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# Elementary School Children's Home Learning Environments: Mathematics, Reading, Science, and Written Language

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**Abstract:** It is well accepted that the home learning environment impacts school performance; however, much of the previous research has focused on preschool children. This exploratory study used an online, Qualtrics survey to ask parents ($n$ = 177) of elementary students about the home learning environment. Our research questions addressed (1) the amount of time children spend on mathematics, reading, written language, and science at home, and differences by subject and/or grade; (2) parental beliefs about the importance of engaging in home learning activities in each of the four subjects; (3) parental confidence in supporting each of the four academic subjects; (4) parental and child enjoyment of the four academic subjects; and (5) who (parents, child, or teacher) initiated home learning activities in the different subject areas. The results indicated that elementary school-age children were engaged in reading, mathematics, science, and written language activities at home; however, the most time was spent on reading activities. Parents reported viewing engagement and assistance with academically related activities at home as important; however, they were more confident assisting with reading and written language than mathematics or science. Strong associations were noted between parental enjoyment of a subject and their confidence in assisting their child. Overall, teachers initiated more activities for older children and were more likely to initiate mathematics activities. When children initiated an activity, it was typically reading related.

**Keywords:** home learning; elementary school; parenting; classroom; mathematics

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## 1. Introduction

There is a large body of research showing that the academically related activities children do at home are associated with their educational development, although much of the research has used samples composed of preschoolers and children at the start of elementary school [1–4].

For example, the frequency of reading different types of books during this time period is positively associated with the development of children's reading skills [3,5]. A similar relation holds for mathematics activities and skill development ([6,7]; for review, see [8]) although the relation is less clear cut for mathematics than literacy and varies, to a degree, across demographic groups [9,10]. Research also shows that parents' beliefs about their role in their children's learning and how to foster academic skills is positively and significantly related to the frequency of children's engagement in relevant reading and mathematics activities (e.g., [11]).

Research on the home learning environment has generally focused on reading, and more recently, mathematics. There has been less focus on science or written language, two other important components of children's schooling [2]. Such research has also mainly focused on young children's home learning activities and not those of children in elementary school.

How children acquire academically related skills depends upon what occurs at home and school, and communication between the two settings [12–14]. We focus here primarily

on home-based activities in mathematics, reading, written language, and science in elementary school-age children while acknowledging the importance of both settings for children's development. Although the competencies developed in the preschool years and those before the start of formal schooling are very important (e.g., [15–17]), we need a better understanding of what occurs at home as children go through school. As Serpell et al. (2005) [3] found, children's early reading trajectories can be improved by increased home-based literacy activities once children start formal schooling. Such findings provide further evidence for the need to study the home learning environment as children proceed through school.

This paper expands upon prior research by documenting the amount and type of mathematics, reading, written language and science activities children in first through sixth grade engage in at home. It is not sufficient to document just the frequency of activities; we also need to consider parents' beliefs about how children learn and their role in such learning. Accordingly, we document various components of parents' beliefs about children's learning and their role in it. All of the data are based on parents' reports. In what follows, we first present the theoretical framework that guides our conceptualization, we next provide a summary of relevant research on children's home-based engagement in the four subjects and relevant beliefs about such engagement.

## 2. Theoretical Framework

This research reflects academic socialization theory [18] and Bronfenbrenner's (1979) [12] ecological model. Parents' academic socialization includes parents' attitudes, values, goals, expectations, and beliefs about education as well as the opportunities and activities they make available to their children [18,19]. Hoover-Dempsey et al. (2005) [20] discussed that parents must believe they have the relevant skills with which to assist their children, and the time to do so, to be involved in their children's education. Relatedly, Pomerantz and Moorman (2010) [21] reviewed how parents socialize their children's skill development and motivation to succeed at a task. This implies that parents must believe they have the relevant skills with which to assist their children. However, we know very little about how confident parents feel about their ability to socialize their children's academic skills (cf. [22–24]).

Parents' socialization of their children's academic development is associated with their development of such skills [18,25,26]. For example, children's exposure to various literacy-related activities is associated with their literacy skills [3]. How parents socialize their children's academic development is grounded in cultural models shared by members of a cultural group (e.g., Blacks and Latinx, [27,28]) but also may reflect family income, parents' educational level and their knowledge of children's development [11,29].

The ecological model notes that children's development occurs in several overlapping contexts (e.g., microsystems) and stresses that these contexts need to work well together (mesosystems) to optimize children's development [12]. For example, Epstein (2001) [13] talked about overlapping spheres of influence in which parents and educators together exert an influence on children's learning. Relatedly, Hoover-Dempseyet al. (2005) [20] talked about the importance of home and school factors in predicting parents' involvement in their children's education.

### *2.1. Parents' Socialization of Children's Academic Skills*

We begin by reviewing research on children's home-based activities and then present a brief review of parents' pertinent beliefs.

#### 2.1.1. Reading

Research on parents' socialization of children's early literacy development has included documentation of parents' beliefs, children's relevant activities, and related development. Participation in reading-related activities at home is positively related to the development of early reading skills (e.g., [3–6,11,16,24,26,29–36]). Most studies that have documented the frequency of children's engagement in activities have considered the

number of times a child does an activity but not for how long. The number of minutes a child engages in an activity gives a more nuanced measure than just focusing on the number of times [24].

Research on early reading has also considered parents' beliefs about their role in socializing their children's educational skills. Serpell et al. (2005) showed the importance of an approach that engaged children's interest and tried to make it fun for the child [3]. Such an approach was positively and significantly related to children's engagement in activities and reading development as children progressed from preschool through third grade. Sonnenschein and colleagues found that most parents in their sample of low-income families ($n$ = 70) strongly believed that children should engage in reading activities at home, and they should assist their children with these activities [11]. However, children engaged in reading activities only once or twice a week, less than others find optimal (see also [3,37]). These data beg the question of what other factors might play a role in whether parents and children engage in reading-related activities? Two such factors are [38] whether parents have confidence in their knowledge of what to do; and [8] whether teachers are requesting that children engage in reading-related activities.

