Percent |
|--------------------------|-----------|---------|
| **Gender ($n=44$)**      |           |         |
| Female                   | 23        | 52.3    |
| Male                     | 21        | 47.7    |
| **Age ($n=40$)**         |           |         |
| 8                        | 12        | 30.0    |
| 9                        | 16        | 40.0    |
| 10                       | 7         | 17.5    |
| 11                       | 5         | 12.5    |
| **Race/ethnicity ($n=44$)** |       |         |
| African American         | 28        | 63.6    |
| Latino/a                 | 11        | 25.0    |
| White                    | 3         | 6.8     |
| Another not listed       | 2         | 4.5     |

### Table 2  Parent/guardian demographics

|                          | Frequency | Percent |
|--------------------------|-----------|---------|
| **Gender**               |           |         |
| Female                   | 41        | 93.2    |
| Male                     | 3         | 6.8     |
| **Race/ethnicity**       |           |         |
| African American         | 24        | 54.5    |
| Latino/a                 | 7         | 15.9    |
| White                    | 9         | 20.5    |
| Another not listed       | 4         | 9.1     |
| **Language**             |           |         |
| English                  | 36        | 83.7    |
| Spanish                  | 5         | 11.6    |
| Another not listed       | 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 of college | 21 | 47.7    |
Compliance with Ethical Standards

Data collection was conducted with approval from the university’s Institutional Review Board under IRB11944. Parent participants signed an informed consent and the youth participants completed a child assent prior to completing the survey.

Analyses

To answer research questions one and two, a tool score was created for each participant. Each response of “yes” to having access was coded as one and “no” was coded as zero for a tool score ranging from zero to 20. An independent samples t-test was conducted to determine if there were significant differences between the tool scores of children and parents to partially address research question three. To address the remainder of research question three, a Mann–Whitney U test (used to compare Likert-scaled data of unrelated groups) was conducted to compare the amount of time the adults and child participants reported spending on various science-related activities that included the use of a tool. A Bonferroni correction was applied to the alpha value (0.008) to protect against type 1 errors. Mean, standard deviation, mean rank, U test statistic, p-value, and the effect size, r, for significant results were calculated (Field, 2013). McNemar’s tests were run to determine whether there were statistically significant differences in the proportions of individuals who indicated they had a particular tool between parents and children as well as between African American and Latino/a students. McNemar’s test allows for the comparison of related, binary data (e.g., yes vs no; Eliasziw & Donner, 1991). A Bonferroni correction was applied to the alpha value (0.0025) to protect against type 1 errors. A Pearson product-moment correlation was run to assess the relationship between the children’s tool score and their Science Achievement Value score (see Jones et al., 2021 for more information).

Results

In the section that follows, the results related to tool access and time spent on science experiences are described. The results were examined for the elementary youth, their parents, and the differences between the two groups of participants prior to participating in the year-long program.

Child Tool Access

Each child was asked to indicate whether they had 20 different tools available at home. The children reported a mean tool score of 11.16 (SD = 1.13) out of 20. Approximately a third or more indicated they did not have access to Legos® (31.1%), building blocks (31.1%), a thermometer (35.6%), a weight scale (37.8%), or a magnifying glass (42.2%). More than half indicated they did not have access to a map (51.1%), compass (60.0%), yardstick (60.0%), kitchen scale (62.2%), science kit (66.7%), health monitor (68.9%), telescope (72.7%), Lincoln Logs® (77.8%), or microscope (86.7%) (Table 3). Almost all of the children (95.6%) reported having a camera at home.

There were no significant differences between the tool scores of males (M=11.11, SD=4.32) and females (M=9.86, SD=3.52). Differences were also examined for African
American and Latino/a children. African American children had a statistically higher mean tool score of 11.23 (SD = 4.06) than the Latino/a children’s tool score of 8.00 (SD = 2.61), (t(28.90) = 2.89, p = 0.007). Of the 28 African American youth participants, more than three quarters reported they did not have access to a microscope (82.1%) or Lincoln Logs® (78.6%). More than half reported not having access to a health monitor such as a blood pressure cuff or fitness band (64.3%), a kitchen scale (64.3%), a compass (64.3%), a yard or meter stick (57.1%), or a chemistry or science kit (53.6%). More than a third did not have access to a map (42.9%), a magnifying glass (39.3), or a weight scale (39.3%). A quarter or more of the African American children reported they did not have access to building blocks (28.6%), a thermometer (25.0%), or Legos® (25.0%) (Table 4).

