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Parents' approaches to numeracy support: what parents do is rarely what they think is most important

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The math children are exposed to at home is a crucial source of early math knowledge, but little is known about parents' general approaches for supporting their children's math development at home. The current study examined what general pedagogical approaches parents believed to be most important to use in their home and if these beliefs aligned with the approaches they reported using most often. In a survey of 344 U.S. preschool parents (56% mothers, 61% sons, 77% White, 79% with a bachelor's degree or more), 83% of parents showed a mismatch in the pedagogical approach they used most often compared to what they believed to be most important to use. The most popular pedagogical approach to use was incorporating math during daily living experiences (the "daily living" approach) compared to three other approaches. Notably, although used most often, the "daily living" approach was the approach most frequently selected as least important. Rather, "direct teaching" was the approach most frequently selected as most important. Overall, this suggests a disconnect between how parents approach their home math support and what they believe is most important for their child's math development at home.

KEYWORDS

home math environment, early math development, pedagogy, parents' beliefs, parent support, involvement

Introduction

Early math knowledge predicts later math achievement, which in turn predicts future academic and life success (Rivera-Batiz, 1992; Duncan et al., 2007; Reyna et al., 2009; Watts et al., 2014). One learning environment important to early math knowledge development is the home math environment (HME). The HME encompasses the math-related activities and interactions children engage in at home, including the math support that parents provide their children through math talk, toys, everyday interactions, and direct instruction. Overall, parents report engaging in home math activities with their preschool children at least once a week (Saxe et al., 1987; Skwarchuk et al., 2014; Sonnenschein et al., 2016; Rittle-Johnson and Zippert, 2018). However, little research has examined parents' pedagogical approaches, or the teaching approaches parents use and believe are important for helping their young children learn math at home. Three studies have examined parents' pedagogical approach beliefs, and some evidence suggests parents differ in these beliefs based on their socioeconomic status (SES). However, there is no agreed-upon measure across studies and no study has examined pedagogical approach use.

The current study examined parents' pedagogical approach beliefs and how they relate to their pedagogical approach use. Parents' beliefs are related to the frequency and complexity of their numeracy support which in turn are related to their child's math knowledge (see Douglas et al., 2021 for a review). For example, parents who believed numeracy skills were important for

their child also reported more frequent and advanced numeracy activities compared to parents with lower numeracy expectations (Skwarchuk et al., 2014) and the same was true for parents who rated their child as having better numeracy skills than their peers (Zippert and Ramani, 2017; Uscianowski et al., 2020; Zippert and Rittle-Johnson, 2020). Additionally, numeracy support is positively associated with children's early and later math knowledge (Mutaf-Yıldız et al., 2020; Zhang et al., 2020; Daucourt et al., 2021).

The current study focuses on a rarely studied aspect of parents' beliefs and support: pedagogical approach. Four common pedagogical approaches for supporting math learning have emerged from research with parents in the United States: (1) incorporating math during daily living experiences, or the "daily living" approach, (2) setting time aside to directly teach math skills, or the "direct teaching" approach, (3) providing math-related toys or activities, or the "give math toys" approach, and (4) incorporating math during activities their child enjoys, or the "during child enjoyment" approach (Cannon and Ginsburg, 2008; DeFlorio and Beliakoff, 2015; Sonnenschein et al., 2016). These pedagogical approaches align with some HME literature which attempts to categorize HME activities as informal or indirect and formal or direct (LeFevre et al., 2009; Skwarchuk et al., 2014). Specifically, the "daily living," "give math toys," and "during child enjoyment" approaches align with the common definition of informal or indirect activities (i.e., activities that support children's math learning indirectly, where numeracy is not the purpose of the activity but occurs incidentally). In contrast, the "direct teaching" approach aligns with the definition of formal or direct activities (i.e., activities that support children's learning directly and intentionally to enhance children's numeracy knowledge; Skwarchuk et al., 2014). Understanding how parents use and assign value to these pedagogical approaches could be an important part of HME that has been ignored.