#### 2.1.2. Mathematics

As with research on literacy development, research on parents' socialization of young children's mathematics skills has taken two general approaches, sometimes in the same study. One is to document children's activities and parents' beliefs. The other is to investigate relations between home activities, parents' beliefs, and children's outcomes. Research shows that, as with reading, parents support the importance of children engaging in mathematics activities at home and the need to assist them with such activities [11]. Although one would expect to find positive relations between engaging in mathematics activities at home and children's skills, the research evidence is equivocal ([23]; for a review, see [8]). This lack of consistent relation may reflect inconsistencies between the types of mathematics activities children engage in and the specific mathematics skills assessed [8]. As with research on reading, research on mathematics also considered the number of times and not the amount of time children engaged in activities. Research also did not generally consider how confident parents were to assist their children (cf., [24]).

We are aware of only three studies that considered the confidence that parents had to assist their children with mathematics. All used parents of preschoolers. Cannon and Ginsburg (2008) asked 37 middle-income parents of preschoolers how confident they felt to assist their children with mathematics [22]. Most of the parents reported not feeling very confident. Missall et al. (2015) asked a similar set of questions to 70 parents of preschoolers [23]. Their sample was more diverse. Most reported feeling moderately comfortable. Sonnenschein et al. (2021) reported data with 105 parents of preschoolers [24]. These parents reported feeling moderately comfortable assisting their children with mathematics. Thus, their results were similar to that of Missall et al. (2015) but the sample was mainly well educated and affluent [23].

#### 2.1.3. Written Language

Most of the research on this topic has considered how children learn written language in school (e.g., [38–40]). We have not been able to find a body of research on parents' socialization of their children's written language. In fact, we found only two studies [2,3] and neither considered the factors that we are considering in this paper nor documented engagement in focal activities.

#### 2.1.4. Science

There are also limited studies focusing on how parents socialize their children's science development at home. However, recent research has indicated that parents who are interested in science are more likely to engage in science learning at home with their children [41]. The authors of the aforementioned study also reported that parents with

higher levels of education and income are more likely to engage in science-based activities with their children. These findings are consistent with what several researchers have suggested: that is, findings from research on parent involvement at home for reading or mathematics should be applicable to the domain of science (e.g., [42,43]).

#### 2.1.5. Comparison between Reading and Mathematics Socialization

Given how limited the research on parents' socialization of written language and science is, we do not include those domains in this section. The fairly limited research comparing parents' socialization of children's reading and mathematics skill shows that parents view reading as more important than mathematics [44]. Overall, parents see it as more important for their children to engage in reading than mathematics at home and assist their children with reading more frequently than with mathematics [11,44]. This trend has continued even as there has been more of a societal emphasis on STEM fields. For example, Sonnenschein et al. (2021) recently surveyed 105 parents of preschoolers about home-based reading and mathematics-related practices [24]. They used an online survey distributed on social media sites. Participants were primarily middle to upper income and highly educated. As with the other data reported here, parents viewed reading engagement as more important than mathematics engagement. Relatedly, children engaged in reading activities more days per week and minutes per day than in mathematics activities. And parents were more confident in assisting their children with reading than mathematics. The difference in confidence is particularly interesting given the nature of the sample, which was mainly highly educated.

### *2.2. Parents' Beliefs about Their Role in Children's Learning*

Most of the research on this topic has been based on preschool-age children. For example, Sonnenschein et al. (2016) [11] found that parents from low-income backgrounds emphasized the importance of preschool children engaging in reading and mathematics activities and the need for parental assistance. However, parents emphasized reading more highly. As reviewed in Elliott et al. (2021) [10], some studies have found positive associations between parents' ratings of importance and children's engagement in reading and mathematics activities [33], whereas others have not found such associations between parents' ratings of importance and children's academic skills [44].

The present study expands consideration of parents' beliefs and attitudes to focus on older children with the four focal academic subjects, mathematics, reading, written language, and science. We consider emotionally valanced beliefs by documenting parents' ratings for how much they and their children enjoy engaging in these four academic domains. We also consider cognitive beliefs by asking parents to rate how good they and their children are at the four academic domains.

There is a growing body of research that has explored parents' anxiety when engaging in mathematics interactions (e.g., [45]). Anxiety displayed by parents during interactions with their children interferes with children's learning. Another way of considering the topic is by considering how confident parents feel to teach their children various content. This is not a heavily researched topic. In fact, we are aware of only three studies which we reviewed in a prior section. For example, Sonnenschein et al. (2021) [24] found that educated and affluent parents of preschoolers reported being more confident to assist their preschool children with reading than mathematics.

#### Who Initiates Activities at Home

There is little research on this topic. We know that parents are dissatisfied with information that teachers of preschoolers send home [24]. And children start getting homework from teachers as they enter and proceed through elementary school. Accordingly, we expect that parents will report that teachers are more likely to initiate the activities that children do at home as they get older.

### 2.3. The Present Study

Despite there being a large and growing body of research on children's home learning environments, as reviewed above, there are still some significant limitations to our knowledge. Most of the research has focused on reading or mathematics activities or both but has not considered how written language and science are socialized at home. However, written language and science are important components of schooling, especially as children get older. Therefore, we need to understand how these four subjects, not just one or two, are socialized at home. Considering just reading or just reading and mathematics may give an incorrect picture.

Most of the research uses preschool children with little attention devoted to children in elementary school. However, it is important to understand the home learning environment as children go through elementary school. Are there differences in how much time is devoted to mathematics, reading, written language, and science? What are parents' beliefs about the importance of each and their confidence in assisting their children with each? Although it may be reasonable to assume that activities during the preschool years are initiated by the family, little research has been conducted on this topic (cf., [24]). And, who initiates activities may well vary by academic domain or by children's grade (as homework demands initiated by teachers may play a larger role as children get older).

