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# Relations between the Home Learning Environment and the Literacy and Mathematics Skills of Eight-Year-Old Canadian Children

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**Abstract:** The home learning environment includes parental activities, attitudes, affect, knowledge, and resources devoted to supporting children's development, including literacy and mathematics skills. These factors are related to the academic performance of preschool children (aged 3 to 6 years), before formal schooling and possibly beyond. In the present research, we examined the home learning environment of Canadian families as reported by either the mother ($n$ = 51) or father ($n$ = 30) of their Grade 3 child ($n$ = 81; $M_{age}$ = 8.7 years; range 8 to 9 years of age). Importantly, mothers' and fathers' reports of the home learning environment for school children were similar. For literacy, parents' knowledge of children's books and attitudes toward literacy were related to children's vocabulary skills; home literacy was not related to word reading skills. For mathematics, parents' reports of the frequency of activities such as practicing arithmetic facts and their attitudes toward mathematics were related to children's arithmetic fluency. Other aspects of the home learning environment (time spent helping with homework, parents' math anxiety) were not related to children's performance. These results suggest some continuity between home learning environments and academic skills after children's transition to school.

**Keywords:** home literacy; home numeracy; early academic skills; grade 3 children; parental involvement; home mathematics environment; home activities

## 1. Introduction

Literacy and mathematics are foundational life skills. International assessments of large cross-national cohorts have shown that poor skills development affects subsequent educational choices and career options [1]. Low cognitive skills and educational attainment has been associated with poor physical and mental health [2,3]. Inequities begin early: Substantial achievement gaps are observed even before children start school. School exposure has been found to reduce variability in academic skills in some research, presumably because all children can access the same relevant curricular content once they are in school full time [4,5]. However, more often, children's literacy and mathematics skills at school entry predict academic achievement and educational attainment both in the short-term [6] and beyond [7–10].

The home learning environment is one potential source of variability in early academic skills. Indeed, the frequency with which preschool children are exposed to numeracy and literacy activities at home is correlated with their success in literacy [11] and numeracy [12]. In the present study, we asked whether similar relations between home learning activities and academic performance are found for a school-age group of 8-year-old children.

There are many potential sources of variability affecting the acquisition of early literacy and mathematics skills. Children's early literacy and mathematical skills are correlated with socioeconomic factors, such as parental education [13], child health variables [14], and family income [15–18]. Even among middle-class samples and when socio-economic factors are controlled, there is variability in the development of early academic skills [19,20] that continues once children are in school. Skills development is related to cross-national differences in age and curricular starting points [21], speed of curricular exposure [22], variability in curriculum expectations at certain ages [23], amount of spiralling curriculum overlap [24], and the amount of time outside of school spent on curricular concepts [24]. These variations in the learning context may have direct (e.g., regional age of school start) and indirect effects (e.g., curriculum exposure rate) on home influences. In the present study, we focused on factors within the home learning environment that are directly influenced by parents [21,24].

### *1.1. The Home Learning Environment*

The home learning environment encompasses a wide range of factors that relate to children's literacy and mathematics skills [25]. Parents and other caregivers contribute to the home learning environment through their personal attitudes, affective responses, activity choices, and resources available to support learning [16]. Some researchers have emphasized that the processes for learning literacy and numeracy are interrelated, and parents are especially likely to become involved in supportive learning activities when their children's skills are slow to develop and require additional support [26].

Home activities and intentions that focus on skills within the children's zone of proximal development [27] may help children expand their conceptual knowledge [28]. For example, listening to storybooks helps children acquire meaning and learn new vocabulary words (e.g., [29]) and activities focused on phonemic awareness support the decoding skills that are requisite for reading (e.g., [30,31]). Considering mathematics development, playing games that involve naming numbers and counting objects supported children's knowledge of the symbolic cardinal number system (e.g., [17]), whereas tasks that encouraged playfulness of routinized life skills supported children's applied number skills (e.g., [32]. Although self-report survey data is a common method of data collection for these studies [33], observational approaches [34,35], in-home interviews [36], and data from large-scale international assessments [37] have also been used to corroborate findings.

Parental involvement, that is, the extent to which caregiving adults (usually parents) provide mentorship opportunities and become involved in children's learning, is linked to children's academic performance. Hoover-Dempsey and Sandler [38] define home-based parent involvement as a deliberate process of deciding whether to be involved, and how to be involved, considering parents' motivational goals (e.g., supporting children's school success). Parental involvement in early childhood education contexts is usually desirable; for example, parent collaboration [39], joint book reading, discussions about school topics and family heritage [40], and parent responsiveness and sensitivity [41] are all positively related to children's learning outcomes. For Chinese-American students, Huntsinger et al. [36] found that high mathematics achievement was related to routine, structure, and formal directive teaching provided at home. In New Zealand, McDowall, Taumoepeau, and Schaughency [42] found that the long-term consistency of parental involvement was dependent on having two or more adults in the home, and parental perceptions of their time and energy available to support their first and second grade student. During joint parent-child activities, children's learning was negatively affected when mothers were high in directiveness [43], control [44,45], or controlling supportiveness [46]. Various parent characteristics

such as education level, arithmetic fluency, positive affect toward mathematics, and availability and/or children's interest in math or literacy activities are positively correlated with young children's mathematics scores [11]. Parental involvement with school aged populations can be operationalized in various ways, including parent communication, home supervision, homework help, emotional support, parent expectations, and affect. These factors may continue to be linked to children's success during the formative school years [47].

Despite considerable evidence that the home learning environment is linked to academic success for preschool children across cultures [48,49], there is less evidence about whether parents' involvement in specific home learning activities are related to learning trajectories once children are enrolled in school full time [11,25]. Children may spend less time with parents once they are older, given they spend more time in school involved in extracurricular activities [50] and completing homework [51]. Furthermore, parent involvement with school aged children may change because of other pressures, such as parents assuming outside employment to contribute to the family's financial resources, providing support to extended family [52], or supporting children's increased autonomy now that they are in school [53]. Thus, in the present study, we focused on two questions. First, how can the home learning environment be described for eight-year-old Canadian children? Second, is involvement in home activities related to children's academic outcomes in a school-aged sample?

### *1.2. Home Learning Environments of School Aged Children*

For primary/early school-aged children (i.e., aged 6 to 9 years), researchers have found positive relations between home learning influences and children's achievement scores for literacy [54–59], mathematics (e.g., [28,37]), and literacy and mathematics achievement combined (e.g., [60,61]).

#### 1.2.1. Home Literacy Environment

For home literacy experiences, in a meta-analysis involving 59 studies published between 1998 and 2018 and including children in Kindergarten through Grade 6, the average effect size was 0.30 for the correlation between children's home learning and their reading comprehension scores [55]. Parental literacy involvement and their literacy expectations had higher correlations with children's scores than with the availability of literacy resources (i.e., literacy equipment such as TV, radio, storybooks, or audiobooks). The relation was not moderated by grade.

In contrast, some research does suggest that the role of the home literacy environment declines with age. In the Netherlands, Boerma et al. [54] found that the frequency of home literacy activities decreased from Grade 3 to Grade 6 (range 6.9 to 13.4 years) and urged stakeholders to be aware of the continuing effectiveness of the home literacy environment for this critical age group. Klauda's [57] literature review on how to maintain the already-established reading habits of school aged students (Grade 3 to Grade 12) indicated that parental beliefs and behavior (e.g., modeling literacy activities) were positively related to children's reading development. In Dong and Chow's [56] meta-analysis of factors influencing the learning of an additional language across all school grades, parent behaviors were a stronger influence than parent beliefs on language learning. Finally, Myrberg and Rosén [58] concluded that the cultural capital affecting the home literacy environment is directly and moderately influenced by parent education in their Swedish study involving Grade 3 students (aged 9 to 10 years), but more than half of the effect is mediated by other home literacy influences (i.e., number of books in the home, the frequency and quality of home literacy activities, and the child's emergent literacy skills at school onset).

In summary, home literacy activities may be less prevalent among school aged children than for preschoolers, but the positive relations between the home environment and literacy development persist.

#### 1.2.2. Home Mathematics Environment

A meta-analysis of the relation between home mathematics environment and mathematical performance including 64 quantitative studies (completed between 1993 and 2020), found a small positive effect size of 0.13 for the relation between home mathematics learning and children's mathematical performance [11]. However, only a few studies included children in primary school; most were with preschool children (i.e., age 6 and younger). Although age did not moderate the relation between the home mathematics environment and performance, there are so few studies with older children that more work is needed to determine whether the same patterns hold for school-aged children.

Some studies indicate that home mathematics activities in preschool may continue to influence mathematical learning for elementary school students. Zhu and Chui [37] analysed assessment data from a large sample of 3600 Grade 4 Hong Kong students attending 132 different schools who completed the Trends in International Mathematics and Science Study (TIMSS). Questionnaire data requiring parents to retrospectively report their children's early home mathematics environment established a link between these early experiences and children's mathematics scores on the TIMSS.

Niklas and Schneider [61] included mathematics and reading assessments of German children before school started (age 4), in Grade 1, and again at the end of Grade 4. Children's early home learning environments predicted achievement scores and ratings of student school tracks after controlling for the children's former achievement and background factors, such as family income. In another German study [60], parent reports of the home learning and achievement data were collected each year starting at age 4 until age 13; the home learning environment was both retrospectively and concurrently predictive of children's mathematics and reading scores.

In a concurrent study of French children, Girard et al. [28] found that Grade 3 children's involvement in advanced home mathematics activities was related to parent expectations and predicted children's arithmetic skills even after other factors were controlled (i.e., SES, child IQ, parent arithmetic scores, time spent with child). In contrast, for Chilean children in Grades 1, 2, and 3 (ages 6 to 9), children's concurrent home mathematics environment did not predict their mathematics achievement scores [62]. Similarly, U.S. school-children's conceptions of mathematics utility in Grades 1–4 was not related to home experiences [63]. In summary, contextual factors (e.g., cultural expectations, cultural and social capital, language(s) spoken, schooling) and other study-specific factors, such as the size of available samples, may be important for understanding the relation between home experiences and skill development. Studies involving students from other cultural contexts such as English and French-speaking Canada are needed to explore these connections.

### *1.3. Mothers and Fathers*

Although both fathers and mothers are central influences in Bronfenbrenner's [64] socio-ecological theory of child development, they may contribute differently to the home learning environment. Although data about fathers' home learning contributions for academic skills are sparse [53,65–67], there is some evidence of benefits when fathers participate [68,69]. For example, in a US longitudinal database with data collection points from birth through Kindergarten, Baker et al. [70] found that fathers' and mothers' warmth as well as fathers' home learning involvement mediated the relation between poverty and kindergartener's reading skills. The authors also found that fathers' and mothers' warmth and mothers' involvement in home learning mediated the relation between poverty and kindergarteners' mathematics skills.

Researchers have described barriers to father participation, such as being unavailable to participate because of work hours or work schedules; holding gender role stereotypes that leave mothers in charge of educational duties; or holding views that masculinity may run contrary to the values of educational participation [71]. Mothers also typically take responsibility for communications between the home and the school [69,72] homework completion [73], speech-language therapy participation [74], and filling out research questionnaires [33]. Some

studies have included a small percentage of fathers and simply referred to the whole group of respondents as "parents" (e.g., [20,42,75]), or only solicited or included mothers (e.g., [76]). A few studies have solicited information from both parents [62,77]. Despite the low participation rates of fathers across studies, conclusions have often been extrapolated to include recommendations for homes and parents in general. Including fathers in home-learning research can help validate these extrapolated recommendations.

#### 1.3.1. Home Literacy Environments

In some home literacy studies that included both parents, mothers were more involved in literacy activities with their children than fathers. For example, Swain et al. [71] described data from the Millenium Cohort Study (MCS) in the UK, which started in 2001 and included assessments in 2004, 2006, 2008, and 2012. In the MCS, both parents reported reading to their children frequently, but mothers were more likely to read every day or a few times a week at ages 3, 5, and 7. In Klauda and Wigfield [78], American children in Grades 4 and 5 completed a reading support survey and reported that their mothers were more supportive in encouraging recreational reading than fathers. However, the ways in which fathers participate in home literacy activities may be different and possibly not captured if the focus is on literacy activities that are most common for mothers.

Saracho [66] published a list of recommendations to encourage fathers' participation perspectives and role modelling for supporting reading behavior. In one qualitative analysis of Hispanic and Latino fathers from the US, the fathers reported having reading discussions with their children and felt empowered to contribute to home educational responsibilities [79]. In a narrative review, Varghese and Wachen [67] reported that fathers showed responsive behaviors that contributed uniquely to children's language and literacy learning, but they concluded that more research is needed to understand the contextual factors related to father involvement.