Of the 11 children who identified as Latino/a, none reported having access to a chemistry/science kit or a microscope at home. More than three quarters of the Latino/a children reported not having access to several items including Lincoln Logs® (90.9%), a map (81.8%), a yard or meter stick (81.8%), a health monitor (81.8%), or a telescope (81.8%). More than half of this group reported a lack of access to a magnifying glass (72.7%), a

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Note: Participants were recruited from African American and Latino/a communities. There were only three youth who identified as being White and two who identified as another race/ethnicity and these participants were not included in the racial analyses.
kitchen scale (72.7), a thermometer (63.6%), Legos® (63.6%), or a compass (54.5%). More than a third of the Latino/a children reported a lack of access to tools such as a weight scale (45.5%), building blocks (45.5%), or a calculator (36.6%; Table 4).

**Parent Tool Access**

The mean tool score for the parent participants was 13.26 (SD = 3.41) out of 20 (Table 3). Nearly all of the parents reported having a ruler (97.7%) or calculator (95.5%) at home. About a quarter of the parents said they did not have a map (25.6%) or a yardstick (27.3%). Approximately a third or more reported they did not have access to a weight scale (34.1%), magnifying glass (36.4%), compass (40.9%), or building blocks (40.9%). More than half of the parents indicated they did not have access to a health monitor (53.5%), kitchen scale (56.8%), chemistry or science kit (65.9%), Lincoln Logs® (72.7%), a telescope (77.3%), or a microscope (84.1%).

**Child vs Parent Reported Tool Access**

The results of tool scores for the parent and child participants were compared to identify differences in perceived tool access (Table 3). The children reported significantly lower

| Tool                          | African American (n = 28) | Latino/a (n = 11) |
|-------------------------------|---------------------------|-------------------|
| Chemistry or science kit      | 13 (46.4)                 | 0 (0)             |
| Microscope                    | 5 (17.9)                  | 0 (0)             |
| Lincoln Logs®                 | 6 (21.4)                  | 1 (9.1)           |
| Map                           | 16 (57.1)                 | 2 (18.2)          |
| Yard/meter stick              | 12 (42.9)                 | 2 (18.2)          |
| Health monitor                | 10 (35.7)                 | 2 (18.2)          |
| Telescope                     | 8 (28.6)                  | 2 (18.2)          |
| Magnifying glass              | 17 (60.7)                 | 3 (27.3)          |
| Kitchen scale                 | 10 (35.7)                 | 3 (27.3)          |
| Thermometer                   | 21 (75.0)                 | 4 (36.4)          |
| Legos®                        | 21 (75.0)                 | 4 (36.4)          |
| Compass                       | 10 (35.7)                 | 5 (45.5)          |
| Building blocks               | 20 (71.4)                 | 6 (54.5)          |
| Weight scale                  | 17 (60.7)                 | 6 (54.5)          |
| Ruler                         | 26 (92.9)                 | 7 (63.6)          |
| Calculator                    | 26 (92.9)                 | 7 (63.6)          |
| GPS                           | 25 (92.6)                 | 8 (72.7)          |
| Measuring cups                | 26 (92.9)                 | 9 (81.8)          |
| Timer                         | 23 (82.1)                 | 9 (81.8)          |
| Camera                        | 27 (96.4)                 | 10 (90.9)         |

*a Only 27 African American youth responded to the item GPS. The McNemar test found that the difference between groups for perceived access was not significant for any individual tool at p = .0025*
tool scores than the parent participants, \( t(83) = -2.551, p = 0.013 \). Of interest are the 60.0% of the children who said they do not have access to a yardstick compared to 27.3% of the parents who said no. More than half of the child participants (51.1%) said they did not have access to a map whereas only a quarter of the parents (25.6%) reported not having a map. Additionally, more than a third of the children (35.6%) said they did not have access to a thermometer whereas only 13.6% of the parents agreed. While only 2.3% of the parents reported not having access to a ruler, 15.6% of the child participants said they did not have a ruler at home.