This study addressed five questions. One, how much time do children spend on mathematics, reading, written language, and science at home? Does the amount of time spent differ by subject or grade of child or both? Most of the research that quantifies children's engagement in activities considers the number of days per week but not the number of minutes per day (cf., [24]). It is important to get a more nuanced metric. Consistent with prior research, we expect that children will spend more time engaged in reading than mathematics activities or the other two subjects. Two, how important do parents think it is that children engage in home learning activities in each of the four subjects and assist their children with these activities? Does it vary by subject and/or by children's grade? Prior research suggests that parents will rate highly the importance of these activities [11]. Three, how confident are parents to support their children's learning in these four academic subjects and does it differ by subject or children's grade? Again, consistent with research with parents of preschoolers, we expect that parents will be more confident in supporting their children's reading activities. Four, how do parents rate their and their children's enjoyment of engagement in these activities and their aptitude for them. Does it differ by subject or grade? Five, who (parents, child, or teacher) prompts engagement in home learning activities in each subject and does it differ with grade? Although we are unaware of other research on this topic, we expect that teachers will increasingly initiate activities as children get older.

## 3. Method

### 3.1. Participants

This study was approved by the Institutional Review Board at the researchers' academic institution (Protocol Number: Y18SS20008). After receiving IRB approval, parents were recruited mainly through social media sites that target parents of school-age children. Unfortunately, respondents to online surveys are often primarily White, well educated, and affluent (e.g., [24]). To increase the diversity of our sample, we also recruited in two local public schools in the middle Atlantic region whose students came from more diverse, less affluent backgrounds. We put an ad in the school newspapers with the link to our Qualtrics survey. We also dropped off paper-and-pencil questionnaires at these two schools. No paper-and-pencil surveys were returned. Given the anonymity of the Qualtrics survey, we cannot determine how many parents whose children attended the two target schools completed the survey.

Participants included 177 parents (160 mothers, 10 fathers, 7 other) between the ages of 24 and 59 ($M$ = 39.0, $SD$ = 6.07, see Table 1) of children in first through sixth grade. These parents were participating in a larger study on parents' beliefs about their children's

education and their use of digital technology. We include in this paper only information pertinent to parents' beliefs about educational issues. Also, the number of respondents per question varied somewhat as parents did not always respond to each question.

**Table 1.** Demographic Information ($n$ = 177).

| Variable | *M(SD)* or % |
|---|---|
| Age (years) | 39.0 (6.07) |
| Relationship to child (%) | |
| Mother | 90.4 |
| Father | 5.6 |
| Other | 3.4 |
| Race/Ethnicity (%) | |
| American Indian or Alaskan Native | 0.6 |
| Asian | 4.0 |
| African American | 6.8 |
| Latino/a | 4.0 |
| White | 82.5 |
| Other | 2.4 |
| Highest Educational Degree (%) | |
| HS/GED | 3.4 |
| Some college | 11.9 |
| Associate degree | 7.3 |
| Bachelor's | 24.3 |
| Post-graduate | 53.1 |
| Household Income (%) | |
| Under $25,000 | 5.1 |
| $25,000–$49,000 | 7.9 |
| $50,000–$74,999 | 11.3 |
| $75,000–$99,999 | 13.6 |
| $100,000–$124,999 | 20.3 |
| $125,000–more | 40.7 |
| Child's age (years) | 8.32 (1.61) |
| Child's gender (female-%) | 43 |
| Child's grade (%) | |
| First/second | 36.2 |
| Third/fourth | 40.1 |
| Fifth/sixth | 23.8 |

Most of the respondents (83%) identified as White and had at least a bachelor's degree (78%). In addition, 61% of parents reported having household incomes of $100,000 or higher. Respondents resided in 22 states across the United States, with the majority residing in one of the middle Atlantic States (e.g., Maryland, Pennsylvania). Parents reported having one to six children in their family ($M$ = 1.70, $SD$ = 0.95). For those parents who had more than one eligible child, they responded to the survey questions based on the oldest eligible child's characteristics.

We categorized focal children into three grade levels: first/second grade (37%, $M_{age}$ = 6.63, $SD_{age}$ = 0.62), third/fourth grade (40%, $M_{age}$ = 8.64, $SD_{age}$ = 0.69), and fifth/sixth grade (23%, $M_{age}$ = 10.49, $SD_{age}$ = 0.63).

### 3.2. Measure

Parents reported what types of reading, mathematics, science, and written language activities children engaged in at home using a survey created by the first author. The Qualtrics online survey consisted of 35 multiple choice and open-ended questions along with questions about the participant's demographic characteristics. A preliminary version of the survey was piloted with 6 parents whose children were the age of the intended focal children. The final version of the measure was based on minor revisions stemming from the pilot information.

"How confident are you that you know what to do to support your child's learning in the following areas?" is an example of a question where participants were asked to select the response options that apply for each subject—mathematics, reading, science, and written language. Responses that parents could select included not confident, slightly confident, moderately confident, confident, and very confident.

As shown in Table 2, the survey contained questions in keeping with the overarching research questions described in the introduction to this paper. The constructs tapped in the survey were: (1) the amount of time spent in each subject per week (in minutes), (2) parents' perceptions of how important it is to do the various academic learning activities at home and how important it is to help their children with these activities, (3) parents' ratings of their confidence in assisting their children, (4) parents' perceptions of themselves and their children's enjoyment of each subject and their skills, (5) parents' reports of who initiates learning on these subjects at home. Each of the questions, other than question 1, contained a 5-point rating scale appropriate to the specific question. For example, if parents were asked to rate their confidence in a subject, the rating scale was: not confident, slightly confident, moderately confident, confident, and very confident. Question 1 contained a seven point scale. Parents were asked the same series of questions about each of the four subjects, mathematics, reading, written language, and science.