#### 1.3.2. Home Mathematics Environments

Research on fathers' participation in home mathematics experiences is limited; most studies had mainly mothers in their research sample and only a few were focused on the influence of fathers. Some studies have shown mixed results of paternal influences across country, culture, language, education system, and child age. In Hong Kong, after accounting for mothers' home numeracy activities, fathers' involvement in numeracy activities with real-life applications predicted children's number knowledge for both three-year-olds [80] and five-year-olds [81]. In contrast, after accounting for fathers' home numeracy activities, mothers' involvement was unrelated to their child's number knowledge [80,81].

In two different studies conducted in Chile, no relations were found between fathers' home practices and children's mathematical competencies [62,77]. In these studies, mothers and fathers completed separate home learning questionnaires. Mothers and fathers who had high expectations for their Kindergarten children also reported low mathematics anxiety scores and engaged in more advanced numeracy related activities with their children [77]. However, only the home numeracy practices of mothers predicted the children's mathematics scores. In Susperreguy and colleagues [61], which was a cross-sectional study of Chilean children attending either public or private schools, mathematical performance of Kindergarten children was correlated with the frequency of operational activities (such as mental arithmetic) reported by their mothers but not by fathers. For children in Grades 1–3, however, mothers', but not fathers', mathematics fluency predicted children's mathematics scores but reported frequencies of home numeracy influences were not predictive of children's performance for either parent. In Chile, school quality is tied to socioeconomic status [82,83]; there are large gender differences in mathematical achievement [84], which may contribute to overall low national PISA scores [48]. Thus, these findings may not generalize to countries with higher levels of performance, less socioeconomic stratification of education, and smaller or non-existent gender disparities.

To encourage participation from both parents in a traditional family unit, researchers from Chile visited family homes to interview parents directly; participation was required from both parents [62,77]. Similarly, a researcher in Greece recruited parents by pursuing direct connections with them, such as holding impromptu meetings outside kindergartens as caregivers were waiting to pick up children [49]. These pro-active recruitment strategies resulted in greater participation by fathers. Therefore, in the current study, fathers and mothers were encouraged to participate through face-to-face contact during parent–teacher conferences at their children's school, with the goal of obtaining data from either a father or mother from each household.

### *1.4. Beliefs, Attitudes, and Affect*

Parents beliefs, attitudes, and affect about children's learning are related to their cultural background and personal histories [85]. These factors presumably shape their parenting choices, child-rearing practices, and the home learning environment. In research on the academic beliefs of parents in Canada, Chile, and Mexico, Mexican parents had higher expectations for their children's early literacy and numeracy skills than Canadian and Chilean parents. However, all parents reported similarly high expectations for the most basic items such as "count to 10" and "print name", "print all letters", and "read a few words" before the start of Grade 1. For literacy, parenting beliefs were related to children's early reading skills development [86], decisions about book choices [87], and children's motivation to continue reading once they have mastered reading skills [78]. Mothers' attitudes toward reading were correlated with the number of books in the household, the home literacy environment, and children's attitudes toward reading [88]. Ref.[20] found that the academic expectations of Canadian parents were correlated with their formal literacy practices, and the frequency of these practices predicted children's letter knowledge and reading ability. Additionally, parents' positive attitudes toward literacy (e.g., I enjoy reading) were related to their involvement in basic and informal literacy practices, and these practices were related to children's vocabulary skills.

Likewise for mathematics, parents' beliefs and attitudes have been linked to home mathematics practices. Canadian parents' beliefs about the importance of children achieving specific mathematical benchmarks, such as counting to 100 before Grade 1, predicted children's exposure to books and numeracy outcomes [49]. Ref.[20] also found that parents' academic expectations affected their tendency to complete basic mathematics activities with their children; and numeracy attitudes (I enjoy mathematics) were related to their children's non-symbolic arithmetic and symbolic number knowledge.

Considering parent affect, parents' anxiety about math has been linked to the amount of early home math talk [89] and to children's exposure to advanced home mathematics practices [77]. Links between mathematical performance and parent math anxiety, however, are tenuous. For example, lower math scores were found only when math-anxious parents were involved in homework helping sessions with the child [90]. Retanal et al. [46] found that Canadian parents use of a controlling supportive parenting style while helping their Grade 6–8 children (i.e., 11- to 14-years old) with mathematics homework was related to mathematics anxiety and mathematics performance. Math attitudes and anxieties can also follow typical gender stereotypes, with boys and fathers reporting they enjoy math and have low math anxiety, compared to girls and mothers who have negative math attitudes and high levels of math anxiety [91]. Sometimes, students' perceptions of their parents' beliefs can also follow these gender lines, with concern that these perceptions may influence career choices [92]. However, because few studies in this area have included fathers, and those that did found few differences in these factors [62,77], we did not have predictions about gender effects.

### *1.5. The Current Study*

Research on home learning has been heavily focused on mothers' activities with their young children (i.e., pre-school to Grade 1; aged 3 through 6 years). Home-learning research

on fathers and school-aged children has been limited. To address this gap, we attempted to focus on both parents, and older children in our study (i.e., Grade 3, aged 8 to 9 years). We examined the relations among parental beliefs, attitudes, and affect, the frequency of literacy and numeracy activities, and Canadian students' literacy and mathematics skills. Children completed literacy and mathematics assessments. For each child, either a mother or a father completed surveys on their attitudes, anxieties, and the frequency with which they participated in home learning activities with their child. We addressed two research questions.

#### 1.5.1. Research Question 1: How Can the Home Learning Environment Be Described for Eight-Year-Old Canadian Children?

In previous work with Canadian preschool children (i.e., aged 3 to 6 years), parents (mainly mothers) reported on the literacy and numeracy activities that they shared with their children [20,93]. Overall, parents frequently provided a range of activities, including frequent shared book reading, counting, and practicing arithmetic facts. We adjusted survey measures (i.e., activities, book and game list, parents' attitudes, beliefs, and affect) used in previous work [20,75] to be relevant for older children [62]. Multiple regression analyses were used to determine whether these activities would continue to characterize the home learning environment. Based on the small amount of research with fathers, we predicted that fathers would respond similarly to mothers on the home learning questionnaire in Canada. We also predicted that, because parents would be responsive to their child's developing mathematical knowledge [94], they would report engaging in age-appropriate activities [28,62]. Furthermore, we predicted that parents' attitudes and anxiety would be related to reports of home learning activities [19,95] and homework helping quality [90,96,97].

#### 1.5.2. Research Question 2: Is the Home Learning Environment for Eight-Year-Old Children Related to Their Academic Performance?

Canadian school aged children spend most of their time at home in communal family areas [98] and thus opportunities exist for parents to interact with their children, whether connecting with homework or participating in joint activities. We performed multiple regression analyses to determine whether home environment factors, such as parents' reports of activities, attitudes, and anxiety, were related to children's home literacy and numeracy performance. Following previous research with younger Canadian children, we expected that parents' knowledge of children's books and their literacy activities would be related to children's receptive vocabulary, and literacy activities would be related to word reading [93,99]. With this older sample, we expected that parents who reported spending more time helping their child read words would have children with weaker reading skills [99]. For mathematics, we expected that parents' reports of increased home activities and their positive attitudes toward mathematics would be related to children's mathematical performance [20].

## 2. Method

### *2.1. Ethics*

The current analyses involve data collected as part of a larger project on language learning and mathematics, called Language Learning and Mathematics Achievement (i.e., LLAMA). The complete list of tasks is available at Open Science Framework site: https://osf.io/428hp/ (accessed on 29 April 2022). The study received ethics approval from the Ethics Review Board at The University of Winnipeg; approval from two Canadian school divisions (i.e., Louis Riel School Division and Seine River School Division); and four urban schools and three rural schools. Parents provided written consent and children provided verbal assent prior to data collection. Schools were recruited that offered programming in English or French. Because most individuals in the Province of Manitoba, Canada (where the study was conducted) speak English, the French instruction was an Immersion milieu, designed for students whose first language was not French. The schools were located in a middle-class Canadian neighborhood or town, with proximal access to many amenities

and services. All children received a colorful record chart with stickers to record their participation in the project. Each child received a chart with stickers regardless of whether they consented to participate to promote inclusivity. Once all students from a classroom participated in the testing, research assistants debriefed each classroom, and all children were allowed to try the iPad activities.

### 2.2. Participants

Parent–child dyads ($n$ = 81) included mothers ($n$ = 50) or fathers ($n$ = 31). In the sample, surveys were collected from one parent in each family, which could include the mother or the father. At the time of testing, children were in Grade 3 and ranged in age from 8.2 to 9.1 years ($M_{age}$ = 8.71 years, $SD$ = 0.28; 37% boys). Children came from homes where 70% of fathers and 80% of mothers had either a college or university degree, and less than 3% of homes had a parent (i.e., one father and two mothers) who did not complete high school. English was the first language spoken by most children (91%). The remaining 9% of children's first language was Serbian ($n$ = 2), French, Mandarin, Chinese, Polish, Russian or Gujarati ($n$ = 1 each). Children were enrolled in either English (30%) or French immersion (70%) schools.

### 2.3. Recruitment

Children attended information sessions and were shown the iPad and samples of games that they would play, along with the sticker charts that would be used to record their participation in the project. An information sheet, consent form, and a 20-min parent questionnaire were sent home with each child for parents to read, sign, and return to the school. Participation rates for the children ranged from 80–90% per classroom. However, very few parent questionnaires were returned. Thus, researchers set up a table during parent teacher conferences where direct contact was made with parents. School staff directed parents to the research table to hear about the study, and parents were told that the project findings would be used to benefit academic learning. Consistent with processes used by the school to have paperwork completed by "the home", one survey was requested for each child, to be completed by either the mother or the father. Given the slow survey return rates, a goal was to receive one questionnaire back from any parent of a participating child. When both parents were present, fathers were encouraged to complete the survey, since mothers are overrepresented in home-learning research, and to allow us to consider the Canadian father perspective. Some surveys were completed while parents were waiting to meet the teacher; other surveys were returned to the research office in a self-addressed stamped envelope or directly to the child's school. The survey was translated to French for one French-speaking mother who completed the survey orally. Parents received a biodegradable pencil that contained herb and flower seeds inside as a participation incentive. In cases when parents did not attend the interviews (approximately 10–20% of students in each classroom), teachers sent another copy of the survey home with the child, but none of these surveys were returned. In total, parents of 81 children returned surveys (50.9% of the children who participated in the larger study). For 12 of these children, both the mothers and fathers completed the questionnaire, creating concerns about how to aggregate the survey data. We elected to include the father questionnaires (before any analyses were conducted), since the viewpoints of mothers have been over-represented in the literature (between 83% and 96% of our samples have involved only mother's input in our past Canadian samples). In summary, the parent participation rate was 50.9%. This rate of parent participation is similar to that found in other studies.

### 2.4. Materials

#### 2.4.1. Parent Measures

One parent from each family completed a 20-min paper-and-pencil survey that included demographic questions and questions about the home learning environment. Versions of the survey have been used for children in pre-school to kindergarten [20,48,49,100]

and adapted for older students [28,62]. In our revised version, age-appropriate questions were added to assess parent attitudes (Table 1), home practices (Table 2), and questions about homework helping. See Open Science Framework site: https://osf.io/428hp/ (accessed on 29 April 2022) for the survey questions.

**Table 1.** Descriptive statistics and rotated factor loadings for math anxiety survey.

| Mathematics Anxiety Items | *M* | *SD* | Factor Loadings | |
|---|---|---|---|---|
| | | | General Math | Homework Help |
| General Mathematics Anxiety | | | | |
| Working out prices in foreign currency | 1.99 | 1.25 | 0.86 | 0.10 |
| Figuring out how much a shirt will cost at 25% off | 1.47 | 0.89 | 0.86 | 0.12 |
| Working out a 15% tip | 1.62 | 1.03 | 0.85 | 0.26 |
| Doing math calculations | 1.66 | 1.02 | 0.81 | −0.02 |
| Completing a math course as part of job training | 1.71 | 1.06 | 0.75 | 0.22 |
| Interpreting numerical information to compare cellphone plans | 1.46 | 0.71 | 0.73 | 0.29 |
| General Math Anxiety Scale | 1.65 | 0.82 | | |
| Homework Helping Anxiety | | | | |
| Helping your child with math subtraction homework | 1.18 | 0.47 | 0.12 | 0.94 |
| Helping your child with math area and volume homework | 1.39 | 0.72 | 0.20 | 0.91 |
| Homework help anxiety scale | 1.28 | 0.56 | | |
| Scale Reliability (Cronbach's $\alpha$) | | | 0.90 | 0.80 |

*Note.* Parents responded on a 5-point scale. 1 = low anxiety, 2 = some anxiety, 3 = moderate anxiety, 4 = quite a bit of anxiety, and 5 = high anxiety.