Three previous studies have measured parents' *beliefs* about pedagogical approaches, and results about which approach parents believed to be most important varied across the studies and the SES background of the parents. In a study with U.S. parents from unknown SES backgrounds, parents most frequently described "daily living" or "during child enjoyment" approaches when asked an open-ended question about the best way for their preschool-aged child to learn math at home (Cannon and Ginsburg, 2008). Similarly, in a study with U.S. parents from low and middle-SES backgrounds, as measured by their income-based qualification to attend federally funded or pay for private preschool programs, parents from middle-SES backgrounds most frequently chose the "daily living" approach when asked to rank a list of three approaches in order of importance (DeFlorio and Beliakoff, 2015). In contrast, in the same study, parents from low-SES backgrounds most frequently chose the "direct teaching" approach as most important. Similarly, in a study with U.S. parents from low SES backgrounds only, as measured by income-based qualification to a Head Start Preschool program, parents most frequently described the "direct teaching" approach when asked about the best way to help their child learn to do math (Sonnenschein et al., 2016). Thus, there is some evidence that parents differ in these beliefs based on their SES, with parents from low SES backgrounds believing "direct teaching" is most important and parents from middle or high SES backgrounds believing "during child enjoyment" is most important. One of the studies also reported that some beliefs varied with the child's age, with parents of four-year-olds more likely to believe "give math-related toys" was most important than parents of three-year-olds, while their beliefs about the "daily living" and "direct teaching" approaches did not differ by child age (DeFlorio and Beliakoff, 2015).

Notably, DeFlorio and Beliakoff (2015) first asked parents a question of *use:* "Which of the following approaches do you use at home on a regular basis to help your child develop mathematical knowledge and skills?" However, they seemed to falsely equate belief and use, where anyone who chose more than one approach was asked to rank the approaches in order of importance, which is the question that they reported in their results. The current study aimed to address this question by using DeFlorio and Beliakoff (2015) first question but following up with a question of use, not belief, to examine both beliefs and use, and how parents' pedagogical approach beliefs relate to their pedagogical approach use. The current study examines three questions:

1. What pedagogical approach do parents report using most often to help their child learn math at home? Are there differences by child age, parent education, or income? We hypothesized parents would use one of the more informal approaches (e.g., "daily living," "give math toys," or "during child enjoyment") most often over the more formal approach of "direct teaching" because families engage in informal math activities more often than formal activities at home (Skwarchuk et al., 2014; Rittle-Johnson and Zippert, 2018; Susperreguy et al., 2020). We explored potential differences by parent education and income, two commonly used measures of SES, and potential differences by child age because differences exist for related HME factors (DeFlorio and Beliakoff, 2015; Thompson et al., 2017). Although our age range is narrow and age-related differences are more likely in a wider age range, we still explored potential differences by child age.
2. What approach do parents believe is most important for helping their child learn math at home? Are there differences by child age, parent education, or income? We hypothesized that in our sample of predominantly middle and upper SES parents, "daily living" approaches would be reported as most important on average (Cannon and Ginsburg, 2008; DeFlorio and Beliakoff, 2015). We explored potential differences by parent education and income, two commonly used measures of SES, and potential differences by child age because one study suggests these differences exist (DeFlorio and Beliakoff, 2015). Although our age range is narrow and age-related differences are more likely in a wider age range, we still explored potential differences by child age.
3. Is there a difference between the pedagogical approach(es) parents use most often and believe is most important? We tentatively hypothesized beliefs and use would align as they do when measured in other contexts.

Methods

Participants

Participants were 344 U.S. parents of 3- to 4-year-olds (child mean age = 3 years and 10 months, SD = 7.8 months), with almost as many fathers as mothers responding (44% vs. 56%). More parents of boys than girls responded (61% vs. 39%) and 58% reported that their child was enrolled in preschool the previous year. Most parents reported

their race as Caucasian or White (77%). Additionally, 19% of participants identified as Hispanic or Latino. Most parents (72%) reported a household income above $45,000 and 79% had at least a bachelor's degree. See Table 1 for demographic information.