**Table 2.** Sample survey items.

| Sample Question | Response Type |
| --- | --- |
| How many days per week does your child do the following activities? When they engage in these activities, how many minutes do they engage in the activity? | 7-point rating scale<br>Fill in the blank |
| How important do you think it is for your child to do the following activities? | 5-point rating scale |
| How important do you think it is for you to help your child with the following activities at home? | 5-point rating scale |
| How enjoyable do you find the following activities? | 5-point rating scale |
| How good do you think you are at each of the following? | 5-point rating scale |
| How enjoyable do you think your child finds the following activities? | 5-point rating scale |
| How confident are you in your ability to support your child's learning in the following activities? | 5-point rating scale |
| How good do you think your child is at each following activity? | 5-point Likert scale |

Note: Each question was answered separately for mathematics, reading, written language, and science separately. Neither demographic questions nor ones about how initiated home-based activities are included in this table. Demographic questions are not included in the table.

Parents were also asked open-ended questions about what activities children did for each of the four subjects. One example of an open-ended question is "Please describe the typical mathematics activities your child do at home". Parents were instructed to answer the same question for reading, science, and written language as well.

Additional survey questions included demographic inquiries such as age, gender, income, race/ethnicity, education, and location.

### *3.3. Procedure*

After screening for eligibility (must be a parent of a child in 1st through 6th grade as of August 2017), participants were asked to complete an anonymous online Qualtrics survey. Parents were informed that opening the survey implied their consent to partake in this study, as also instructed on the first page of the survey. Upon completion of the survey, parents were given to the option to be entered into a raffle for one of five $20 Amazon gift cards.

## 4. Results

Prior research shows differences regarding children's ethnicity, income, and gender in their engagement with academically related activities [11]. Therefore, we initially included income, ethnicity, and child gender as covariates. However, because there were no

significant associations found in analyses which included these covariates ($p > 0.10$), for parsimony, we did not include them further in this paper.

In what follows, we present data addressing each of the five overarching research questions. We first present descriptive information followed by inferential statistics, usually analyses of variance (ANOVA). Unless noted differently, we conducted mixed 4 (subject) × 3 (grade level: first/second grade, third/fourth grade, fifth/sixth grade) ANOVAs with appropriate follow-up tests (Bonferroni for domain-wise comparisons and Tukey's b for the grade-level comparisons).

**RQ1. How Much Time Do Children Spend on Mathematics, Reading, Written Language, and Science at Home? Does The Amount of Time Spent Differ by Subject or Grade of Child or Both?**

Consistent with our expectations and as shown in Table 3, parents reported that their children spent more time at home each week engaged in reading followed by mathematics, writing, and science activities. The overall subject effect was significant, $F(3, 178) = 78.53$, $p < 0.001$, $\eta p^2 = 306$. More specifically, the amount of time spent doing each activity at home differed significantly from each of the others ($p <$ than at least 0.039). Neither the main effect for grade level ($p = 0.405$) nor the interaction between grade level and subject was statistically significant ($p = 0.489$).

**Table 3.** Means and standard deviation for parents' ratings on each research questions.

| Research Questions | *M* | *SD* |
|---|---|---|
| **1. Time Spent at Home (Mins per Week)** | | |
| *Subjects* | | |
| Mathematics | 122.07 | 147.27 |
| Reading | 275.77 | 265.16 |
| Science | 74.96 | 87.88 |
| Written Language | 97.30 | 89.11 |
| *Grade Level* | | |
| First/Second | 144.23 | 13.94 |
| Third/Fourth | 131.54 | 13.56 |
| Fifth/Sixth | 161.44 | 17.82 |
| **2A. Importance of Doing at Home (Out of 5)** | | |
| *Subjects* | | |
| Mathematics | 4.38 | 0.85 |
| Reading | 4.78 | 0.52 |
| Science | 4.18 | 0.99 |
| Written Language | 4.41 | 0.78 |
| *Grade Level* | | |
| First/Second | 4.48 | 0.08 |
| Third/Fourth | 4.53 | 0.07 |
| Fifth/Sixth | 4.20 | 0.10 |
| **2B. Importance of Helping (Out of 5)** | | |
| *Subjects* | | |
| Mathematics | 4.16 | 1.11 |
| Reading | 4.12 | 1.13 |
| Science | 3.91 | 1.17 |

**Table 3.** *Cont.*

| Research Questions | *M* | *SD* |
|---|---|---|
| Written Language | 4.24 | 1.00 |
| *Grade Level* | | |
| First/Second | 4.43 | 0.12 |
| Third/Fourth | 4.14 | 0.11 |
| Fifth/Sixth | 3.53 | 0.15 |
| **3. Parents' Confidence (Out of 5)** | | |
| *Subjects* | | |
| Mathematics | 3.86 | 1.23 |
| Reading | 4.50 | 0.85 |
| Science | 3.91 | 1.16 |
| Written Language | 4.34 | 0.94 |
| *Grade Level* | | |
| First/Second | 4.14 | 0.11 |
| Third/Fourth | 4.21 | 0.10 |
| Fifth/Sixth | 4.06 | 0.13 |
| **4A. Parents' Enjoyment (Out of 5)** | | |
| *Subjects* | | |
| Mathematics | 2.91 | 1.25 |
| Reading | 4.31 | 0.92 |
| Science | 3.62 | 1.04 |
| Written Language | 3.49 | 1.05 |
| *Grade Level* | | |
| First/Second | 3.47 | 0.08 |
| Third/Fourth | 3.70 | 0.08 |
| Fifth/Sixth | 3.55 | 0.10 |
| **4B. Parents' Abilities (Out of 5)** | | |
| *Subjects* | | |
| Mathematics | 3.73 | 0.97 |
| Reading | 4.59 | 0.64 |
| Science | 3.90 | 0.86 |
| Written Language | 4.27 | 0.82 |
| *Grade Level* | | |
| First/Second | 3.96 | 0.06 |
| Third/Fourth | 4.27 | 0.06 |
| Fifth/Sixth | 4.13 | 0.08 |
| **4C. Child's Enjoyment (Out of 5)** | | |
| *Subjects* | | |
| Mathematics | 3.45 | 1.17 |
| Reading | 3.85 | 1.17 |
| Science | 4.09 | 0.89 |
| Written Language | 3.14 | 1.21 |