**Table 2.** Means and standard deviations for formal home learning activities.

| Activity | M | SD |
|---|---|---|
| Literacy Activities | | |
| We visit the library for children's books | 1.78 | 0.82 |
| I help my child read English books | 3.70 | 1.20 |
| I teach my child to recognize printed words | 3.53 | 1.17 |
| I encourage my child to write stories | 2.83 | 1.24 |
| I encourage my child to explain a story or incident in their own words | 3.33 | 1.27 |
| Scale Reliability (Cronbach's alpha) | 0.74 | |
| Operational Activities | | |
| I encourage my child to do math in their head | 3.48 | 1.03 |
| We practice counting, addition, and subtraction | 3.43 | 1.01 |
| I teach my child about multiplication tables | 2.11 | 1.17 |
| I encourage my child to practice number facts | 3.02 | 1.20 |
| Scale Reliability (Cronbach's alpha) | 0.80 | |
| Mapping Activities | | |
| I encourage counting by 2 s and 3 s | 2.79 | 1.23 |
| I help my child weigh, measure, and compare quantities | 2.17 | 1.29 |
| I ask about how many quantities | 2.48 | 1.14 |
| I teach my child to print numbers | 2.57 | 1.32 |
| We use number or arithmetic flashcards | 1.88 | 1.28 |
| I ask my child about fractions | 2.00 | 0.94 |
| We practice answering how many without counting | 2.43 | 1.29 |
| Scale Reliability (Cronbach's alpha) | 0.84 | |
| Spatial Activities | | |
| My child uses maps | 1.76 | 0.90 |
| My child does mazes or similar puzzles | 2.56 | 1.00 |
| My child fixes mechanical objects | 2.21 | 1.11 |

**Table 2.** *Cont.*

| Activity | M | SD |
|---|---|---|
| I help my child practice the difference between left and right | 2.81 | 1.29 |
| I discuss directions to familiar places | 2.89 | 1.19 |
| My child builds with Lego or similar toys | 3.33 | 1.15 |
| Scale Reliability (Cronbach's alpha) | 0.78 | |

*Note.* Parents responded on a 5-point scale. 1 = rarely or never, 2 = monthly, 3 = weekly, 4 = several days a week and 5 = most days per week.

1. Attitudes and Affect

Parents rated their attitudes toward literacy and mathematics by rating statements such as "I was good at math in school" and "I find reading enjoyable" on a scale from 1 (strongly disagree) to 5 (strongly agree). One statement on each survey was reverse-coded (i.e., I avoid situations involving math/reading). Reliability was 0.66 (5 items) and 0.67 (4 items) for literacy and mathematics attitudes, respectively. Mean scale scores were used in subsequent analyses.

Mathematics anxiety was assessed using a 7-item survey that was developed for this study. Parents rated how anxious they felt doing specific tasks on a scale of 1 (low anxiety) to 5 (high anxiety) (see Table 1). Responses were analyzed using a principal component analysis with varimax rotation. Two components were extracted that accounted for 74% of the variance in scores. The regression factor scores were saved and used in further analyses. One factor, labelled general mathematics anxiety, reflected anxiety about using mathematics in daily living (e.g., working out a 15% tip). The other factor, labelled homework helping anxiety, reflected parents' anxiety about helping children with mathematics homework. As shown in Table 1, parents were not very anxious about mathematics. Factor scores were used in subsequent analyses.

2. Home Activities

Parents rated how often they engaged in home literacy and home math activities on a scale of 1 (rarely) to 5 (most days per week). All items and scale reliabilities are shown in Table 2. Scale reliability was calculated with Cronbach's alpha—a measure of inter-item consistency, also described as the extent to which the items assessed are related to each other. Literacy items included questions about reading at home, storytelling, and writing. Mathematics items were classified as having operational, mapping, or spatial content. The operational and mapping classifications were used in previous work [62,100]. Operational activities involve manipulating quantities or numbers (e.g., practicing number facts). Mapping activities involve representing quantities or numbers (e.g., counting by 2 s or asking about fractions). Questions about spatial activities were included as an exploratory measure, and included items such playing with Lego, and how parents support spatial skills such as teaching about left and right. Mean scores for mapping, operations, spatial, and reading activities were calculated and used in subsequent analyses.

3. Homework Help

Parents reported how much homework their children were assigned in English and in French (as applicable in subject areas studied such as math, reading, spelling, writing and science); and the amount of time that parents helped with that homework. Responses were rated on a five-point scale (i.e., from 1 (none), and increasing by 15-min intervals for middle ratings, to 5 (more than 1 h per week). The homework helping frequency for mathematics homework, and the mean score for literacy homework (which included reading, spelling, and writing) were used in subsequent analyses.

4. Knowledge of Math Games and Books

Game and book checklists have been used in prior studies to assess informal exposure to mathematics and reading [20]. Additional age-appropriate items were added to the lists for this study (see Appendix A). The games checklist includes 40 games: some with

mathematics content ($n$ = 16, e.g., "Yahtzee"), some with minimal math content ($n$ = 10, e.g., "Operation") and foils ($n$ = 14). The book checklist includes 54 titles of children's books, 37 real books and 17 foils. On each list, parents were asked to indicate titles/games that they recognized. They were discouraged from guessing or looking up information on the internet. Knowledge of mathematics games was calculated as the difference between the percentage of mathematics games selected and the percentage of foils selected. Knowledge of children's books was calculated as the difference between the percentages of books correctly identified and foils selected. Each score could range from 0 to 100%.

#### 2.4.2. Children's Measures

5. Arithmetic Fluency

Children completed a timed pencil-and-paper fluency test [101]. The test was three pages: one page of single-digit addition (e.g., 8 + 7), one page with the corresponding subtraction items (e.g., 15 − 8), and one page of single-digit multiplication up to the fives times tables (e.g., 5 × 8). There were 60 items per page, and the items were arranged in 3 columns (20 rows). Children were given 1 min per page to complete as many items as they could without skipping items. Score was the total correct for all pages with a maximum score of 180. Cronbach's alpha was 0.77 using the addition, subtraction, and multiplication sub-scores.

6. Word Problem Solving

Children completed 12 questions (items 1 to 12) from the Applied Problem-Solving subtest of KeyMath 3rd Edition [102]. Children listened to a mathematics problem and provided a response; some of the items contained pictures. Solving problems required that students extract key information from the description and use arithmetic skills to solve the problem. Testing was discontinued after 3 consecutive errors. Score was the number of correct responses. Cronbach's alpha based on all 12 items was 0.942.

7. Algebra

Children completed 15 questions (items 7 to 21) from the Algebra subtest of KeyMath 3rd Edition [102]. In this task, the researcher showed the student an image and read the corresponding question to the student. Questions included completing patterns, filling missing numbers into equations and balancing equations. Testing was discontinued after 3 consecutive errors. Score was the number of correct responses. Cronbach's alpha based on all 15 items was 0.959.

8. Measurement

This task was developed by the authors to assess children's understanding of time, temperature, and money. In this task, the researcher showed the student an image and read the corresponding question to the student. Questions included telling the time (e.g., What time does this clock show?), naming coins (e.g., nickel, quarter), and identifying temperatures on a thermometer (e.g., What is the temperature shown in the picture?). There were 24 questions. Score was the number of correct responses. Cronbach's alpha based on all items was 0.79.

### *2.5. Procedure*

Children participated in two English 30-min individual testing sessions in a quiet room at their school. If the children attended French Immersion, they completed an additional 30-min testing session in French, but performance on the French measures was not analyzed in the present study. The order of the tasks was the same for all children and for all sessions. Bilingual (English/French speaking) research assistants conducted all of the testing. Tasks were balanced so children could enjoy variety within each testing session.

## 3. Results

More girls than boys participated in the study. No gender differences were found in student performance (multivariate $p$s 0.28 to 0.99) or the Canadian home learning

environments (multivariate *p*s 0.32 to 0.87). Student gender was not a confound and thus was not considered in further analyses.

### 3.1. Data Reduction

Accuracy was similar for each of the three untimed, applied mathematics measures (i.e., word problems, algebra, and measurement, see Table 3). Furthermore, these scores were strongly inter-correlated (*r*s > 0.60) (Field, 2013, p. 270). Thus, principal components analysis was used to create a single mathematics outcome. The factor loadings for algebra, measurement, and fluency were 0.87, 0.88 and 0.88, respectively, and the factor score accounted for 76% of the variance. The regression factor score was saved and labelled "applied mathematics".

**Table 3.** Descriptive statistics and correlations for children's academic outcomes ($n$ = 81).

| | Applied Mathematics | | | Arithmetic | Literacy | |
|---|---|---|---|---|---|---|
| | **Word Problems** | **Algebra** | **Measurement** | **Fluency** | **Vocabulary** | **Word Reading** |
| Word problems | | 0.63 *** | 0.63 *** | 0.47 *** | 0.54 *** | 0.40 *** |
| Algebra | | | 0.65 *** | 0.46 *** | 0.53 *** | 0.52 *** |
| Measurement | | | | 0.52 *** | 0.48 *** | 0.51 *** |
| Fluency | | | | | 0.22 | 0.46 *** |
| Vocabulary | | | | | | 0.42 *** |
| Word Reading | | | | | | |
| Score range | 1 to 11 | 1 to 15 | 2 to 23 | 5 to 68 | 15 to 64 | 10 to 42 |
| Mean Score (*SD*) | 5.80 (2.40) | 7.82 (3.06) | 15.66 (4.24) | 30.99 (12.79) | 48.62 (9.26) | 27.99 (8.01) |
| Mean Accuracy (*SD*) | 0.59 (0.14) | 0.60 (0.18) | 0.61 (0.16) | | | |
| z-skew | 0.59 | −1.04 | −0.82 | 3.06 | −3.63 * | 1.84 |

* $p < 0.05$. *** $p < 0.001$.

The vocabulary score was negatively skewed (see Table 3). One extreme low outlier (4.3 SD below the mean) was excluded from subsequent analyses involving the vocabulary measure. The other measures were normally distributed and did not show floor or ceiling effects.

### 3.2. How Can the Home Learning Environment Be Described for Eight-Year-Old Canadian Children?

#### 3.2.1. Home Literacy Environment

Parents reported engaging in home literacy activities on average, once per week above and beyond the demands required for school (see Table 4). There were some statistically significant differences; the mothers in this study reported spending more time on home literacy activities than father respondents. The mothers in the study also correctly identified more children's books than the father respondents, suggesting they spent more time on informal shared reading with their children than the fathers who responded about their involvement with their children. Mothers reported more positive attitudes to literacy than fathers.

**Table 4.** Descriptive statistics for the home learning environment.

| | Parents | | Mother | | Father | | Comparison | | |
|---|---|---|---|---|---|---|---|---|---|
| **Home Learning Environment** | **M** | **SD** | **M** | **SD** | **M** | **SD** | **t** | **df** | **d** |
| **Mathematics** | | | | | | | | | |
| Operational Activities [1] | 3.01 | 0.88 | 3.12 | 0.81 | 2.84 | 0.96 | 1.64 | 78 | 0.38 |
| Mapping Activities [1] | 2.33 | 0.88 | 2.42 | 0.80 | 2.19 | 0.99 | 1.26 | 78 | 0.29 |
| Spatial Activities [1] | 2.60 | 0.77 | 2.74 | 0.74 | 2.37 | 0.78 | 2.39 * | 78 | 0.55 |
| Math Games [4] | 47.38 | 3.01 | 47.55 | 18.43 | 41.62 | 18.42 | 1.41 | 78 | 0.32 |
| Homework time [2] | 2.58 | 1.12 | 2.51 | 1.14 | 2.68 | 1.11 | 0.07 | 78 | 0.15 |
| Homework help [2] | 2.53 | 1.18 | 2.51 | 1.23 | 2.57 | 1.10 | −0.09 | 76 | 0.02 |
| Math attitudes [3] | 3.86 | 0.76 | 3.70 | 0.72 | 4.13 | 0.76 | −2.56 * | 78 | 0.59 |
| General math anxiety | 0.00 | 1.00 | 0.20 | 1.13 | −0.33 | 0.63 | 2.34 * | 76 | 0.54 |
| Math homework anxiety | 0.00 | 1.00 | −0.01 | 1.02 | 0.02 | 0.98 | −0.04 | 76 | 0.01 |

**Table 4.** *Cont.*

| Home Learning Environment | Parents | | Mother | | Father | | Comparison | | |
|---|---|---|---|---|---|---|---|---|---|
| | M | SD | M | SD | M | SD | t | df | d |
| **Literacy** | | | | | | | | | |
| Literacy Activities [1] | 3.03 | 0.80 | 3.22 | 0.76 | 2.74 | 0.80 | 3.01 ** | 78 | 0.71 |
| Children's Books [4] | 22.89 | 17.18 | 27.51 | 16.39 | 15.43 | 15.98 | 3.19 ** | 79 | 0.73 |
| Homework time [2] | 2.75 | 0.96 | 2.72 | 1.02 | 2.80 | 0.88 | −0.34 | 78 | 0.08 |
| Homework help [2] | 2.63 | 1.05 | 2.80 | 1.01 | 2.37 | 1.09 | 1.97 | 77 | 0.46 |
| Literacy attitudes [3] | 3.81 | 0.73 | 3.94 | 0.63 | 3.61 | 0.84 | 2.06 * | 78 | 0.47 |

Notes. [1] Scale. 1 = rarely or never, 2 = monthly, 3 = weekly, 4 = several days a week and 5 = most days per week. [2] Scale 1 = none, 2 = 1 to 15 min, 3 = 16 to 30 min, 4 = 31 to 1 h, 5- more than 1 h per week. [3] Scale 1= strongly disagree, 2 = disagree, 3 = neither agree nor disagree, 4 = agree, 5 = strongly agree. [4] Percentage recognized (adjusted for false alarms). * $p < 0.05$. ** $p < 0.01$.