Measures

Pedagogical approach use and belief

The questions, and the first three approaches provided, were adapted from DeFlorio and Beliakoff (2015) in an attempt to create an agreed-upon measure (see Supplementary Table S1). A fourth pedagogical approach, "during child enjoyment," was included based on a common open-ended response from two other studies (Cannon and Ginsburg, 2008; Sonnenschein et al., 2016). The first question asked, "Which of the following approaches do you use at home on a regular basis to help your child develop mathematical knowledge and skills?" (DeFlorio and Beliakoff, 2015). If a parent selected more than one approach, they automatically received a follow-up question "Which approach do you use most often?" All parents were then asked, "Rank the following approaches from least important (1) to most important (4) in your home." (DeFlorio and Beliakoff, 2015). All questions were close-ended and parents were provided four pedagogical approaches (see column 2 in Table 2).

Demographics

Each parent reported their race/ethnicity, gender, and child's age, and child's gender at the end of the survey. They also reported their household income and their highest educational attainment, which we used as two measures of SES for our analyses.

Procedure

Parents were recruited using CloudResearch, an internet-based research platform that integrates with Amazon's crowdsourcing platform Mechanical Turk (MTurk; Litman et al., 2017). Our initial goal was to recruit based on education with a goal of recruiting a representative sample of the United States, but initial participation was low, specifically because we had other requirements. In the end, to achieve a powerful enough sample size, we had to change our requirement to not target participants based on education. Participants were prescreened in a survey requiring them to be in the United States, have a 95% approval rate from their previous MTurk participation, and be parents, and the prescreening survey asked about their child's age. Qualifying parents of 4- and 5-year-olds were able to complete the survey for the current study. Parents were paid $0.05 for the initial screening survey and $10 for completion of the study. After providing informed consent, parents completed surveys on their pedagogical approach use and beliefs and their demographics. Parents completed attention checks that were embedded in the survey such as "To show that you are paying attention, please select the 'none of the above' option as your answer." Participants who failed at least one attention check (n = 121) were not included in the final sample of 344 participants.

Results

Pedagogical approach use

Each approach was used by 52–73% of parents and most parents (88%) reported using more than one pedagogical approach. Table 2 shows descriptive statistics for the pedagogical approach questions. The "daily living" approach was most frequently selected as the approach they used most often. The "during child enjoyment" approach was least frequently selected. A chi-square difference test indicated no significant difference in parents' pedagogical approach used most often by child age as a categorical variable in years, X^2 (3, 332) = 7.06, $p = 0.07$ or continuous variable in months [X^2 (102, 233) = 91.14, $p = 0.77$]. See S2 for descriptive statistics by child age.

TABLE 1 Demographic statistics.

Variable	Proportion	Variable	Proportion
Child Age		**Household income**	
3 year old	0.52	Less than $27,000	0.07
4 year old	0.48	$27,000 to $44,999	0.20
Race/Ethnicity		$45,000 to $89,999	0.41
White	0.77	$90,000 to $134,999	0.25
Black	0.08	$135,000 or more	0.06
Asian or Pacific Islander	0.05	**Highest educational attainment**	
Biracial or Mixed Race	0.04	High School Diploma or GED	0.05
American Indian or Native	0.03	Some college or 2-year degree	0.15
Other Race/ethnicity	0.02	Bachelors degree	0.55
I am unsure or I prefer not to say	0.01	Some graduate work	0.03
Identify as Hispanic/Latino	0.19	Masters professional or doctoral degree	0.21
Previous year preschool attendance	0.58		

To have more equal SES groups for data analysis, we collapsed the responses for both SES variables into three more equally-sized groups: less than a bachelor's degree, a bachelor's degree, and more than a bachelor's degree, and less than $45,000, $45,000–$89,999, and more than $90,000.

TABLE 2 Proportions and averages for parents' pedagogical approaches use and belief.

Pedagogical Approach Name	Full pedagogical approach	Proportion who used	Average importance rank	Proportion who used most often	Proportion who believed most important	Proportion who believed least important
"Daily living" approach	I give my child math-related tasks or ask math-related questions during ongoing daily living experiences or routines (e.g., we talk about numbers as we use measuring cups or spoons while preparing food).	0.73	2.19	0.45[a]	0.19	0.38
"Direct teaching" approach	I set aside time to focus on directly and intentionally teaching my child math skills (e.g., we use a math workbook or math flashcards).	0.52	2.77	0.20[a]	0.38	0.21
"Give math toys" approach	I enrich my child's playtime by providing math-related toys and materials that my child uses alone or with other children (e.g., my child spontaneously plays with playing cards or puzzles alone).	0.67	2.46	0.19	0.21	0.23
"During child enjoyment" approach	I incorporate math during activities that I think my child will enjoy or play math games with my child to engage my child's math interest (e.g., we talk about math while playing board games or watching Sesame Street together).	0.55	2.58	0.16[a]	0.22	0.18

[a]Significant difference to the proportion who believed this approach was most important.
When participants were asked to rank the approaches, they ranked them from least important = 1 to most important = 4.
***$p < 0.001$; ** $p < 0.01$; *$p < 0.05$.