### Science Experiences

In addition to tool access, the participants were asked how many times they had engaged in science tool-related activities over the last year (Table 5). The children were specifically asked how often they had engaged in these activities outside of school. Parents reported spending significantly more time than their children reading maps \( (p < 0.000) \), using a thermometer \( (p < 0.000) \), and using a ruler \( (p = 0.003) \) with medium to large effect size calculations (Rosenthal, 1996). While there were differences between children and parents, there were no significant differences in the amount of time boys reported spending on these activities in comparison to girls. Additionally, there were no significant differences by race/ethnicity.

### Tool Access and Science Achievement Value

To examine for relationships between reported tool access and children’s self-efficacy and self-concept, a Pearson correlation was calculated. The correlation between the children’s tool scores and their Science Achievement Value scores (a measure of self-efficacy and self-concept) was significant, \( r(41) = 0.472, p < 0.001 \), with children’s tool scores explaining 22% of the variation in their Science Achievement Value scores.

### Discussion

Although there has been prior research that examined tool use by children, this study examined how contemporary children perceive access to science-related tools at home. Here we examined not just children’s perceptions of access to science-related tools, but we also compared parents’ perceptions to those of their children. The results showed that while the children reported access to various types of tools, their parents indicated they had access to significantly more tools at home than were reported by their children. The findings also suggest that having access to science tools at home contributes to students’ science self-efficacy. In the section that follows, we discuss implications for these findings for researchers and caregivers.

### Access of Children to Science-Related Tools

The children in this study reported having access to a variety of science-related tools such as a camera, measuring cups, and a calculator. However, many children reported a lack of perceived access to tools such as a thermometer, scale, magnifying glass, science kits,
Table 5  Comparison of reported time elementary children and parents spend on science tool-related activities

| How many times in the last year have you:  | n   | Children M (SD) | Parents M (SD) | Mean difference (SE) | U    | p (effect size) |
|------------------------------------------|-----|-----------------|----------------|-----------------------|------|-----------------|
| Read a map                               | 45  | 0.82 (1.07) 34.96 | 1.79 (1.17) 54.49 | −0.97 (0.24)          | 538.00 | <.000* (0.40) |
| Used a thermometer                       | 45  | 1.02 (1.10) 32.27 | 2.21 (0.89) 57.30 | −1.19 (0.22)          | 417.00 | <.000* (0.51) |
| Used a ruler                              | 43  | 1.72 (1.14) 36.49 | 2.39 (0.87) 51.34 | −0.67 (0.22)          | 623.00 | .003** (0.31) |
| Gone online to learn about science       | 45  | 1.40 (1.18) 38.96 | 1.98 (1.02) 51.18 | −0.58 (0.23)          | 718.00 | .020            |
| Used binoculars or a telescope           | 45  | 1.31 (1.16) 49.43 | 0.89 (1.04) 40.47 | 0.43 (0.23)           | 790.50 | .085            |
| Built or taken things apart              | 45  | 0.69 (1.00) 42.96 | 0.82 (1.00) 47.09 | −0.13 (0.21)          | 898.00 | .402            |

*aEach item was scored “never” (0), “1 time” (1), “2–4 times” (2), or “5 or more times” (3).  * p < .001,  ** p < .008*
microscopes, or telescopes. While not every child will have access to a microscope at home, the children growing up without perceived access to foundational science tools such as measuring cups, a calculator, ruler, building blocks, thermometer, scales, magnifying glass, or yardstick may be at a disadvantage when they enter the science classroom (Claussen & Osborne, 2013).

In addition to knowing they have access to these tools, children need to have experiences with the tools so they can build the knowledge and skills to use the tools as well. Adults play the vital role of introducing children to new “tools where necessary and [providing] support and guidance for students to make sense of these for themselves” (Driver et al., 1994, p. 11). Carter et al. (1999) suggested that if children do not have prior experiences with these types of tools, they run the risk of being disadvantaged by having to learn how to use the tool or lacking knowledge of what tools are appropriate while simultaneously learning new concepts in science. Without the ability to develop basic science process skills by using these tools, they may lag behind their classmates in developing the scientific practice skills needed to conduct science inquiry in the classroom (Claussen & Osborne, 2013).