#### 3.2.2. Home Numeracy Environment

Parents reported engaging in operational home mathematics activities (e.g., math facts practice) about once per week; they reported engaging in mapping and spatial activities somewhat less often, on average (see Table 4). Mean frequency ratings for math activities were analyzed in a 2 (parent: mother, father) by 2 (activity: operational, mapping) mixed ANOVA. Parents reported spending more time on operational activities than on mapping activities, $F(1,78) = 70.54$, $p < 0.001$. This pattern was true for both mothers and fathers (i.e., there was no main effect of parent), $F(1,78) = 2.51$, $p = 0.12$. Furthermore, there was no interaction between parents and activity, $F(1,78) = 0.17$, $p = 0.68$, indicating that mothers and fathers reported engaging in similar levels of math-related activities with their children. For spatial activities, the mean for mothers was higher than for fathers. Examination of the individual items, however (see Table 2), indicated that the only item differed between mothers and fathers: "I discuss directions to familiar places" ($M_M = 3.20$ vs. $M_F = 2.43$), $t(77) = 2.96$, $p = 0.004$. The other items involved activities of the children and did not differ across parents.

Comparing parents' attitudes toward math, there were some statistically significant differences as shown in Table 4. Attitudes toward math were more positive for fathers than for mothers, and mothers were more math-anxious than fathers (Table 4). Nonetheless, both parents reported low anxiety when helping their children with math homework (Table 1), and this anxiety did not differ for fathers and mothers (see Table 4). Moreover, there were no statistically significant differences in the amount of time mothers and fathers reported helping their children with math homework or in the amount of time parents reported that children spent doing homework.

We compared parents' attitudes toward math and literacy using a 2 (parent: mother, father) by 2 (attitude: math, literacy) mixed ANOVA. Overall, there were no significant differences between parents' math and reading attitudes, $F(1,78) = 1.84$, $p = 0.18$. However, there was an interaction between parent and attitudes, $F(1,78) = 15.22$, $p < 0.001$, such that mothers' attitudes were more positive toward reading than math; in contrast, fathers' attitudes were more positive toward math than reading.

In summary, the home mathematics environments provided by fathers and mothers were quite similar in terms of the frequency of activities that were reported and the time spent helping with homework. Mothers reported more negative attitudes toward math than fathers and were more anxious about using math in everyday life. They were not more anxious than fathers about helping their children with math homework, however. These parental differences should be considered with caution because of the small number of participating fathers. Anxiety and attitudes were controlled in subsequent analyses.

### 3.3. Research Question 2. Is the Home Learning Environment of Eight-Year-Old Children Related to Their Academic Performance?

#### 3.3.1. Home Literacy Environment

To understand how parental factors related to the home literacy environment and children's literacy performance, we examined the relations among parent attitudes, activities, and children's literacy outcomes (see Table 5). Parents' knowledge of children's books and their attitudes toward reading were positively correlated with children's vocabulary scores. However, none of the home literacy environment measures were correlated with children's word reading performance. The amount of time parents reported helping with literacy homework was not correlated with word reading. Unexpectedly, parents who were more anxious about helping their child with math homework did fewer literacy activities, recognized fewer children's books, and were less positive about reading than parents who were less anxious about helping with math homework. Furthermore, parents' math homework anxiety was negatively correlated with children's vocabulary. These correlations between math homework helping anxiety and literacy will be explored further in the discussion.

To determine how the home literacy environment was related to children's literacy performance, we regressed vocabulary and word reading performance on the home environment measures (see Table 6). All parents were included in the regression analyses. Model 1 included parent education, Model 2 included literacy attitudes, and Model 3 included time spent on literacy activities and knowledge of the children's book list.

Children's vocabulary was predicted by parents' knowledge of children's books (Model 3). Model 3 accounted for 22% of the variance in vocabulary skills. To determine if the predictive patterns were driven by parental differences, we conducted a regression that included the interactions between parent and each of literacy attitudes, literacy activities, and booklist knowledge. These interactions did not contribute unique variance to students' vocabulary knowledge (see Table A4).

In contrast to vocabulary, word reading was not predicted by any of the home literacy measures (see Table 7). Furthermore, the parent factors and home literacy measures only accounted for 7% of the variance in word reading skills. In Model 4, we included vocabulary as a predictor of word reading. Vocabulary accounted for 12% unique variance in word reading, as expected.

**Table 5.** Correlations between the home learning environment and students' outcomes.

| | | | | | Mathematics | | | | | | | | Literacy | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | Activities | | | | Affect | | Outcomes | | | Activities | | Att. | Outcomes | |
| | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 | 15 | 16 | 17 |
| 1. Education | 0.27 * | 0.18 | 0.04 | 0.01 | 0.11 | 0.11 | −0.23 * | −0.20 | 0.22 | 0.19 | 0.18 | 0.24 * | 0.13 | 0.21 | 0.20 | 0.21 |
| **Numeracy** | | | | | | | | | | | | | | | | |
| 2. Operational | | 0.67 ** | 0.50 ** | −0.29 * | 0.43 ** | 0.16 | −0.21 | −0.22 | 0.32 ** | 0.19 | 0.42 ** | 0.07 | 0.36 ** | 0.37 ** | 0.17 | 0.16 |
| 3. Mapping | | | 0.72 ** | −0.18 | 0.39 ** | 0.00 | −0.07 | −0.14 | 0.23 * | 0.16 | 0.56 ** | 0.08 | 0.48 ** | 0.42 ** | −0.02 | 0.14 |
| 4. Spatial | | | | −0.06 | 0.26 * | −0.14 | 0.07 | −0.15 | 0.15 | 0.07 | 0.60 ** | 0.12 | 0.35 ** | 0.26 * | 0.03 | 0.08 |
| 5. Games | | | | | −0.24 * | −0.07 | 0.26 * | −0.17 | −0.07 | 0.10 | 0.04 | 0.42 ** | −0.16 | 0.05 | 0.13 | 0.09 |
| 6. HW help | | | | | | 0.20 | −0.14 | −0.20 | 0.07 | −0.07 | 0.13 | −0.04 | 0.76 ** | 0.26 * | 0.06 | −0.04 |
| 7. Attitudes | | | | | | | −0.48 * | −0.15 | 0.28 * | 0.10 | −0.11 | −0.13 | 0.11 | 0.22 | 0.11 | 0.08 |
| 8. Gen.anxiety | | | | | | | | 0.00 | −0.07 | 0.00 | 0.17 | 0.20 | −0.06 | 0.02 | 0.12 | −0.00 |
| 9. HW anxiety | | | | | | | | | −0.03 | −0.11 | −0.25 * | −0.24 * | −0.13 | −0.24 * | −0.29 * | −0.17 |
| 10. Fluency | | | | | | | | | | 0.55 ** | 0.09 | −0.09 | −0.06 | 0.24 * | 0.22 | 0.46 ** |
| 11. AppliedMath | | | | | | | | | | | 0.07 | 0.13 | −0.12 | 0.23 * | 0.52 ** | 0.55 ** |
| **Literacy** | | | | | | | | | | | | | | | | |
| 12. Activities | | | | | | | | | | | | 0.35 ** | 0.43 ** | 0.39 ** | 0.11 | 0.10 |
| 13. Book list | | | | | | | | | | | | | 0.03 | 0.16 | 0.36 ** | 0.07 |
| 14. HW help | | | | | | | | | | | | | | 0.38 ** | 0.02 | −0.15 |
| 15. Attitudes | | | | | | | | | | | | | | | 0.25 * | 0.18 |
| 16. Vocabulary | | | | | | | | | | | | | | | | 0.42 ** |
| 17. Word Reading | | | | | | | | | | | | | | | | |

*Notes.* * $p < 0.05$. ** $p < 0.01$. HW = homework.

**Table 6.** Hierarchical regressions predicting students' vocabulary and word reading.

| | Vocabulary | | | Word Reading | | |
|---|---|---|---|---|---|---|
| | ***β*** | ***p*** | **Semi- Partial *r* [1]** | ***β*** | ***p*** | **Semi- Partial *r* [1]** |
| Model 1 | | | | | | |
| Parent Education | 0.30 ** | 0.008 | 0.30 ** | 0.22 | 0.062 | 0.22 |
| $\Delta R^2$ | | 0.008 | 0.09 ** | | 0.062 | 0.05 |
| Model 2 | | | | | | |
| Parent Education | 0.25 * | 0.030 | 0.24 * | 0.19 | 0.120 | 0.18 |
| Literacy Attitudes | 0.23 * | 0.044 | 0.22 * | 0.14 | 0.251 | 0.13 |
| $\Delta R^2$ | | 0.044 | 0.05 * | | 0.251 | 0.02 |
| Model 3 | | | | | | |
| Parent Education | 0.18 | 0.105 | 0.17 | 0.17 | 0.161 | 0.16 |
| Literacy Attitudes | 0.22 | 0.060 | 0.20 | 0.14 | 0.265 | 0.13 |
| Literacy Activities | −0.06 | 0.625 | −0.05 | −0.04 | 0.779 | −0.03 |
| Children's book list | 0.30 ** | 0.013 | 0.27 ** | 0.06 | 0.624 | 0.06 |
| $\Delta R^2$ | | 0.040 | 0.08 * | | 0.880 | 0.00 |
| Total $R^2$ | | 0.002 | 0.22 ** | | 0.290 | 0.07 |
| Model 4 | | | | | | |
| Parent Education | | | | 0.10 | 0.387 | 0.10 |
| Literacy Attitudes | | | | 0.06 | 0.644 | 0.05 |
| Literacy Activities | | | | −0.01 | 0.909 | −0.01 |
| Children's book list | | | | −0.05 | 0.675 | −0.05 |
| Vocabulary | | | | 0.39 ** | 0.002 | 0.34 ** |
| $\Delta R^2$ | | | | | 0.002 | 0.12 ** |
| Total $R^2$ | | | | | 0.013 | 0.19 * |

[1] Value in this column for the $\Delta R^2$ and Total $R^2$ rows are proportion of variance. * $p < 0.05$. ** $p < 0.01$. *Notes.* Vocabulary: Model 1, $F(1,73) = 7.41$, $p = 0.008$; Model 2, $F(2,72) = 5.97$, $p = 0.004$; Model 3, $F(4,70) = 4.87$, $p = 0.002$. Word Reading: Model 1, $F(1,73) = 3.59$, $p = 0.062$; Model 2, $F(2,72) = 2.47$, $p = 0.091$; Model 3, $F(4,40) = 1.27$, $p = 0.29$; Model 4, $F(5,69) = 3.13$, $p = 0.013$.