Table 3 shows the pedagogical approach used most often by parents' highest educational attainment and household income. Chi-square difference tests showed no significant differences for pedagogical approach used most often by educational attainment, X^2 (6, 329) = 11.66, $p = 0.07$, or household income, X^2 (6, 329) = 9.72, $p = 0.14$. However, a chi-square difference test for pedagogical approach use by whether their child attended preschool the year before the study suggested there was a difference, X^2 (1,332) = 13.73, $p < 0.01$. *Post hoc* comparisons with Bonferroni correction indicated that parents with a child who did *not* attend preschool the previous year more frequently selected the "during child enjoyment" approach as the approach they used most often compared to parents with a child who attended preschool the previous year, X^2 (1,332) = 10.24, $p < 0.001$.

Pedagogical approach beliefs

As shown in Table 2, and contrary to our hypothesis, parents most frequently selected "direct teaching" as the approach they believed was most important. The other three approaches were selected as most important by a similar proportion of parents. Parents most frequently selected "daily living" as least important. There was no significant difference in pedagogical approach believed to be most important by child age, as a categorical variable, X^2 (3, 341) = 5.06, $p = 0.17$, or continuous variable in months [X^2 (102, 242) = 119.351, $p = 0.11$], or by household income level, X^2 (6, 338) = 6.14, $p = 0.41$. A chi-square difference test for pedagogical approach believed to be most important by highest educational attainment suggested there was a difference, X^2 (6, 338) = 13.31, $p = 0.04$. *Post hoc* comparisons with Bonferroni correction indicated that parents with a bachelor's degree most frequently selected the "during child enjoyment" approach as most important compared to parents with less than or more than a bachelor's degree. Additionally, a chi-square difference test for pedagogical approach believed to be most important by whether their child attended preschool last year suggested there was a difference, X^2 (3, 341) = 15.24, $p < 0.01$. *Post hoc* comparisons with Bonferroni correction indicated that parents with a child who attended preschool last year more frequently selected the "during child enjoyment" approach as most important compared to parents with a child who did not attend preschool last year, X^2 (1,332) = 10.24, $p < 0.001$. Additionally, parents with a child who did not attend preschool last year more frequently selected "direct teaching" approach as most important compared to parents whose child did attend preschool last year, X^2 (1,332) = 11.56, $p < 0.001$.

Match in pedagogical approach use and beliefs

Most parents (83%) showed a mismatch in the approach they used most often and believed to be most important (see Table 4 for a contingency table of these variables). This mismatch was confirmed with a Chi-Square test of independence, X^2 (9, 335) = 33.16, $p < 0.001$. *Post hoc* comparisons with Bonferroni correction showed significant differences for the "daily living," "direct teaching," and "during child

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TABLE 3 Proportion of parents who selected pedagogical approach most often and most important by education, income level, and previous preschool attendance.

		Most often[a]					Most important				
	N	Pedagogical approach proportion				X^2	Pedagogical approach proportion				X^2
		Daily living	Direct teaching	Give math toys	During child enjoyment		Daily living	Direct teaching	Give math toys	During child enjoyment	
Highest education	–	–	–	–	–	11.66	–	–	–	–	13.31*
< bachelor's degree	73	0.40	0.13	0.21	0.26		0.21	0.40	0.25	0.15	
bachelor's degree	189	0.44	0.24	0.19	0.13		0.15	0.38	0.17	0.29[a]	
> bachelor's degree	82	0.52	0.17	0.20	0.11		0.24	0.38	0.24	0.13	
Household income	–	–	–	–	–	9.72	–	–	–	–	6.14
< $45,000	95	0.44	0.24	0.16	0.16		0.22	0.35	0.22	0.21	
$45,000–$89,999	140	0.51	0.13	0.19	0.17		0.14	0.45	0.18	0.23	
> $90,000	109	0.38	0.26	0.23	0.13		0.21	0.33	0.23	0.23	
Previous year preschool attendance	–	–	–	–	–	13.73**	–	–	–	–	15.24**
Yes	198	0.44	0.24	0.21	0.10b		0.18	0.31b	0.23	0.28[b]	
No	146	0.46	0.14	0.17	0.23		0.19	0.49	0.18	0.14	