**Table 3.** *Cont.*

| Research Questions | *M* | *SD* |
|---|---|---|
| *Grade Level* | | |
| First/Second | 3.61 | 0.09 |
| Third/Fourth | 3.66 | 0.09 |
| Fifth/Sixth | 3.61 | 0.12 |
| **4D. Child's Abilities (Out of 5)** | | |
| *Subjects* | | |
| Mathematics | 4.21 | 0.91 |
| Reading | 4.30 | 0.89 |
| Science | 4.24 | 0.69 |
| Written Language | 3.80 | 1.00 |
| *Grade Level* | | |
| First/Second | 4.03 | 0.08 |
| Third/Fourth | 4.23 | 0.08 |
| Fifth/Sixth | 4.15 | 0.10 |

We also asked parents what kinds of mathematics, reading, written language and science activities their children engaged in at home. We made a listing of all activities for each subject. These were then reliably categorized by two raters. In general, parents reported that their children engaged in a wide variety of activities. The most common activities engaged in for mathematics were doing homework, practicing skill development (flashcards and worksheets) and playing online games (video and computer games). They also engaged in daily living activities such as cooking. The most common activities engaged in for reading were reading for pleasure and doing homework. Children reportedly read a wide range of genres (e.g., novels/chapter books, non-fiction, graphic novels, comic books, and magazines). They read e-books, audiobooks and printed matter). For science, children most frequently did experiments and exploratory activities (trying to figure out how things worked). For written language, the most common activities children engaged in were academic activities (doing homework, practicing writing letters and words), free/creative writing (writing poems, plays, and stories), and writing cards/letters.

**RQ2. How Important do Parents Think That Children Engage in Home Learning Activities in Each of the Four Subjects and Assist Their Children with These Activities? Does It Vary by Subject and/or by Children's Grade?**

We asked parents two questions about importance of the four subjects. One, how important do parents think it is for their child to do reading, mathematics, written language, and science activities at home? The means (SDs) are reported in Table 3. Consistent with prior research on the importance of children doing reading and mathematics activities at home [4], the majority of parents thought that engaging in reading, mathematics, written language, and science at home was important to very important (reading 79% of parents, mathematics 73%, written language, 72%, science 63%). Nevertheless, there was a significant main effect for subject [$F(2, 180) = 33.98$, $p < 0.001$, $\eta p^2 = 0.159$]. Engaging in reading was viewed as significantly more important than engaging in mathematics, science, or written language activities ($p < 0.001$, respectively). None of the other comparisons differed significantly ($p > 0.10$).

There also was a main effect of grade level, $F(2, 180) = 4.01$, $p = 0.020$, $\eta p^2 = 0.043$. Parents of children in fifth/sixth grades were less likely to view their children's home learning as important than parents of children in third/fourth grade ($p = 0.018$, see Table 3).

None of the other contrasts were statistically significant ($p$ > than at least 0.10). The interaction between grade level and subject was not significant ($p$ = 0.267).

Two, we asked parents how important it was for them to assist their children with reading, mathematics, science, and written language activities at home. There was a main effect for subject, $F(3167) = 8.63$, $p < 0.001$, $\eta p^2 = 0.049$. As shown in Table 3, assisting with written language or mathematics was rated as significantly more important than assisting with science ($p < 0.001$, respectively), but not significantly more important than reading ($p = 0.114$). None of the other differences were statistically significant ($p > 0.10$).

There also was a main effect for grade level, $F(2, 167) = 11.35$, $p < 0.001$, $\eta p^2 = 0.120$. As shown in Table 3, parents believed it is significantly more important to help children in first/second grade and third/fourth grade than in fifth/sixth grade ($p < 0.001$, 0.004, respectively). The interaction between subject and grade level was not significant, ($p = 0.132$).

**RQ3. How Confident Are Parents to Support Their Children's Learning in These Four Academic Subjects and Does It Differ by Subject or Children's Grade?**

Sixty-two percent of the participating parents reported they were confident/very confident in supporting their children's reading activities. Slightly more than half of the parents (59%) parents reported being confident to very confident to help their children with written language activities. Similarly, 56% reported feeling confident/to very confident to support their children's mathematics activities, and 56% of parents reported feeling confident in assisting their children's science activities. There was a main effect for subject, $F$ (3, 166) = 35.84, $p < 0.001$, $\eta p^2 = 0.178$. Parents were significantly more confident in assisting their children's reading than written language ($p = 0.01$), mathematics ($p < 0.001$), or science ($p < 0.001$) at home. In contrast, parents were less confident to assist their children with science learning at home than with reading ($p < 0.001$) or writing ($p < 0.001$). However, there were no significant differences between parents' confidence level in supporting science and mathematics activities at home ($p = 0.35$).

Although there was no significant main effect for grade level ($p = 0.68$), the interaction between grade level and parents' confidence in assisting their children's learning at home was significant, $F$ (6, 166) = 4.07, $p < 0.001$, $\eta p^2 = 0.047$. Parents' confidence in helping with reading, written language, and science activities did not differ by grade level ($p$> 0.20); in contrast, parents' confidence in helping their children with mathematics did vary by their children's grade level. Parents were more confident to support mathematics home learning for their first/second graders ($M = 4.02$, $SD = 0.15$) or their third/fourth ($M = 4.01$, $SD = 0.14$) than their fifth/sixth graders ($M = 3.35$, $SD = 0.19$), ($p = 0.019$, 0.022, respectively).