**Table 7.** Hierarchical regressions predicting students' arithmetic fluency and applied mathematics.

| | Fluency | | | Applied Mathematics | | |
|---|---|---|---|---|---|---|
| | ***β*** | ***p*** | **Semi Partial (*r*) [1]** | ***β*** | ***p*** | **Semi Partial (*r*) [1]** |
| Model 1 | | | | | | |
| Education | 0.21 | 0.068 | 0.21 | 0.21 | 0.071 | 0.21 |
| $\Delta R^2$ | | 0.068 | 0.05 | | 0.071 | 0.05 |
| Model 2 | | | | | | |
| Education | 0.21 | 0.069 | 0.21 | 0.23 | 0.063 | 0.22 |
| Math attitudes | 0.31 * | 0.017 | 0.27 * | 0.12 | 0.359 | 0.11 |
| Math anxiety | 0.13 | 0.338 | 0.11 | 0.11 | 0.412 | 0.10 |
| $\Delta R^2$ | | 0.056 | 0.08 | | 0.595 | 0.01 |
| Model 3 | | | | | | |
| Education | 0.15 | 0.185 | 0.15 | 0.20 | 0.113 | 0.19 |
| Math attitudes | 0.29 * | 0.024 | 0.25 * | 0.11 | 0.407 | 0.10 |
| Math anxiety | 0.16 | 0.217 | 0.14 | 0.13 | 0.349 | 0.11 |
| Operational activities | 0.25 * | 0.031 | 0.24 * | 0.13 | 0.304 | 0.12 |
| $\Delta R^2$ | | 0.031 | 0.06 * | | 0.304 | 0.01 |
| Total $R^2$ | | 0.008 | 0.18 * | | 0.234 | 0.08 |

**Table 7.** *Cont.*

| | Fluency | | | Applied Mathematics | | |
|---|---|---|---|---|---|---|
| | *β* | *p* | Semi Partial (*r*) [1] | *β* | *p* | Semi Partial (*r*) [1] |
| Model 4 | | | | | | |
| Education | 0.17 | 0.162 | 0.17 | 0.09 | 0.429 | 0.08 |
| Math attitudes | 0.24 | 0.061 | 0.21 | 0.00 | 0.971 | 0.00 |
| Math anxiety | 0.16 | 0.221 | 0.13 | −0.00 | 0.997 | 0.00 |
| Operational activities | 0.25 * | 0.032 | 0.24 * | 0.08 | 0.471 | 0.08 |
| Vocabulary | 0.14 | 0.253 | 0.13 | 0.51 *** | < 0.001 | 0.44 *** |
| Children's Book List | −0.21 | 0.103 | −0.18 | −0.08 | 0.490 | −0.07 |
| $\Delta R^2$ | | 0.222 | 0.04 | | < 0.001 | 0.21 *** |
| Total $R^2$ | | 0.011 | 0.22 * | | <0.001 | 0.28 *** |

[1] Value in this column for the $\Delta R^2$ and Total $R^2$ rows are proportion of variance. * $p < 0.05$. *** $p < 0.001$. *Note.* Fluency: Model 1, $F(1,72) = 3.44$, $p = 0.07$; Model 2, $F(3,70) = 3.21$, $p = 0.03$; Model 3, $F(4,69) = 3.75$, $p = 0.07$; Model 4, $F(6,67) = 3.05$, $p = 0.01$. Applied Mathematics: Model 1, $F(1,72) = 3.37$, $p = 0.07$; Model 2, $F(3,70) = 1.46$, $p = 0.23$; Model 3, $F(4,69) = 1.36$, $p = 0.27$; Model 4, $F(6,67) = 4.33$, $p = 0.001$.

#### 3.3.2. Home Mathematics Environment

To understand how parental factors related to the home numeracy environment and children's mathematical performance, we first examined the correlations (see Table 5). Frequency of operational and mapping activities were correlated, and both were related to children's arithmetic fluency scores. Parents' math attitudes were also positively correlated with children's arithmetic fluency. In contrast, home mathematics factors were not related to the applied mathematics composite. Parents' math anxiety was not correlated with math outcomes: Recall that most parents reported low levels of math anxiety in our sample.

To determine which home math environment factors were unique predictors of children's mathematical performance, we regressed fluency and applied math performance on the home environment variables (see Table 7). Model 1 included parent education, Model 2 included parent attitudes and anxiety, and Model 3 included time spent on operational activities. We did not include mapping or spatial activities in the regressions. Mapping was strongly correlated with operational activities and thus the two measures would account for mostly the same variance in arithmetic fluency; and spatial activities were not correlated with either outcome.

As shown in Table 7, parents' reports of the frequency of operational activities and positive attitudes toward mathematics predicted children's arithmetic fluency. Parents' math anxiety and education were not unique predictors, likely because of the high number of educated parents and low levels of parent math anxiety in the sample. To determine if these patterns were driven by differences between mothers and fathers, interaction variables were added to the regression (see Table A2 in Appendix A). However, none of the interactions between parent and any of math attitudes, math anxiety, and operational activities predicted unique variance. Thus, for this group of Grade 3 students, variance in their arithmetic fluency scores was accounted for, in part, by their parents' attitudes toward math (6%) and shared time on activities such as practicing number facts (7%).

For applied mathematics, none of the predictors included in Models 1 to 3 accounted for unique variance. Applied mathematics included assessments related to algebra, word problem solving, and measurement. Notably, these measures all require substantial language knowledge, both in terms of the task administration and the knowledge of math-specific vocabulary. To explore these relations, we added vocabulary and book list knowledge, the latter as an indicator of the home literacy environment (Model 4). For applied mathematics, vocabulary explained an additional 21% of the variance but did not explain statistically significant variance in the arithmetic fluency. Book list knowledge did not account for unique variance in either outcome.

In summary, variability in the home environment, specifically parents' math attitudes and their reports of operational activities, accounted for some variance in arithmetic fluency.

However, the home learning environment did not account for individual differences in applied mathematics. Instead, vocabulary skills predicted children's applied mathematics scores. This finding will be explored in the Discussion.

## 4. Discussion

In the present study, we had two research goals. The first goal was to understand the home learning environment of 8-year-old, Grade 3 Canadian children; and the second goal was to determine whether the home learning environment predicts academic skills performance for these school aged children. In general, we found that the home learning environment included a variety of literacy and mathematics activities that parents shared with their children. As in previous studies with young children, parents showed individual differences to the extent to which they reported various home learning activities. We also found some relations between the home learning environment and children's literacy and mathematics skills. Below, we describe the ways in which the home learning environments in the current study with 8-year-old children were similar and different to those observed for younger Canadian children [20].

### 4.1. Literacy

Parents reported providing a range of literacy activities. The least frequent activity was visiting the library for children's books, whereas the most frequent activities were helping their child read English books and teaching their child to recognize printed words. On close examination, only three of the seven schools in the study had an accessible neighborhood public library within a 15-min walking or biking distance. The proximity of libraries to other participating schools involved a 10-min car ride or a 45-min bus ride in one direction. Library use has been associated with increased shared reading practices for kindergarten students in the U.S. [103]; library proximity within a community may account for the overall low frequency score in this sample. However, considering that the most frequent activity parents reported was reading books and working on printed words, these families were accessing reading materials in other ways. These ways might include materials sent home from school, use of the school libraries, and/or through the purchasing of home materials. For example, all schools in which the recruitment took place during the parent–teacher conferences had a popular book fair with new books available for purchase as a fundraiser for the school library.

Consistent with other research (e.g., [12,20]), parents' literacy attitudes were correlated with their reported frequency of literacy activities and knowledge of children's books, suggesting that these relations are consistent features of the home literacy environment involving 8-year-old children across various Canadian demographics (e.g., rural/urban, single language versus Immersion learning contexts). Canadian parents are still influencing children's literacy learning once their children are in school. In fact, parents are sensitive to the developmental reading capabilities of their children [41].

With respect to children's skills, parents' attitudes toward literacy and their knowledge of children's books (an indirect indicator of their time spent reading with their child) were correlated with their children's vocabulary. This finding is consistent with research involving young children in which shared reading and the availability of children's books is related to vocabulary knowledge [12]. Dong et al. [55] reported that reading comprehension was related to parents' home literacy activities and beliefs for children aged 6 through 12 years and was not moderated by age. We did not assess children's comprehension skills in the present study, but the pattern of relations with vocabulary is consistent with the view that this aspect of the home literacy environment is stable for children in the early school grades.

In contrast to research involving 5- and 6-year-old children [20], parents' reports of literacy activities in the current study were not related to their children's word reading skills. One possibility is that the literacy activities queried in the present study may not align with those important for reading skills for this age group. For example, 8-year-old children may have developed independent reading skills which may change the home

reading dynamic, or they may be practicing reading skills in an additional language (where parents may or may not be able to help depending on their familiarity of the additional language). The majority of these children attended Immersion schools but had learned to read in both English and French. Moreover, although it was not statistically significant, the trend was for a negative relation between frequency of literacy activities and word reading, suggesting that some parents may be helping children with weaker skills [94,99]. Another possibility is that, because parents' reports of literacy activities indicated that they frequently helped their child read, recognize words, and write stories, these home activities may be common regardless of children's reading skill level.

### 4.2. Mathematics

Parents reported a range of mathematics activities: "Doing math in your head", "Practicing addition and subtraction facts" and "Playing with toys such as Lego" were reported as the most frequent home mathematics activities of those listed on the survey. Activities associated with more complex skills, such as practicing multiplication facts and fractions, were reported less frequently than those associated with addition and subtraction. Mapping activities, many of which are frequently reported for young children in previous work (e.g., teaching about quantities, printing numbers [20]), were reported with somewhat lower frequency than in previous studies. Operational activities that were focused on arithmetic skills were reported more frequently, overall, than mapping activities. These patterns are consistent with the focus of mathematics instruction at this grade level, and so may reflect parents' knowledge of their children's skill levels for these activities [94,99].

Consistent with [20], parents' mathematics attitudes were correlated with arithmetic fluency, but not with other measures of the home learning environment. Mathematics attitudes were correlated with math anxiety of parents. Mothers reported higher anxiety and less positive attitudes toward math than fathers, consistent with the large literature on gender differences in mathematics anxiety and attitudes [104,105]. However, likely because of the low overall level of math anxiety reported by the parents in the current work, math anxiety was not related to children's mathematics performance. Mathematics homework was reported infrequently, and parents did not report feeling anxious about helping with their child's math homework, perhaps because the basic skills practiced in Grade 3 were within the competency range of these parents with community college or university education.

The frequency of reported literacy and mathematics activities was positively correlated. Literacy activities were correlated highly with both mapping and spatial activities, and moderately with operational activities. Thus, parents who reported one type of activity also reported similar levels of other types of activities. Despite these reporting consistencies, home learning experiences were differentially related to the literacy and mathematical outcomes, and thus replicate similar nuanced patterns for the home learning environments of young children from Canadian homes [20].

### 4.3. Mothers versus Fathers

In general, mothers' and fathers' reports of home learning environments were similar. For example, parents reported spending equal amounts of time helping with homework and had similar levels of knowledge about mathematics games (used as a proxy for how often families play games). This similarity in responses between parents can provide us with some confidence when extrapolating home learning research involving Canadian mothers, to Canadian families in general. In addition, most parents in this Canadian study were equally visible, attending the parent–teacher interviews at the schools together. According to Rose and Atkin [106], fathers have become more visible parents compared to previous generations of fathers. Baker [68] found that, when fathers were involved in their kindergarteners' school events, their involvement predicted reading and mathematics achievement scores even after controlling for maternal involvement, home learning context, and other demographic variables.

Some commonly observed differences across parents were nevertheless seen in our sample. For literacy, mothers reported engaging in more home literacy activities, they felt more positive toward reading and writing, and they had more knowledge of children's books than fathers. This pattern of differential shared reading is consistent with results reported by Swain et al. [71], who found that mothers were three times more likely to read to their 4- and 5-year-old children every day than were fathers.

For mathematics, Canadian mothers and fathers reported spending the same amount of time on home mathematics activities and helping children with their mathematics homework, which is in line with a Chilean study showing no gender differences in home mathematics contexts [62]. However, the Canadian fathers in the current study reported feeling more positive and less anxious about mathematics than mothers. The differences in responses of mothers and fathers in terms of math anxiety reflect the prevalence of negative feelings about mathematics among women, more generally [104], but did not extend to activities with their children. del Río et al. [84] attributed gender differences in parenting practices to societal cultural beliefs about males being proficient in mathematics, and these stereotypes are set before children start school. Although some research has suggested that parents' math anxiety may influence children's mathematics learning in the early grades [90] and into high school [107], the influence of teachers is also critical [108,109]. More research is needed to understand the factors that influence relations between parents' affect toward mathematics and literacy and their children's performance.

### 4.4. Homework

Because the children in this study were in their third year of formal schooling, we asked about homework. Parents reported that children spent between 1 and 15 min of homework per week for each of math, reading, writing, and spelling, which is consistent with the view in these schools that homework should play a limited role in learning for children at this age. Parents reported helping their children with homework about the same amount of time as they reported that children had homework, suggesting this was a shared activity. In summary, homework was infrequent and the amount of homework reported to be completed was unrelated to children's academic performance. These patterns might be different in school systems where homework is expected and occurs frequently.

### 4.5. Spatial Activities

Research on spatial activities within the home learning environment is limited [11]. Consistent with some research (e.g., [110]), the frequency of spatial activities was not related to children's mathematics in the present study. Moreover, although mathematics is related to spatial abilities, the relation is complex and may not be causal [111]. More detailed and precise measures of children's home experiences that might relate to spatial skills at all age and grade levels will be necessary to understand the extent to which these specific home activities may influence mathematical development.