[a]Both parents with less than a bachelor's degree and with more than a bachelor's degree were significantly different from parents with a bachelor's degree, $p < 0.05$.
[b]Parents with a child who attended preschool the previous year were significantly different from parents whose child did not attend school, using Bonferonni correction ($p = 0.05/4 = 0.0125$).
***$p < 0.001$; **$p < 0.01$; *$p < 0.05$.

enjoyment" approaches, but no significant difference for the "give math toys" approach (see Table 2, columns 5 and 6).

Discussion

To the best of our knowledge, this was the first study to separately examine parents' use and beliefs about how to best support their children's math development at home. Additionally, the current study has an important strength compared to previous research on the HME by surveying both mothers and fathers. The previous three studies on pedagogical approach beliefs were almost exclusively with mothers.

The disconnect between pedagogical approach use and beliefs

Contrary to our hypothesis and findings in DeFlorio and Beliakoff (2015), parents in the current study, who were predominantly from middle- and high-SES backgrounds, most often selected a "direct teaching" approach as most important to their children's home math learning compared to three other informal approaches. This was more similar to prior findings with low-SES parents (Cannon and Ginsburg, 2008; DeFlorio and Beliakoff, 2015). We also did not find differences by parents' education level or income in the frequency of believing "direct teaching" to be most important, contrary to DeFlorio and Beliakoff (2015). At the same time, the combined frequency of selecting any of the three informal pedagogical approaches as most important indicated that parents were more likely to believe an informal approach was more important than a formal, direct teaching approach.

Turning to pedagogical approach use, parents in the current study tended to select the "daily living" approach as the approach they used most often. This finding provides support that pedagogical use is separate from belief. Indeed, parents' pedagogical approach beliefs did not align with what pedagogical approach they used most often. This mismatch held for individual parents - over 80% of parents did not believe the approach they used most often was most important to their child's math development at home. This disconnect may have important implications for how to support successful math learning at home. If parents believe a particular approach is most important for their child's success but are not engaging their child with that approach as often as with other approaches, updating their beliefs about the importance or usefulness of an approach may not change behavior. Another potential reason for this disconnect could be that because parents engage in less direct instruction with their children (20% used it most often), they might believe they should use the approach more and thus rank it as most important.

TABLE 4 Contingency table of pedagogical approach believe most important and use most often.

		Use most often				
	Pedagogical approach	Daily living	Direct teaching	Give math-related toys	During child enjoyment	N
Believe most important	Daily living	18	20	10	14	62
	Direct teaching	65	12	31	21	129
	Give math-related toys	29	20	8	14	71
	During child enjoyment	38	16	16	3	73
	N	150	68	65	52	335

N is 335 instead of full sample ($N = 344$) due to 9 participants missing use and use most often question.

Parents' pedagogical approaches align somewhat with the broader literature on pedagogy in teaching. The "daily living" and "during child enjoyment" approaches share similarities with guided play and guided participation, the "direct teaching" approach shares similarities with direct instruction, and the "give math related-toys" approach shares similarities with play-based and child-initiated play. In this way, pedagogical approaches can be compared and discussed with findings in the teaching literature. In fact, similar to the current study, there is a disconnect between teachers believing children can learn from play but still mostly using direct instruction (Kim, 2004; Pui-Wah and Stimpson, 2004; Pyle et al., 2017). These parallel pedagogical disconnects suggest implications for our findings, for, not parents alone but, perhaps all adults who interact with learners. Importantly, while both teachers and parents have a disconnect in their pedagogical behaviors and practices, they used and believed opposite approaches were most important. Teachers tend to use mostly direct instruction and believe play is important while parents tend to use play and believe direct instruction is most important. Future research should examine explanations for common threads between these disconnects and what might explain these differences (e.g., messages schools and society send about direct instruction and preparation for formal schooling which potentially emphasizes direct teaching to parents but play to teachers, social desirability, and the impact of experience and routine for teachers compared to parents). For example, previous research highlights the impact of additional variables like parent-educator communication on parents' math support (Lin et al., 2019).