Imagine a student without access to a scale of any form, who has never had an opportunity to weigh herself or other objects. When she reaches fifth grade in the USA, she is expected to master the NGSS physical science standard: “Measure and graph quantities to provide evidence that regardless of the type of change that occurs when heating, cooling, or mixing substances, the total weight of matter is conserved” (NGSS Lead States, 2013, p. 38). Now, she is not only learning that matter is conserved but to do so, she must first learn to use a scale.

In addition to scientific skills such as measuring, early experiences with science tools are important for building the science self-efficacy of students. This study found a significant correlation between tool scores and Science Achievement Value scores (which measures science self-efficacy and self-concept). Students, such as the one described above, may lack the performance accomplishments needed to support high levels of self-efficacy (Bandura, 1978). If she is unsuccessful in her attempt to master the scale and discover that matter retains mass, then she may be less likely to expend as much effort in her next attempt. She may know what needs to be done to complete the task (weigh the object), but she may doubt her ability to complete the task. This belief may influence whether she will even attempt the next task, how hard she will work, and how long she may be willing to try to accomplish the task (Bandura, 1978). Supporting children’s science self-efficacy is particularly important for girls. While there appears to be no difference in science self-efficacy between boys and girls in kindergarten, a gender gap has been found as early as middle school where boys develop higher levels of self-efficacy than girls (Patrick et al., 2009).

The data were examined both as a whole as well as by race as little research has been done to explore tool use by underrepresented groups and this allowed for exploration of what differences might exist. The children in this study predominantly identified as African American or Latino/a and there was a significant difference in their reported sum tool scores. The African American youth reported having access to significantly more tools than their Latino/a counterparts. Although all of the children were recruited from programs that serve youth with low or limited income, we cannot eliminate the possibility that there could be additional socioeconomic or cultural differences between the Latino/a and African American participants. More research is needed to examine the intersection of culture and access to tools in home environments to identify ways to specifically support the science capital and family habitus of Latino/a families.
Perceptions of Children and Parents

When comparing the reported tool access of children to that of their parents, there were large differences in reported access to tools, these included items such as rulers, maps, thermometers, and yardsticks. One can speculate that adults might use maps more often in traveling but one could also expect children to use objects such as thermometers, yardsticks, or rulers at home. Tools such as these play a central role in scientific inquiry in school as discussed above and may be a form of unrecognized capital, or resources to which children are unaware that they have access. The items listed in this study are useful scientific tools and many are fairly common in the home such as rulers and thermometers. To help their children engage with these foundational tools, parents should intentionally give their children opportunities to freely explore with them. By encouraging their children to manipulate these tools, parents may improve their success in science by increasing their familiarity with science tools and skills. Tinkering with these tools may help children to build experience to draw from when they enter school and also helps them develop ideas about how the tools work and why (Bevan et al., 2015; Carter et al., 1999). It is worth noting that there were no families that reported lacking access to all of these tools.

In addition to reporting greater access to tools in the home, the parents in this study also reported spending more time than their children engaging in three science tool-related activities. These included reading a map, using a thermometer, and using a ruler. Opportunities to engage in these activities with their parents may support children in developing understandings about science. Parents are responsible for early access to science resources and experiences (Dabney et al., 2013), and therefore, it would be beneficial for them to either engage their child in using these tools with them or offer their children the ability to explore these tools on their own. As parents most likely choose where these tools are stored, they may inadvertently act as a gatekeeper to accessing them. Engaging children in experiences and with household tools is a malleable factor easily within the control of a parent whereas socioeconomic status is much more rigid and difficult to change. The results suggest that parents must explicitly let their children know they have access to these types of tools and actively engage them in science-based activities. However, there may be cultural differences to why some families may engage with science tools at home and others do not. Research shows that families of different backgrounds often have different leisure interests with African American families tending to choose to engage in social activities, sports, indoor activities, or fishing (e.g., Philipp, 1999; Shinew et al., 2004). Further work should be done to explore how cultural differences influence tool use in the home.