**RQ4. How Do Parents Rate Their and Their Children's Enjoyment of Engaging in These Activities and Their Aptitude for Them? Does It Differ by Subject or Grade?**

*4.1. Parents' Reports of Their Enjoyment and Abilities in the Four Subjects*

Parents' ratings of their enjoyment of reading, mathematics, science, and written language are shown in Table 3. Parents rated reading as the subject they enjoyed the most followed by science, then written language, and then mathematics. There was a significant main effect for subject, $F(3, 186) = 59.417$, $p < 0.001$, $\eta p^2 = 0.246$. More specifically, parents enjoyed reading significantly more than mathematics ($p < 0.001$), science ($p < 0.001$), and written language ($p < 0.001$). Differences between written language and science and mathematics were not statistically significant ($p > 0.10$, respectively). Neither the main effect for grade level ($p = 0.107$) nor the interaction between grade level and parents' enjoyment was statistically significant ($p = 0.984$).

Parents also reported their perceptions of how good they were in each subject. They rated themselves as the best at reading activities followed by written language, then science, and then mathematics. There was a main effect of subject, $F(3, 185) = 50.85$, $p < 0.001$, $\eta p^2 = 0.216$. Parents' perceptions of how good they were at each subject differed significantly ($p < 0.001$ across all pairwise comparisons), except for the mean differences between mathematics and science ($p = 0.086$).

There was a main effect of grade level, $F(2, 185) = 6.53$, $p = 0.002$, $\eta p^2 = 0.066$. Parents of third/fourth graders viewed themselves as significantly better than parents of first/second graders' in terms of their abilities in each subject ($p = 0.001$), but not significantly better than fifth/sixth graders' parents ($p = 0.343$). The interaction between grade level and parents' abilities was not significant ($p = 0.823$).

Zero-order correlations were calculated between parents' enjoyment of the four subjects and perceptions of how good they were at each subject. There were positive and significant moderate to strong associations among parents' enjoyments and skills for mathematics $r(187) = 0.726$, $p < 0.001$, reading $r(187) = 0.578$, $p < 0.001$, science $r(188) = 0.670$, $p < 0.001$, and written language $r(186) = 0.630$, $p < 0.001$.

### *4.2. Parents' Reports of Children's Enjoyment and Abilities in the Four Subjects*

We also asked parents to report their children's perceived enjoyment and abilities in each subject. Parents reported that their children enjoyed science activities the most followed by reading, mathematics, and written language. There was a main effect of subject for children's enjoyment, $F(3, 182) = 34.54$, $p < 0.001$, $\eta p^2 = 0.160$. Parents reported that their children enjoyed science significantly more than reading ($p < 0.001$) and reading significantly more than mathematics ($p < 0.001$) and written language ($p = 0.001$). Differences between the enjoyment of written language and mathematics were not statistically significant ($p > 0.13$). Neither the main effect for grade level ($p = 0.887$) nor the interaction between grade level and subject was significant ($p = 0.222$).

Parents also rated how good they thought their children were at these four subjects. There was a main effect of subject, $F(3, 181) = 19.73$, $p < 0.001$, $\eta p^2 = 0.098$. Parents' ratings of children's abilities significantly differed only in terms of how good they were at written language. Parents viewed their children as not as good at written language as mathematics ($p < 0.001$), reading ($p < 0.001$), and science ($p < 0.001$). Differences in ratings between mathematics, reading, and science did not differ significantly among themselves ($p > 0.70$). Neither the main effect for grade level ($p = 0.194$) nor the interaction between grade level and subject was statistically significant, $p = 0.426$.

We also computed zero-order correlations for children's enjoyment and skills. The results revealed positive and significant moderate relations between children's enjoyment and skills for mathematics [$r(185) = 0.723$, $p < 0.001$], reading [$r(185) = 0.689$, $p < 0.001$], science [$r(185) = 0.606$, $p < 0.001$], and written language [$r(184) = 0.687$, $p < 0.001$].

**RQ5. What is the Proportion of Teacher, Student, And Parent Led Activities at Home for Each Subject? Does It Differ by Grade Level?**

We explored who prompts activities at home for each subject and whether it changed with children's grade level. Parents reported that mathematics activities ($M = 63.34$, $SD = 31.14$) were initiated by teachers more than written language ($M = 54.10$, $SD = 33.15$) and reading activities ($M = 40.52$, $SD = 29.65$), while science activities ($M = 33.63$, $SD = 38.05$) were initiated by teachers the least. There was a main effect for subject for teacher-initiated activities, $F(3, 155) = 51.737$, $p < 0.001$, $\eta p^2 = 0.250$. Teachers reportedly initiated mathematics activities more frequently than home-based activities in any of the other subjects ($p < 0.001$, respectively). As shown in Table 4 and at the beginning of this paragraph, all of the pairwise differences were statistically significant ($p < 0.001$ across all pairwise comparisons).

There was a main effect of grade level, $F(2, 155) = 14.249$, $p < 0.001$, $\eta p^2 = 0.155$, which revealed that teachers prompted home learning activities significantly more for fifth/sixth graders ($M = 62.31$, $SD = 3.92$) than third/fourth ($M = 50.19$, $SD = 3.11$) and first/second graders ($M = 35.54$, $SD = 3.25$), ($p = 0.05$, $p < 0.001$, respectively). The mean differences for teacher-led activities between first/second and third/fourth graders were also significant ($p = 0.004$).