### 4.6. Limitations

Despite our efforts to recruit fathers and even parents in general, mothers were still more likely to agree to complete the survey than fathers. Parents are often considered an untapped resource on the one hand, but busy with their families on the other, and do not have the resources to participate in non-monetized activities with little direct benefit. Although the findings are in line with our home learning Canadian research program, because of the small sample size, comparisons between mothers and fathers should be considered with caution. Further research that includes fathers and this school-age demographic are recommended to replicate and generalize findings. Studies that include both parents from the same families are also important [62]. Further investigation through focus groups or pilot testing may also consider the range of questions on home learning surveys; fathers may make qualitatively different contributions that have not been considered in this research area. Anecdotally, fathers in this current study mentioned their role in physical

activities and sports, and supervision during free play or leisure times, involvement which might be distinct from that of mothers. Other diversity considerations include information about non-binary support roles and families that include other caregivers who provide additional learning supports. Although an attempt was made to recruit diverse families in this research, even more diversity than that reported in the current work would have been informative. Finally, given increased societal awareness about the important role of parents as illuminated by the COVID-19 pandemic, future research is needed to determine if and how the pandemic lockdowns and social isolation periods affected the educational dynamics of the home-school learning relationship.

### *4.7. Educational Implications*

Based on the findings of this study and other research (e.g., [61,112], caregivers should be encouraged to continue literacy and mathematics learning opportunities even after children start full-day schooling. Moreover, fathers' participation in research, home learning, and school involvement should be encouraged. Both parents are encouraged to contribute to home learning in Canada, with non-stereotypic genderized roles, and by providing literacy and mathematics practice opportunities to support their children's educational goals. Finally, providing parents and teachers with information about the diverse activities that can be included in the home learning environment may help them to understand that attitudes, preferences, and stereotypes may shape their children's learning.

### *4.8. Conclusions*

The study extends our understanding of the home learning environment of Canadian children into middle childhood. Consistent with previous Canadian research [20,75,93,99], school aged children receive academic support from their parents (or caregivers), who guide, expose, mentor, explain, expand, apply, and interpret literacy and mathematics in home contexts. The home environment (attitudes, affect, activities) was related to Grade 3 (8-year olds) children's vocabulary and arithmetic fluency scores. Responses were similar for Canadian mothers and fathers; however, mothers reported more positive attitudes toward literacy and they knew more titles of children's books (indicative of reading practices) than fathers. In contrast, fathers showed more positive attitudes and less anxiety toward mathematics than mothers. Despite these parental differences, both mothers and fathers reported helping with children's homework and providing a variety of educational home activities. Given differences in sample sizes and age ranges, and the linguistic and cultural differences from studies completed around the world, further collaborative large scale, multi-site work using similar measures and methods is required to interpret the growing range of cross-cultural findings extant on home-school practices encouraging learning from the preschool years and beyond [25].

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## Appendix A

**Table A1.** Correlations amongst the home numeracy environment and students' mathematical outcomes (mothers are above the diagonal, fathers are below the diagonal).

| | | | | Home Activities | | | | Math Attitudes | | | Outcomes | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | **1** | **2** | **3** | **4** | **5** | **6** | **7** | **8** | **9** | **10** | **11** |
| 1 | Parent Education | | 0.25 | 0.18 | 0.26 | 0.13 | 0.04 | −0.07 | 0.01 | −0.25 | 0.01 | −0.09 |
| | Home Activities | | | | | | | | | | | |
| 2 | Operational | 0.43 * | | 0.65 ** | 0.48 ** | −0.25 | 0.42 ** | 0.13 | −0.27 | −0.05 | 0.29 * | 0.29 * |
| 3 | Mapping | 0.17 | 0.70 ** | | 0.65 ** | −0.04 | 0.46 ** | 0.04 | −0.07 | −0.11 | 0.16 | 0.24 |
| 4 | Spatial | 0.04 | 0.55 ** | 0.82 ** | | 0.01 | 0.30 * | −0.10 | 0.05 | −0.14 | 0.00 | 0.11 |
| 5 | Games checklist | −0.01 | −0.47 ** | −0.41 * | −0.29 | | −0.16 | −0.08 | 0.02 | −0.32 * | 0.03 | 0.17 |
| 6 | Math HW help | 0.35 | 0.52 ** | 0.31 | 0.30 | −0.40 * | | 0.16 | −0.11 | −0.15 | −0.04 | −0.08 |
| | Attitudes/Anxiety | | | | | | | | | | | |
| 7 | Math attitudes | 0.17 | 0.33 | 0.06 | −0.00 | 0.07 | 0.28 | | −0.44 ** | 0.19 | 0.14 | −0.04 |
| 8 | Gen. math anxiety | 0.40 * | −0.33 | −0.24 | −0.18 | 0.26 | −0.41 * | −0.50 ** | | −0.13 | 0.01 | 0.09 |
| 9 | Math HW anxiety | −0.48 ** | −0.38 * | −0.15 | −0.10 | 0.08 | −0.23 | −0.71 ** | 0.42 * | | 0.18 | 0.12 |
| | Outcomes | | | | | | | | | | | |
| 10 | Fluency | 0.39 * | 0.43 * | 0.38 * | 0.46 * | −0.15 | 0.23 | 0.38 * | −0.12 | −0.35 | | 0.52 ** |
| 11 | Applied Math | 0.45 * | 0.12 | 0.11 | 0.10 | 0.00 | −0.02 | 0.29 | −0.22 | −0.47 * | 0.60 ** | |

*Notes*. * $p < 0.05$. ** $p < 0.01$.

**Table A2.** Regression predicting arithmetic including interaction effects.

| | $\beta$ | $p$ | Semi Partial ($r$) | Unique $R^2$ |
|---|---|---|---|---|
| Full Model | | | | |
| Parent education | 0.16 | 0.18 | 0.145 | 0.021 |
| **Math attitudes** | **0.30** | **0.03 *** | **0.238** | **0.057** |
| Math anxiety | 0.39 | 0.07 | 0.198 | 0.039 |
| **Operational activities** | **0.32** | **0.01 *** | **0.281** | **0.079** |
| Parent | **0.26** | **0.05 *** | **0.218** | **0.048** |
| Parent * attitudes | 0.13 | 0.33 | 0.106 | 0.011 |
| Parent * anxiety | 0.24 | 0.25 | 0.127 | 0.016 |
| Parent * operations | 0.04 | 0.75 | 0.035 | 0.001 |
| Total $R^2$ | **0.24** | **0.02 *** | | |

*Notes*. Statistically significant $\beta$ values have been bolded. * $p < 0.05$. Interaction effects were calculated with mean-centred variables and coding mother = −1, father = 1.

**Table A3.** Correlations amongst the home literacy environment and children's mathematical outcomes (mothers above the diagonal, fathers below the diagonal).

| | | **1** | **2** | **3** | **4** | **5** | **6** | **7** |
|---|---|---|---|---|---|---|---|---|
| 1 | Parent education | | 0.04 | 0.35 * | 0.37 ** | 0.16 | 0.19 | −0.05 |
| 2 | Literacy attitudes | 0.40 * | | 0.18 | 0.06 | 0.15 | 0.23 | 0.22 |
| 3 | Literacy Activities | 0.17 | 0.54 ** | | 0.34 * | 0.36 * | 0.27 | 0.15 |
| 4 | Children's book list | 0.37 ** | 0.13 | 0.13 | | −0.09 | 0.36 * | 0.22 |
| 5 | Homework help | 0.02 | 0.47 ** | 0.58 ** | 0.04 | | 0.01 | −0.05 |
| 6 | Vocabulary | 0.34 | 0.31 | 0.04 | 0.30 | −0.04 | | 0.48 ** |
| 7 | Word reading | 0.50 ** | 0.19 | 0.07 | −0.11 | −0.34 | 0.40 * | |

* $p < 0.05$. ** $p < 0.01$.

**Table A4.** Regression predicting student vocabulary including interaction effects.

| | $\beta$ | $p$ | Semi Partial ($r$) |
|---|---|---|---|
| Model 4 | | | |
| Parent education | 0.14 | 0.27 | 0.137 |
| Literacy attitudes | 0.28 | 0.03 * | 0.260 |
| Literacy activities | −0.08 | 0.53 | −0.078 |
| Children's book list | 0.34 | 0.02 ** | 0.281 |
| Parent | 0.06 | 0.65 | 0.056 |
| Parent * attitudes | 0.06 | 0.64 | 0.058 |
| Parent * activities | −0.15 | 0.23 | −0.147 |
| Parent * books | 0.05 | 0.67 | 0.051 |
| Total $R^2$ | 0.27 | 0.01 ** | |

*Notes.* * $p < 0.05$. ** $p < 0.01$. Interaction effects were calculated with mean-centred variables and coding mother = −1, father = 1.

## References


1. Borgonovi, F.; Choi, A.; Paccagnella, M. The Evolution of Gender Gaps in Numeracy and Literacy between Childhood and Young Adulthood. *Econ. Educ. Rev.* **2021**, *82*, 102119. [CrossRef]
2. OECD. *Education at a Glance 2013: OECD Indicators*; OECD: Paris, France, 2013; Volume 196. [CrossRef]
3. Grunau, P. Literacy and Numeracy of Overeducated and Undereducated Workers: Revisiting the Allocation Process in the Labour Market. *Educ. Econ.* **2020**, *28*, 403–417. [CrossRef]
4. Anders, Y.; Grosse, C.; Rossbach, H.G.; Ebert, S.; Weinert, S. Preschool and Primary School Influences on the Development of Children's Early Numeracy Skills between the Ages of 3 and 7 Years in Germany. *Sch. Eff. Sch. Improv.* **2013**, *24*, 195–211. [CrossRef]
5. Skopek, J.; Passaretta, G. Socioeconomic Inequality in Children's Achievement from Infancy to Adolescence: The Case of Germany. *Soc. Forces* **2021**, *100*, 86–112. [CrossRef]
6. Cahoon, A.; Cassidy, T.; Purpura, D.J.; Simms, V. Developing a Rigorous Measure of the Pre-School Home Mathematics Environment. *J. Numer. Cogn.* **2021**, *7*, 172–194. [CrossRef]
7. Davis-Kean, P.E.; Tighe, L.A.; Waters, N.E. The Role of Parent Educational Attainment in Parenting and Children's Development. *Curr. Dir. Psychol. Sci.* **2021**, *30*, 186–192. [CrossRef]
8. Duncan, G.J.; Dowsett, C.J.; Claessens, A.; Magnuson, K.; Huston, A.C.; Klebanov, P.; Pagani, L.S.; Feinstein, L.; Engel, M.; Brooks-Gunn, J.; et al. School Readiness and Later Achievement. *Dev. Psychol.* **2007**, *43*, 1428–1446. [CrossRef] [PubMed]
9. Entwisle, D.R.; Alexander, K.L.; Olson, L.S.; Miech, R.; Direct, F.M. First Grade and Educational Attainment by Age 22: A New Story. *Am. J. Sociol.* **2005**, *110*, 1458–1502. [CrossRef]
10. Siegler, R.S.; Duncan, G.J.; Davis-Kean, P.E.; Duckworth, K.; Claessens, A.; Engel, M.; Susperreguy, M.I.; Chen, M. Early Predictors of High School Mathematics Achievement. *Psychol. Sci.* **2012**, *23*, 691–697. [CrossRef] [PubMed]
11. Sénéchal, M.; Whissell, J.; Bildfell, A. Starting from Home: Home Literacy Practices That Make a Difference. In *Thoeries of Reading Development*; Cain, K., Compton, D.L., Parrila, R.K., Eds.; John Benjamins Publishing Company: Amsterdam, The Netherlands, 2017; pp. 383–408.
12. Daucourt, M.C.; Napoli, A.R.; Quinn, J.M.; Wood, S.G.; Hart, S.A. The Home Math Environment and Math Achievement: A Meta-Analysis. *Psychol. Bull.* **2021**, *147*, 565–596. [CrossRef] [PubMed]
13. Mues, A.; Birtwistle, E.; Wirth, A.; Niklas, F. Parental (Stem) Occupations, the Home Numeracy Environment, and Kindergarten Children's Numerical Competencies. *Educ. Sci.* **2021**, *11*, 819. [CrossRef]
14. Arteaga, I.; Glewwe, P. Do Community Factors Matter? An Analysis of the Achievement Gap between Indigenous and Non-Indigenous Children in Peru. *Int. J. Educ. Dev.* **2019**, *65*, 80–91. [CrossRef]
15. Attig, M.; Weinert, S. What Impacts Early Language Skills? Effects of Social Disparities and Different Process Characteristics of the Home Learning Environment in the First 2 Years. *Front. Psychol.* **2020**, *11*, 3218. [CrossRef] [PubMed]
16. Elliott, L.; Zheng, P.; Libertus, M. Individual Differences in Parental Support for Numeracy and Literacy in Early Childhood. *Educ. Sci.* **2021**, *11*, 541. [CrossRef]
17. Ramani, G.B.; Siegler, R.S. Reducing the Gap in Numerical Knowledge between Low- and Middle-Income Preschoolers. *J. Appl. Dev. Psychol.* **2011**, *32*, 146–159. [CrossRef]
18. Barone, C.; Chambuleyron, E.; Vonnak, R.; Assirelli, G. Home-Based Shared Book Reading Interventions and Children's Language Skills: A Meta-Analysis of Randomised Controlled Trials. *Educ. Res. Eval.* **2019**, *25*, 270–298. [CrossRef]
19. Mutaf Yıldız, B.; Sasanguie, D.; de Smedt, B.; Reynvoet, B. Frequency of Home Numeracy Activities Is Differentially Related to Basic Number Processing and Calculation Skills in Kindergartners. *Front. Psychol.* **2018**, *9*, 1–13. [CrossRef] [PubMed]
20. Skwarchuk, S.-L.; Sowinski, C.; LeFevre, J.-A. Formal and Informal Home Learning Activities in Relation to Children's Early Numeracy and Literacy Skills: The Development of a Home Numeracy Model. *J. Exp. Child Psychol.* **2014**, *121*, 63–84. [CrossRef] [PubMed]