The Impacts of Technology on Tool Use

When examining youth’s access to tools, it is also worth considering the role of technological tools in and out of school. For example, there are now smartphone applications that allow you to use your phone as a ruler to measure an object or as a GPS to find your way. A single smartphone can now be used as a camera, calculator, ruler, GPS, compass, health monitor (such as a pedometer or other device that tracks health data), and even a telescope or microscope (e.g., Horejsi, 2017; Vieyra et al., 2015). A US study of family smartphone use showed that many families invest in a smartphone including 67% of individuals who made less than $30,000 a year, 82% of individuals who made between $30,000 and $49,999 a year, and 69% of individuals with low levels of education (PEW Research Center, 2018).
This means that many families from low-income communities may have access to a rich array of technology-based tools for learning science.

What is not known is to what extent these electronic tools can play the same role as physical tools. If these virtual tools emerge as effective in mediating learning for size and scale concepts, then some disparities for economically disadvantaged children may be offset. However, virtual tools may not completely replace physical tools in developing conceptual understanding. A study of kindergarteners examined the effects of physical versus virtual tools for categorizing objects by mass using a balance beam (Zacharia et al., 2012). For students with alternative conceptions of the purpose of a balance beam, it was necessary to first let the students touch the weights and physically interact with the balance beam before they could complete the task. The students without prior experience needed to hold the weights and move them on the beam before they could develop a more fundamental understanding of what the tool did (Zacharia et al., 2012). However, those with prior experiences with the tool were able to use the virtual representation without difficulty.

A more recent study in the United Arab Emirates found that 76% of the students chose to use a technological option over a manual tool based on perceptions of novelty and enjoyment (e.g., a temperature probe vs a thermometer; Cairns et al., 2021). However, some students who chose the manual tools indicated they did so because they perceived them as being more authentic and because using them made them feel “more like a scientist” (Cairns et al., 2021, p. 6). Cairns and colleagues raise additional questions about the impact of technological tools versus traditional tools and further research should be done in this area.

**Limitations**

Care should be taken when generalizing these results to other populations. Participants were volunteers and their science interests and access to science resources may not be representative of other populations. The sample size in this study was limited by the museums’ capacity to host a certain number of families and care should be taken when generalizing these results to broader populations. Additionally, while we recruited from programs and schools that served low socioeconomic students, we were not able to measure socioeconomic status directly.

We examined some of the factors that may influence science interest and engagement with science in this article; however, we acknowledge that there are other factors that may play a role as well. Additionally, only a sample of tools that might be available in the home was included in the study and the data are self-reported data. The degree to which other tools might influence science learning within other contexts and populations is not known. Furthermore, the sample of tools included in this study vary in cost (both by the type of tool and by the brand of tool) and availability and therefore may not be equally accessible. Future research is needed to explore whether there are other cultural tools families use for learning science, as well as research that examines differences in tool use across cultures.

**Implications**

Parents play an important role in preparing their children to succeed in science. Learning to engage in science practices, such as tool use, is a form of cultural capital that children develop over time by engaging with their parents and through out-of-school science
experiences (Claussen & Osborne, 2013). Some forms of capital are difficult to change such as parental educational attainment, but many of the tools described in this study are low-cost and easily accessible. Schools and other educational organizations should consider ways to offer families access to science tools and examples of activities families can engage in together. This may encourage parents to support their children in science even if they do not feel like they have expertise in science (Lee & Luykx, 2006). The COVID-19 global pandemic accentuated the need to support parents in engaging their children in science learning at home no matter their level of expertise.

Caregivers can increase access and experiences for their child with everyday tools such as measuring cups and spoons, screwdrivers, hammers, rulers, and other common household tools through free play or by using them together. As many families already have these resources, parents need only make a conscious effort to engage their children in science tool use. This has the potential to strengthen their children’s levels of self-efficacy and confidence in conducting science inquiry (Britner & Pajares, 2006) and better prepare them for a successful experience in the science classroom (Carter et al., 1999).

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Data Availability Available upon request from the first author.

Declarations

Ethics Approval All procedures performed in studies involving human participants were in accordance with the ethical standards of the institutional and/or national research committee and with the 1964 Helsinki Declaration and its later amendments or comparable ethical standards. The study was approved by the IRB board at North Carolina State University (no. 11944).

Consent to Participate Informed consent was obtained from all individual participants included in the study.

Consent for Publication Informed consent was obtained from all individual participants included in the study.

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