**Table 4.** Ratings of Proportion of Times Person Initiates Activities.

| Person Who Initiates | Subject *M (SD)* | | | |
|---|---|---|---|---|
| | **Mathematics** | **Reading** | **Science** | **Written Language** |
| Teacher | 63.34 (31.14) | 40.52 (29.65) | 33.63 (38.01) | 54.10 (33.15) |
| Child | 20.13 (24.74) | 44.25 (32.54) | 43.80 (33.63) | 29.52 (30.63) |
| Parent | 20.97 (24.36) | 24.70 (26.62) | 24.46 (26.34) | 21.26 (25.45) |

Note: Respondent was asked for each subject what percentage of the time did the child's teacher, the child and the parent initiate home-based activities.

There was also a significant interaction between grade level and subject, $F(6, 155) = 3.609$, $p = 0.002$, $\eta p^2 = 0.044$. Overall, teacher-initiated activities significantly increased by children's grade level for mathematics ($M = 64.73$, $SD = 2.37$), science ($M = 36.15$, $SD = 2.85$), and written language ($M = 55.64$, $SD = 2.54$) activities ($p <$ than at least 0.015). However, teacher led reading activities did not significantly differ by children's grade level ($p >$ than at least 0.217).

Parents reported that their children prompted science learning ($M = 43.80$, $SD = 33.63$) and reading ($M = 44.25$, $SD = 32.54$) the most and prompted less written language activities ($M = 29.52$, $SD = 30.63$) followed by mathematics activities ($M = 20.13$, $SD = 24.74$) at home. There was a main effect of subject, $F(3155) = 32.503$, $p < 0.001$, $\eta p^2 = 0.173$. Differences between the various activities were all statistically significant ($p <$ than at least 0.002), except for the mean differences between reading and science, ($p = 0.76$).

The overall grade-level effect was also significant, $F(2, 155) = 5.864$, $p = 0.004$, $\eta p^2 = 0.070$. Parents of first/second graders ($M = 41.86$, $SD = 2.73$) reported a significantly higher number of child-led activities than third/fourth ($M = 30.73$, $SD = 2.61$) and fifth/sixth ($M = 29.43$, $SD = 3.29$) graders, ($p = 0.011$, 0.013, respectively). The interaction between subject and grade level was not significant, ($p = 0.255$).

Finally, parents reported how parents themselves initiated home learning activities with their children. As illustrated in Table 4, there was no significant effect for subject, $F(3, 155) = 1.573$, $p = 0.195$, $\eta p^2 = 0.010$. However, there was a main effect of grade level, $F(2, 155) = 11.415$, $p < 0.001$, $\eta p^2 = 0.128$. Parents of children in first/second ($M = 29.59$, $SD = 2.35$) and third/fourth ($M = 23.46$, $SD = 2.25$) grades initiated significantly more activities than parents of children in fifth/sixth grades ($M = 12.02$, $SD = 2.84$; $p = 0.01$). There were no significant differences between first/second and third/fourth graders' initiation of activities. ($p = 0.184$). The interaction between subject and grade level was not significant, ($p = 0.503$).

## 5. Discussion

This study significantly expanded our knowledge of elementary school-age children's home learning environments by considering their home-based engagement in mathematics, reading, science, and writing activities, four important school subjects. Other research has typically considered children's engagement in reading and/or mathematics activities and focused on preschool children not elementary school-age children (e.g., [11]. Considering each subject in isolation or with only one other may give a misleading picture of the home learning environment. We also increased the precision of measuring frequency by not only considering how many days a week but also how many minutes each time children engage in an activity. Aspects of parents' beliefs and attitudes about children engaging in these subjects [e.g., how important parents consider it to be, how confident they felt to assist, and how good they thought they were) were also considered. And, the focal children were elementary school-age children, an older cohort than is typically examined in research (e.g., [24]). Although there is extensive research on children's engagement in reading and, to a degree, mathematics activities at home (e.g., [3,44]), we know far less about written language and science activities. Moreover, we know fairly little about

how parents' beliefs about their role or capabilities, or their attitudes (e.g., confidence, enjoyment) vary across subjects.

We begin this section by briefly answering our five overarching research questions. We then present some important themes that come from combining aspects of the findings across the five research questions. As our results show, in order to understand children's home learning environments, it is necessary to consider their frequency of engagement in activities as well as parents' various beliefs about what is important, how children learn and parents' role in their children's learning as well as the interface between the home and school [11,13,18,20].

**Research Question 1: How Much Time are Children Spending Engaged in Activities in the Four Subjects?**

The elementary school-age children in our study were clearly spending time at home engaged in reading, mathematics, science, and written language activities. However, they by far reportedly spend the most time doing reading activities. They also engaged in different genres of reading activities. The relative frequency of reading engagement is consistent with what others have reported with preschool children (e.g., [24]) and was what we expected. It begs the questions of why they are spending so much more time reading? We believe the answer needs to include other aspects of parents' academic socialization (e.g., parents' confidence to support learning in a subject) and will be discussed in a subsequent section.

**Research Question 2: How Important Do Parents Think It Is for Their Children to Engage in These Activities at Home?**

Research with preschoolers has found that parents highly rate the importance of their children doing reading and mathematics activities at home and the need for parental assistance [11,24,33]. Our results show that parents with older children also believe that engagement in academically related activities is important and that they should assist with such engagement. Our study extended prior findings to include elementary school-age children and four subjects not the typical two (reading and mathematics). As with other research (e.g., [33]), parents emphasized reading more highly than other subjects. We also found that parents' ratings differed by their children's grade. Parents of younger children rated their involvement in their children's home activities as more important than did parents of older children. This may reflect that parents think as children get older, they do more of this work in school and are able to complete schoolwork independently [34].

**Research Question 3: How Confident Do Parents Feel to Assist Their Children?**

A person's confidence to assist others with academic tasks is an understudied topic. The few studies conducted used parents of preschoolers (e.g., [22–24]). In the present study, confidence levels varied across those three studies but generally parents were more confident assisting with reading and written language than mathematics or science. This was true across grade levels. We find this interesting because the parents, as in other research, were highly educated. We turn in a later section to how confidence levels may play a role in what activities children engage in at home.