21. Chen, J.; Park, A. School Entry Age and Educational Attainment in Developing Countries: Evidence from China's Compulsory Education Law. *J. Comp. Econ.* **2021**, *49*, 715–732. [CrossRef]
22. Newton, X. Reflections on Math Reforms in the U.S.: A Cross-National Perspective. *Phi Delta Kappan* **2007**, *88*, 681–685. [CrossRef]
23. Stites, M.L.; Sonnenschein, S.; Chen, Y.; Imai-Matsumura, K.; Gürsoy, H. Facilitating Preschool Children's Mathematics Development in China, Japan, and the United States: Is the Classroom Library Considered? *Educ. Sci.* **2021**, *11*, 792. [CrossRef]
24. Zhao, Y. Increasing Math and Science Achievement: The Best and Worst of the East and West. *Phi Delta Kappan* **2005**, *87*, 219–222. [CrossRef]
25. Hornburg, C.B.; Borriello, G.A.; Kung, M.; Lin, J.; Litkowski, E.; Cosso, J.; Ellis, A.; King, Y.A.; Zippert, E.; Cabrera, N.J.; et al. Next Directions in Measurement of the Home Mathematics Environment: An International and Interdisciplinary Perspective. *J. Numer. Cogn.* **2021**, *7*, 195–220. [CrossRef] [PubMed]
26. Salminen, J.; Khanolainen, D.; Koponen, T.; Torppa, M.; Lerkkanen, M.K. Development of Numeracy and Literacy Skills in Early Childhood—A Longitudinal Study on the Roles of Home Environment and Familial Risk for Reading and Math Difficulties. *Front. Educ.* **2021**, *6*, 1–23. [CrossRef]
27. Vygotsky, L.S. *The Collected Works of LS Vygotsky, Volume 1: Problems of General Psychology, Including the Volume Thinking and Speech*; Springer: New York, NY, USA, 1987.
28. Girard, C.; Bastelica, T.; Léone, J.; Epinat-Duclos, J.; Longo, L.; Prado, J. The Relation between Home Numeracy Practices and a Variety of Math Skills in Elementary School Children. *PLoS ONE* **2021**, *16*, 1–25. [CrossRef] [PubMed]
29. Goldstein, H.; Kelley, E.; Greenwood, C.; McCune, L.; Carta, J.; Atwater, J.; Guerrero, G.; McCarthy, T.; Schneider, N.; Spencer, T. Embedded Instruction Improves Vocabulary Learning during Automated Storybook Reading among High-Risk Preschoolers. *J. Speech Lang. Hear. Res.* **2016**, *59*, 484–500. [CrossRef] [PubMed]
30. Martini, F.; Sénéchal, M. Learning Literacy Skills at Home: Parent Teaching, Expectations, and Child Interest. *Can. J. Behav. Sci.* **2012**, *44*, 210–221. [CrossRef]
31. Suggate, S.P. A Meta-Analysis of the Long-Term Effects of Phonemic Awareness, Phonics, Fluency, and Reading Comprehension Interventions. *J. Learn. Disabil.* **2016**, *49*, 77–96. [CrossRef]
32. Leyva, D.; Davis, A.; Skorb, L. Math Intervention for Latino Parents and Kindergarteners Based on Food Routines. *J. Child Fam. Stud.* **2018**, *27*, 2541–2551. [CrossRef]
33. Mutaf-Yıldız, B.; Sasanguie, D.; de Smedt, B.; Reynvoet, B. Probing the Relationship between Home Numeracy and Children's Mathematical Skills: A Systematic Review. *Front. Psychol.* **2020**, *11*, 2074. [CrossRef]
34. Aubrey, C.; Bottle, G.; Godfrey, R. Early Mathematics in the Home and Out-of-Home Contexts. *Int. J. Early Years Educ.* **2003**, *11*, 91–103. [CrossRef]
35. Skwarchuk, S.-L. How Do Parents Support Preschoolers' Numeracy Learning Experiences at Home? *Early Child. Educ. J.* **2009**, *37*, 189–197. [CrossRef]
36. Huntsinger, C.S.; Jose, P.E.; Larson, S.L. Do Parent Practices to Encourage Academic Competence Influence the Social Adjustment of Young European American and Chinese American Children? *Dev. Psychol.* **1998**, *34*, 747–756. [CrossRef] [PubMed]
37. Zhu, J.; Chiu, M.M. Early Home Numeracy Activities and Later Mathematics Achievement: Early Numeracy, Interest, and Self-Efficacy as Mediators. *Educ. Stud. Math.* **2019**, *102*, 173–191. [CrossRef]
38. Hoover-Dempsey, K.V.; Sandler, H.M. Why Do Parents Become Involved in Their Children's Education? *Rev. Educ. Res.* **1997**, *67*, 3–42. [CrossRef]
39. Lukie, I.K.; Skwarchuk, S.L.; LeFevre, J.-A.; Sowinski, C. The Role of Child Interests and Collaborative Parent-Child Interactions in Fostering Numeracy and Literacy Development in Canadian Homes. *Early Child. Educ. J.* **2014**, *42*, 251–259. [CrossRef]
40. Joe, E.M.; Davis, J.E. Parental Influence, School Readiness and Early Academic Achievement of African American Boys. *J. Negro Educ.* **2009**, *78*, 260–276.
41. Aram, D.; Besser-Biron, S. Parents' Support during Different Writing Tasks: A Comparison between Parents of Precocious Readers, Preschoolers, and School-Age Children. *Read. Writ.* **2017**, *30*, 363–386. [CrossRef]
42. McDowall, P.S.; Taumoepeau, M.; Schaughency, E. Parent Involvement in Beginning Primary School: Correlates and Changes in Involvement across the First Two Years of School in a New Zealand Sample. *J. Sch. Psychol.* **2017**, *62*, 11–31. [CrossRef]
43. Leyva, D.; Catalán Molina, D.; Suárez, C.; Tamis-LeMonda, C.S.; Yoshikawa, H. Mother-Child Reminiscing and First-Graders' Emotion Competence in a Low-Income and Ethnically Diverse Sample. *J. Cogn. Dev.* **2021**, *22*, 501–522. [CrossRef]
44. Ciping, D.; Silinskas, G.; Wei, W.; Georgiou, G.K. Cross-Lagged Relationships between Home Learning Environment and Academic Achievement in Chinese. *Early Child. Res. Q.* **2015**, *33*, 12–20. [CrossRef]
45. Georgiou, G.K.; Inoue, T.; Parrila, R. Developmental Relations between Home Literacy Environment, Reading Interest, and Reading Skills: Evidence from a 3-Year Longitudinal Study. *Child Dev.* **2021**, *92*, 2053–2068. [CrossRef] [PubMed]
46. Retanal, F.; Johnston, N.B.; di Lonardo Burr, S.M.; Storozuk, A.; Distefano, M.; Maloney, E.A. Controlling-Supportive Homework Help Partially Explains the Relation between Parents' Math Anxiety and Children's Math Achievement. *Educ. Sci.* **2021**, *11*, 620. [CrossRef]
47. Gan, Y.; Bilige, S. Parental Involvement in Home-Based Education and Children's Academic Achievement in China. *Soc. Behav. Personal.* **2019**, *47*, 1–15. [CrossRef]
48. Susperreguy, M.I.; Jimenez Lira, C.; Le-Fevre, J.-A. Cross-Cultural Comparisons of Home Numeracy and Literacy. *Educ. Sci.* **2022**, *12*, 62. [CrossRef]

49. LeFevre, J.; Polyzoi, E.; Skwarchuk, S.-L.; Fast, L.; Sowinski, C. Do Home Numeracy and Literacy Practices of Greek and Canadian Parents Predict the Numeracy Skills of Kindergarten Children? *Int. J. Early Years Educ.* **2010**, *18*, 55–70. [CrossRef]
50. Schumacher Dimech, A.; Seiler, R. Extra-Curricular Sport Participation: A Potential Buffer against Social Anxiety Symptoms in Primary School Children. *Psychol. Sport Exerc.* **2011**, *12*, 347–354. [CrossRef]
51. Silinskas, G.; Kiuru, N.; Aunola, K.; Lerkkanen, M.K.; Nurmi, J.E. The Developmental Dynamics of Children's Academic Performance and Mothers' Homework-Related Affect and Practices. *Dev. Psychol.* **2015**, *51*, 419–433. [CrossRef]
52. Dockett, S.; Perry, B.; Kearney, E. Family Transitions as Children Start School. *Fam. Matters* **2012**, *90*, 57–67.
53. Kwing Cheung, S.; Yee Cheng, W.; Cheung, R.Y.; Yi Hung Lau, E.; Kien Hoa Chung, K. Home Learning Activities and Parental Autonomy Support as Predictors of Pre-Academic Skills: The Mediating Role of Young Children's School Liking. *Learn. Individ. Differ.* **2022**, *94*, 102127. [CrossRef]
54. Boerma, I.E.; Mol, S.E.; Jolles, J. Parents Adjust the Quality of Their Home Literacy Environment to the Reading Interest of Their Third to Sixth Graders. *Parenting* **2018**, *18*, 240–258. [CrossRef]
55. Dong, Y.; Dong, W.Y.; Wu, S.X.Y.; Tang, Y. The Effects of Home Literacy Environment on Children's Reading Comprehension Development: A Meta-Analysis. *Educ. Sci. Theory Pract.* **2020**, *20*, 63–82. [CrossRef]
56. Dong, Y.; Chow, B.W.Y. Home Literacy Environment and English as a Second Language Acquisition: A Meta-Analysis. *Lang. Learn. Dev.* **2022**, 1–15. [CrossRef]
57. Klauda, S.L. The Role of Parents in Adolescents' Reading Motivation and Activity. *Educ. Psychol. Rev.* **2009**, *21*, 325–363. [CrossRef]
58. Myrberg, E.; Rosén, M. Direct and Indirect Effects of Parents' Education on Reading Achievement among Third Graders in Sweden. *Br. J. Educ. Psychol.* **2009**, *79*, 695–711. [CrossRef]
59. Torppa, M.; Vasalampi, K.; Eklund, K.; Niemi, P. Long-Term Effects of the Home Literacy Environment on Reading Development: Familial Risk for Dyslexia as a Moderator. *J. Exp. Child Psychol.* **2022**, *215*, 105314. [CrossRef] [PubMed]
60. Lehrl, S.; Ebert, S.; Blaurock, S.; Rossbach, H.G.; Weinert, S. Long-Term and Domain-Specific Relations between the Early Years Home Learning Environment and Students' Academic Outcomes in Secondary School. *Sch. Eff. Sch. Improv.* **2020**, *31*, 102–124. [CrossRef]
61. Niklas, F.; Schneider, W. Home Learning Environment and Development of Child Competencies from Kindergarten until the End of Elementary School. *Contemp. Educ. Psychol.* **2017**, *49*, 263–274. [CrossRef]
62. Susperreguy, M.I.; di Lonardo Burr, S.; Douglas, H.; Xu, C.; LeFevre, J.-A.; del Rio, M.F.; Salinas, V. Home Mathematics Environment and Math Performance of Chilean Students in Kindergarten and Grades 1 to 3. *Early Child. Res. Q.* **2022**, *59*, 84–95. [CrossRef]
63. Metzger, S.R.; Sonnenschein, S.; Galindo, C. Elementary-Age Children's Conceptions about Mathematics Utility and Their Home-Based Mathematics Engagement. *J. Educ. Res.* **2019**, *112*, 431–446. [CrossRef]
64. Bronfenbrenner, U. *The Ecology of Human Development: Experiments by Nature and Design*; Harvard University Press: Cambridge, MA, USA, 1979.
65. Reilly, L.; Rees, S. Fatherhood in Australian Aboriginal and Torres Strait Islander Communities: An Examination of Barriers and Opportunities to Strengthen the Male Parenting Role. *Am. J. Men's Health* **2018**, *12*, 420–430. [CrossRef] [PubMed]
66. Saracho, O.N. Fathers and Young Children's Literacy Experiences in a Family Environment. *Early Child Dev. Care* **2007**, *177*, 403–415. [CrossRef]
67. Varghese, C.; Wachen, J. The Determinants of Father Involvement and Connections to Children's Literacy and Language Outcomes: Review of the Literature. *Marriage Fam. Rev.* **2016**, *52*, 331–359. [CrossRef]
68. Baker, C.E. When Daddy Comes to School: Father–School Involvement and Children's Academic and Social–Emotional Skills. *Early Child Dev. Care* **2018**, *188*, 208–219. [CrossRef]
69. Baker, C.E. Fathers' and Mothers' Language Acculturation and Parenting Practices: Links to Mexican American Children's Academic Readiness. *J. Early Child. Res.* **2018**, *16*, 52–64. [CrossRef]
70. Baker, C.E.; Kainz, K.L.; Reynolds, E.R. Family Poverty, Family Processes and Children's Preschool Achievement: Understanding the Unique Role of Fathers. *J. Child Fam. Stud.* **2018**, *27*, 1242–1251. [CrossRef]
71. Swain, J.; Cara, O.; Mallows, D. 'We Occasionally Miss a Bath but We Never Miss Stories': Fathers Reading to Their Young Children in the Home Setting. *J. Early Child. Lit.* **2017**, *17*, 176–202. [CrossRef]
72. Clark, C. Why Fathers Matter to Their Children's Literacy. *Natl. Lit. Trust* **2009**, 3–16.
73. Schieman, S.; Ruppanner, L.; Milkie, M.A. Who Helps with Homework? Parenting Inequality and Relationship Quality among Employed Mothers and Fathers. *J. Fam. Econ. Issues* **2018**, *39*, 49–65. [CrossRef]
74. Flippin, M.; Hahs-Vaughn, D.L. Parent Couples' Participation in Speech-Language Therapy for School-Age Children with Autism Spectrum Disorder in the United States. *Autism* **2020**, *24*, 321–337. [CrossRef]
75. LeFevre, J.-A.; Kwarchuk, S.L.; Smith-Chant, B.L.; Fast, L.; Kamawar, D.; Bisanz, J. Home Numeracy Experiences and Children's Math Performance in the Early School Years. *Can. J. Behav. Sci.* **2009**, *41*, 55–66. [CrossRef]
76. Wu, T.C.H.; Meehan, A.J.; Rijlaarsdam, J.; Maughan, B.; Fearon, P.; Barker, E.D. Developmental Pathways from Toddler Difficult Temperament to Child Generalized Psychopathology and Adult Functioning. *J. Affect. Disord.* **2022**, *301*, 14–22. [CrossRef] [PubMed]