One related variable to parent-teacher communication that we collected in the current study was if the child had attended preschool last year. The current study found a relationship between children's past preschool attendance and pedagogical approach use and belief. Similar to the typical findings with teachers about playful learning versus direct teaching (Kim, 2004; Pui-Wah and Stimpson, 2004; Pyle et al., 2017), parents with a child who attended preschool last year less frequently reported the "during child enjoyment" approach as the one they used most often and less frequently reported the "direct teaching" approach as the one they believed was most important compared to parents with a child who did not attend preschool. These results and their movement away from the trends we saw with overall parents suggest parents may be getting and internalizing that messaging from teachers and their child's school. However, parents with a child who attended preschool also more frequently reported the "during child enjoyment" approach to be the one they believed most important over parents whose children did not attend preschool the previous year. This result suggests parents with a child who attended preschool the previous year, like our overall results, believe an informal approach is most important. Importantly, the current study only asked about preschool last year, so we do not have data on whether the child was currently attending preschool when the parent filled out the survey.

Additionally, we did not find a relationship between child age and pedagogical approach use or belief. Although previous literature has examined child age as a factor influencing the HME, DeFlorio and Beliakoff (2015) is the only other study so far to examine pedagogical beliefs by child age. They found parents of four-year-olds were more likely to believe "give math-related toys" was most important" than parents of three-year-olds, but beliefs about the "daily living" and "direct teaching" approaches did not differ by child age. Combined with the current study, most pedagogical beliefs do not seem to differ for parents of 3- vs. 4-year-old children. However, age-related differences in pedagogical approach beliefs and use are much more likely in a wider age range.

Overall, the current study found little evidence for SES differences in pedagogical approach use or belief by parent income or education level. We found parents who believed the "during child enjoyment" was most important were significantly different by educational attainment compared to other parents, but there were no significant differences by education or income for any other belief approaches or pedagogical approach use. Notably, our sample was largely well-educated and middle to high-income which limited our ability to detect differences.

Implications

Our results have implications for parental perceptions about the quality of their math support at home. Parents who know their actions to be inconsistent with their beliefs about what is most beneficial may develop self-doubt about the quality of support they are providing to their preschool children. Their beliefs and use of early math support may be shaped by messaging that they receive from media, parent-teacher communication, and other sources around approaches and activities that help their child learn math at home. Current research often relies on the frequency of specific activities to measure the HME. Further research is needed to explore how pedagogical approaches relate to the HME. Specifically, more work is needed on how the four pedagogical approaches align with different types of numeracy activities.

Furthermore, parents' belief that direct instruction was most important to their children's learning at home does not align with beliefs among psychologists that play-based learning is best for preschool-age children (Hirsh-Pasek et al., 2009; Weisberg et al., 2013; Skene et al., 2022). Perhaps parents' beliefs are shaped by educational or other resources about formal school readiness where direct instruction is emphasized. At the same time, most parents are using the informal, play-based approaches that psychologists suggest are best for preschool-age children. However, parents' other beliefs (e.g., beliefs about the importance of their child achieving specific math benchmarks, beliefs about their child's current math abilities) are

uniquely predictive of the frequency and complexity of the math support parents provide their children at home (Douglas, 2022). Interventions geared at changing parents' beliefs about a pedagogical approach may not be enough; parents may not adopt approaches even if they are convinced that the approach is the most beneficial.

Limitations

One limitation is the current study only provides correlational evidence. Another limitation is that our sample was largely well-educated and middle-income, and few parents were on the ends of the economic spectrum, reducing the study's ability to detect SES-related differences. Additionally, MTurk has benefits as a convenient platform to collect a wider sample and research suggests MTurk is representative of the US population by gender and race (Burnham et al., 2018) and Cloud Research represents the US population well in income and education level (Moss and Litman, 2020). However, parents of young children on MTurk may differ from other MTurk participants. We must be careful since our sample was skewed toward highly educated and high-income participants, but this is also a common issue when recruiting from participant databases maintained by university psychology departments.