**Research Question 4: How Much Do Parents (Children) Enjoy and Excel at These Subjects?**

How much people enjoy academically related activities and how good they believe they are at such activities are interesting topics because they may be related. We found strong associations between how much parents said they enjoyed each subject and how skilled at the subject they believed they were. Parents rated themselves as significantly better at reading than the other subjects. Their lowest ratings were in mathematics and science. A similar but not identical pattern occurred with how parents rated enjoyment. They rated reading the highest and mathematics the lowest. Such feelings about one's skills and how much one enjoys an activity also may be related to what activities children engage in at home.

Parents also rated their children's skills and enjoyment across the four subjects. Again, how much children reportedly enjoyed a subject was moderately related to their skills in that subject. Mathematics was not a highly enjoyed activity. Interestingly, however, unlike with how parents rated their enjoyment of science, they rated their children as enjoying science more than the other subjects.

**Research Question 5: Who Initiates Engagement in Activities in the Four Subjects**

There were two findings of note. One, as predicted, teachers initiated more activities for children to do at home as children got older. And older children initiated fewer activities than younger children. Two, teachers were more likely to initiate mathematics activities for children to do at home than activities in other subjects. And, interestingly, children were more likely to initiate reading and science activities than other activities.

We turn next to themes that combine information from several of the research questions.

**Theme 1: Mathematics is Under-Emphasized at Home**

Children spent less time engaged in mathematics activities per week than reading. They spent, on average, two hours a week engaged in mathematics at home which may not be sufficient for them to acquire the necessary skills. How one acquires skills goes beyond exposure to relevant activities; the beliefs parents have about children's learning and their own aptitude or perceived aptitude also matter [18,20]. Consistent with what others have found [11], although parents viewed it as important for their children to do mathematics-related activities at home, these were not viewed as important as reading. Furthermore, parents rated themselves as less confident to assist their children with mathematics than with other subjects and they believed they were less skilled in mathematics than in other subjects. This picture of parents' beliefs about their own mathematics skills and their confidence to assist their children in such activities coupled with parents' ratings of their children as not particularly enjoying mathematics may explain why children less frequently engage in mathematics activities at home. Other research has shown a positive relation between frequency of engagement in activities and children's development of mathematics skills [3,11].

**Theme 2: Who Initiates Engagement in Mathematics, Reading, Science, and Writing Activities at Home and Why?**

Children initiate activities that they think are interesting. Parents initiate activities with children for several reasons: they think their children will like the activity, they themselves like these activities, they think the activity is important for skill development. Teachers also prompt or initiate activities typically as homework assignments as part of the school curriculum or suggestions to parents as ways to develop children's skills.

Teachers increasingly initiated activities, particularly mathematics, as the children got older. Children displayed the opposite pattern. In thinking about skills for children to develop, can educators and parents take advantage of children's interests and suggest activities in keeping with those interests? For example, children reportedly liked to do science activities at home. Science skill development is an important part of STEM competencies; therefore, we should encourage children's skill development in that subject. However, parents did not rate the importance of assisting their children with science at home as high. In fact, it was the lowest rated of the four topics. Similarly, they rated their skills, confidence, and enjoyment of science as relatively low. Therefore, it is not surprising that science activities were the least frequently occurring of the four.

If parents are not going to encourage children to do science activities at home, can teachers play a more active role in encouraging children to engage in science tasks at home? And if so, can they provide more assistance to parents so that parents feel more comfortable engaging in science activities with their children?

*Limitations, Future Directions, and Conclusions*

This study had four limitations that need to be considered when interpreting the findings. One, the generalizability of our findings is limited because our sample was a highly educated, affluent, White sample [46–48]. Therefore, the findings may not necessarily apply to less educated parents or low-income families. For example, low-income families may have less time to assist their children at home or may believe they have less skill for doing so [20]. Unfortunately, as described in the Method section, our attempts to recruit a more diverse sample were not successful. Future research should seek to increase the diversity of the sample or focus more exclusively on groups not well represented in this study. In addition, the sample size in this study was relatively small ($n$ = 177). Therefore, this study should be considered exploratory and replicated with a larger, more diverse sample.

Two, our data are based on parents' (typically mothers') reports, not children's observed behaviors. Asking parents to report on children's engagement in activities is typical (e.g., [3,11]) and we have no reason to doubt the validity of these data. However, it is important to confirm the validity of the findings with actual observations.

Three, our inquiry of the home learning environment was limited to interactions with parents. Children often have siblings who may interact with them when engaging in mathematics, reading, written language, and science activities. Future research should consider the nature of such interactions and expand inquiry into the role that children play in initiating engagement in relevant activities. Four, our study was conducted prior to the outbreak of the COVID-19 pandemic during which parents of preschool and school-age children often engaged in distance learning with their children because of the suspension of in-school classes. It is possible that parents who spent significant time engaging in distance learning with their children might now feel more confident in their ability to assist their children. On the other hand, the limited research on this topic suggests that many parents reported struggling (e.g., [49]). Five, unfortunately, we could not assess children's actual reading, mathematics, written language, or science skills. However, other research shows relations between parents' beliefs, aspects of the home environment and the development of children's academic skills (e.g., [3,11,33]).

In conclusion, while the importance of the home learning environment is widely accepted and children naturally gain an understanding in core subjects as they develop, more attention is needed to leverage the two. Researchers and practitioners alike need to focus on supporting families of school-age children in socializing academic skills. Parents will need support from teachers, especially if their confidence and interest in a subject is low. We know from this exploratory study that parents often report low levels of confidence and interest, particularly in mathematics, which may keep them from engaging in mathematical activities with their children, especially as the difficulty of the content increases. As we continue to make progress in the field, we need to ensure we are considering children's full learning environments which include both the home and the school.

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