77. Del Río, M.F.; Susperreguy, M.I.; Strasser, K.; Salinas, V. Distinct Influences of Mothers and Fathers on Kindergartners' Numeracy Performance: The Role of Math Anxiety, Home Numeracy Practices, and Numeracy Expectations. *Early Educ. Dev.* **2017**, *28*, 939–955. [CrossRef]
78. Klauda, S.L.; Wigfield, A. Relations of Perceived Parent and Friend Support for Recreational Reading with Children's Reading Motivations. *J. Lit. Res.* **2012**, *44*, 3–44. [CrossRef]
79. Ortiz, R.W. Hispanic/Latino Fathers and Children's Literacy Development: Examining Involvement Practices from a Sociocultural Context. *J. Lat. Educ.* **2004**, *3*, 165–180. [CrossRef]
80. Liu, Y.; Zhang, X.; Song, Z.; Yang, W. The Unique Role of Father–Child Numeracy Activities in Number Competence of Very Young Chinese Children. *Infant Child Dev.* **2019**, *28*, 1–16. [CrossRef]
81. Huang, Q.; Zhang, X.; Liu, Y.; Yang, W.; Song, Z. The Contribution of Parent–Child Numeracy Activities to Young Chinese Children's Mathematical Ability. *Br. J. Educ. Psychol.* **2017**, *87*, 328–344. [CrossRef]
82. Valenzuela, J.P.; Bellei, C.; de los Ríos, D. Socioeconomic School Segregation in a Market-Oriented Educational System. The Case of Chile. *J. Educ. Policy* **2014**, *29*, 217–241. [CrossRef]
83. Ramírez, M.J. Understanding the Low Mathematics Achievement of Chilean Students: A Cross-National Analysis Using TIMSS Data. *Int. J. Educ. Res.* **2006**, *45*, 102–116. [CrossRef]
84. Del Río, M.F.; Strasser, K.; Cvencek, D.; Susperreguy, M.I.; Meltzoff, A.N. Chilean Kindergarten Children's Beliefs about Mathematics: Family Matters. *Dev. Psychol.* **2019**, *55*, 687–702. [CrossRef]
85. Sonnenschein, S.; Baker, L.; Serpell, R.; Scher, D.; Truitt, V.G.; Munsterman, K. Parental Beliefs about Ways to Help Children Learn to Read: The Impact of an Entertainment or a Skills Perspective. *Early Child Dev. Care* **1997**, *127*, 111–118. [CrossRef]
86. Sonnenschein, S.; Metzger, S.R.; Thompson, J.A. Low-Income Parents' Socialization of Their Preschoolers' Early Reading and Math Skills. *Res. Hum. Dev.* **2016**, *13*, 207–224. [CrossRef]
87. McGeown, S.; Bonsall, J.; Andries, V.; Howarth, D.; Wilkinson, K. Understanding Reading Motivation across Different Text Types: Qualitative Insights from Children. *J. Res. Read.* **2020**, *43*, 597–608. [CrossRef]
88. Altun, D.; Tantekin Erden, F.; Hartman, D.K. Preliterate Young Children's Reading Attitudes: Connections to the Home Literacy Environment and Maternal Factors. *Early Child. Educ. J.* **2022**, *50*, 567–578. [CrossRef]
89. Berkowitz, T.; Gibson, D.J.; Levine, S.C. Parent Math Anxiety Predicts Early Number Talk. *J. Cogn. Dev.* **2021**, *22*, 523–536. [CrossRef] [PubMed]
90. Maloney, E.A.; Ramirez, G.; Gunderson, E.A.; Levine, S.C.; Beilock, S.L. Intergenerational Effects of Parents' Math Anxiety on Children's Math Achievement and Anxiety. *Psychol. Sci.* **2015**, *26*, 1480–1488. [CrossRef]
91. Hildebrand, L.; Posid, T.; Moss-Racusin, C.A.; Hymes, L.; Cordes, S. Does My Daughter like Math? Relations between Parent and Child Math Attitudes and Beliefs. *Dev. Sci.* **2022**, 1–21. [CrossRef] [PubMed]
92. Lazarides, R.; Watt, H.M.G. Student-Perceived Mothers' and Fathers' Beliefs, Mathematics and English Motivations, and Career Choices. *J. Res. Adolesc.* **2017**, *27*, 826–841. [CrossRef] [PubMed]
93. Sénéchal, M.; LeFevre, J.A. Parental Involvement in the Development of Children's Reading Skill: A Five-Year Longitudinal Study. *Child Dev.* **2002**, *73*, 445–460. [CrossRef] [PubMed]
94. Silinskas, G.; di Lonardo, S.; Douglas, H.; Xu, C.; LeFevre, J.-A.; Garckija, R.; Gabrialaviciute, I.; Raiziene, S. Responsive Home Numeracy as Children Progress from Kindergarten through Grade 1. *Early Child. Res. Q.* **2020**, *53*, 484–495. [CrossRef]
95. Davis-Kean, P.E. The Influence of Parent Education and Family Income on Child Achievement: The Indirect Role of Parental Expectations and the Home Environment. *J. Fam. Psychol.* **2005**, *19*, 294–304. [CrossRef] [PubMed]
96. Vazquez, S.R.; Ermeling, B.A.; Ramirez, G. Parental Beliefs on the Efficacy of Productive Struggle and Their Relation to Homework-Helping Behavior. *J. Res. Math. Educ.* **2020**, *51*, 179–203. [CrossRef]
97. Pomerantz, E.M.; Wang, Q.; Ng, F.F.Y. Mothers' Affect in the Homework Context: The Importance of Staying Positive. *Dev. Psychol.* **2005**, *41*, 414–427. [CrossRef] [PubMed]
98. Morrongiello, B.A.; Kane, A.; Zdzieborski, D. "I Think He Is in His Room Playing a Video Game": Parental Supervision of Young Elementary-School Children at Home. *J. Pediatric Psychol.* **2011**, *36*, 708–717. [CrossRef]
99. Sénéchal, M.; LeFevre, J.-A. Continuity and Change in the Home Literacy Environment as Predictors of Growth in Vocabulary and Reading. *Child Dev.* **2014**, *85*, 1552–1568. [CrossRef] [PubMed]
100. Susperreguy, M.I.; Douglas, H.; Xu, C.; Molina-Rojas, N.; LeFevre, J.-A. Expanding the Home Numeracy Model to Chilean Children: Relations among Parental Expectations, Attitudes, Activities, and Children's Mathematical Outcomes. *Early Child. Res. Q.* **2020**, *50*, 16–28. [CrossRef]
101. Chan, W.W.L.; Wong, T.T.Y. Subtypes of Mathematical Difficulties and Their Stability. *J. Educ. Psychol.* **2020**, *112*, 649–666. [CrossRef]
102. Connolly, A.J. *Key Math 3-Diagnostic Assessment*; Pearson: Minneapolis, MN, USA, 2007.
103. Mann, M.; Silver, E.J.; Stein, R.E.K. Kindergarten Children's Academic Skills: Association with Public Library Use, Shared Book Reading and Poverty. *Read. Psychol.* **2021**, *42*, 606–624. [CrossRef]
104. Hart, S.A.; Ganley, C.M. The Nature of Math Anxiety in Adults: Prevalence and Correlates. *J. Numer. Cogn.* **2019**, *5*, 122–139. [CrossRef] [PubMed]
105. Suárez-Pellicioni, M.; Núñez-Peña, M.I.; Colomé, À. Math Anxiety: A Review of Its Cognitive Consequences, Psychophysiological Correlates, and Brain Bases. *Cogn. Affect. Behav. Neurosci.* **2016**, *16*, 3–22. [CrossRef] [PubMed]

106. Rose, A.; Atkin, C. Family Literacy Programmes: A Comparative Study of Gender Roles in England, Ireland and Malta. *Early Child Dev. Care* **2011**, *181*, 775–790. [CrossRef]
107. Soni, A.; Kumari, S. The Role of Parental Math Anxiety and Math Attitude in Their Children's Math Achievement. *Int. J. Sci. Math. Educ.* **2015**, *15*, 331–347. [CrossRef]
108. Beilock, S.L.; Gunderson, E.A.; Ramirez, G.; Levine, S.C. Female Teachers' Math Anxiety Affects Girls' Math Achievement. *Proc. Natl. Acad. Sci. USA* **2010**, *107*, 1860–1863. [CrossRef] [PubMed]
109. Schaeffer, M.W.; Rozek, C.S.; Maloney, E.A.; Berkowitz, T.; Levine, S.C.; Beilock, S.L. Elementary School Teachers' Math Anxiety and Students' Math Learning: A Large-Scale Replication. *Dev. Sci.* **2020**, *24*, 1–6. [CrossRef] [PubMed]
110. Dearing, E.; Casey, B.M.; Ganley, C.M.; Tillinger, M.; Laski, E.; Montecillo, C. Young Girls' Arithmetic and Spatial Skills: The Distal and Proximal Roles of Family Socioeconomics and Home Learning Experiences. *Early Child. Res. Q.* **2012**, *27*, 458–470. [CrossRef]
111. Mix, K.S.; Levine, S.C.; Cheng, Y.L.; Young, C.; Hambrick, D.Z.; Ping, R.; Konstantopoulos, S. Separate but Correlated: The Latent Structure of Space and Mathematics across Development. *J. Exp. Psychol. Gen.* **2016**, *145*, 1206–1227. [CrossRef]
112. Lehrl, S.; Evangelou, M.; Sammons, P. The Home Learning Environment and Its Role in Shaping Children's Educational Development. *Sch. Eff. Sch. Improv.* **2020**, *31*, 1–6. [CrossRef]