It is beyond the scope of this project to determine which approaches are optimal, but, if some approaches are actually more beneficial than others, our work has important implications for how to encourage parental use of an optimal approach. More research is needed to understand what frictions prevent parents from acting on their beliefs about what is most beneficial and parents' understanding of and feelings toward this misalignment.

Conclusion

HME research focuses on parents' beliefs and support, but little research has focused on the approaches parents take to support their children's math learning at home. We identified a disconnect between parents' pedagogical approach use and beliefs suggesting that the ideas that parents have about what they should do differ from what they are doing. Overall, there is still much to learn about parents' beliefs about the HME and how researchers can best influence the adoption of beneficial approaches to support children's math development at home.

Data availability statement

The raw data supporting the conclusions of this article will be made available by the authors, without undue reservation.

Ethics statement

The studies involving humans were approved by the Vanderbilt University Institutional Review Board. The studies were conducted in accordance with the local legislation and institutional requirements. The participants provided their written informed consent to participate in this study.

Author contributions

CM: project design – conceptualizing the current study questions and revising pedagogical approach measure, data collection, writing – initial draft, and further edits. A-AD: project design, data collection, writing – reviewing and editing, and project administration. BR-J: supervision, writing – reviewing and editing, and project administration. All authors contributed to the article and approved the submitted version.

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Conflict of interest

The authors declare that the research was conducted in the absence of any commercial or financial relationships that could be construed as a potential conflict of interest.

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Supplementary material

The Supplementary material for this article can be found online at: https://www.frontiersin.org/articles/10.3389/feduc.2023.1114803/full#supplementary-material

References

Burnham, M. J., Le, Y. K., and Piedmont, R. L. (2018). Who is Mturk? Personal characteristics and sample consistency of these online workers. *Ment. Health Relig. Cult.* 21, 934–944. doi: 10.1080/13674676.2018.1486394

Cannon, J., and Ginsburg, H. P. (2008). "Doing the math": maternal beliefs about early mathematics versus language learning. *Early Educ. Dev.* 19, 238–260. doi: 10.1080/10409280801963913

Daucourt, M. C., Napoli, A. R., Quinn, J. M., Wood, S. G., and Hart, S. A. (2021). The home math environment and math achievement: a Meta-analysis. *Psychol. Bull.* 147, 565–596. doi: 10.1037/bul0000330

DeFlorio, L., and Beliakoff, A. (2015). Socioeconomic status and preschoolers' mathematical knowledge: the contribution of home activities and parent beliefs. *Early Educ. Dev.* 26, 319–341. doi: 10.1080/10409289.2015.968239

Douglas, A.-A. L. (2022). Parental early math support: the role of parental knowledge about early math development [thesis]. Available at: https://ir.vanderbilt.edu/handle/1803/17531

Douglas, A.-A., Zippert, E. L., and Rittle-Johnson, B. (2021). "Chapter nine – parents' numeracy beliefs and their early numeracy support: a synthesis of the literature" in *Advances in child development and behavior*. ed. J. J. Lockman, vol. *61* (Cambridge, MA: Academic Press), 279–316.

Duncan, G. J., Dowsett, C. J., Claessens, A., Magnuson, K., Huston, A. C., Klebanov, P., et al. (2007). School readiness and later achievement. *Dev. Psychol.* 43, 1428–1446. doi: 10.1037/0012-1649.43.6.1428

Hirsh-Pasek, K., Golinkoff, R. M., Berk, L. E., and Singer, D. (2009). *A mandate for playful learning in preschool: applying the scientific evidence*. Oxford University Press, USA.

Kim, M. (2004). Teachers' philosophical orientation and practices: a study of novice preschool teachers in South Korea. *Contemp. Issues Early Child.* 5, 276–292. doi: 10.2304/ciec.2004.5.3.3

LeFevre, J.-A., Skwarchuk, S.-L., Smith-Chant, B. L., Fast, L., Kamawar, D., and Bisanz, J. (2009). Home numeracy experiences and children's math performance in the early school years. *Can. J. Behav. Sci.* 41, 55–66. doi: 10.1037/a0014532

Lin, J., Litkowski, E., Schmerold, K., Elicker, J., Schmitt, S. A., and Purpura, D. J. (2019). Parent–educator communication linked to more frequent home learning activities for preschoolers. *Child Youth Care Forum* 48, 757–772. doi: 10.1007/s10566-019-09505-9

Litman, L., Robinson, J., and Abberbock, T. (2017). TurkPrime.com: a versatile crowdsourcing data acquisition platform for the behavioral sciences. *Behav. Res. Methods* 49, 433–442. doi: 10.3758/s13428-016-0727-z

Moss, A., and Litman, L. (2020). *Demographics of People on Amazon Mechanical Turk*. CloudResearch. Available at: https://www.cloudresearch.com/resources/blog/who-uses-amazon-mturk-2020-demographics/ (Accessed August 10, 2020).

Mutaf-Yıldız, B., Sasanguie, D., De Smedt, B., and Reynvoet, B. (2020). Probing the relationship between home numeracy and Children's mathematical skills: a systematic review. *Front. Psychol.* 11:2074. doi: 10.3389/fpsyg.2020.02074

Pui-Wah, D. C., and Stimpson, P. (2004). Articulating contrasts in kindergarten teachers' implicit knowledge on play-based learning. *Int. J. Educ. Res.* 41, 339–352. doi: 10.1016/j.ijer.2005.08.005

Pyle, A., DeLuca, C., and Danniels, E. (2017). A scoping review of research on play-based pedagogies in kindergarten education. *Rev. Educ.* 5, 311–351. doi: 10.1002/rev3.3097

Reyna, V. F., Nelson, W. L., Han, P. K., and Dieckmann, N. F. (2009). How numeracy influences risk comprehension and medical decision making. *Psychol. Bull.* 135, 943–973. doi: 10.1037/a0017327

Rittle-Johnson, B., and Zippert, E. L. (2018). The home math environment: more than numeracy. *Early Child. Res. Q.*

Rivera-Batiz, F. L. (1992). Quantitative literacy and the likelihood of employment among young adults in the United States. *J. Hum. Resour.* 27, 313–328. doi: 10.2307/145737

Saxe, G. B., Guberman, S. R., Gearhart, M., Gelman, R., Massey, C. M., and Rogoff, B. (1987). Social processes in early number development. *Monogr. Soc. Res. Child Dev.* 52:i. doi: 10.2307/1166071

Skene, K., O'Farrelly, C. M., Byrne, E. M., Kirby, N., Stevens, E. C., and Ramchandani, P. G. (2022). Can guidance during play enhance children's learning and development in educational contexts? A systematic review and meta-analysis. *Child Dev.* 93, 1162–1180. doi: 10.1111/cdev.13730

Skwarchuk, S.-L., Sowinski, C., and LeFevre, J.-A. (2014). 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.* 121, 63–84. doi: 10.1016/j.jecp.2013.11.006

Sonnenschein, S., Metzger, S. R., and Thompson, J. A. (2016). Low-income parents' socialization of their preschoolers' early reading and math skills. *Res. Hum. Dev.* 13, 207–224. doi: 10.1080/15427609.2016.1194707

Susperreguy, M. I., Douglas, H., Xu, C., Molina-Rojas, N., and LeFevre, J.-A. (2020). Expanding the home numeracy model to Chilean children: relations among parental expectations, attitudes, activities, and children's mathematical outcomes. *Early Child. Res. Q.* 50, 16–28. doi: 10.1016/j.ecresq.2018.06.010

Thompson, R. J., Napoli, A. R., and Purpura, D. J. (2017). Age-related differences in the relation between the home numeracy environment and numeracy skills. *Infant Child Dev.* 26:e2019. doi: 10.1002/icd.2019

Uscianowski, C., Almeda, M., and Ginsburg, H. P. (2020). Differences in the complexity of math and literacy questions parents pose during storybook reading. *Early Child. Res. Q.* 50, 40–50. doi: 10.1016/j.ecresq.2018.07.003

Watts, T. W., Duncan, G. J., Siegler, R. S., and Davis-Kean, P. E. (2014). What's past is prologue: relations between early mathematics knowledge and high school achievement. *Educ. Res.* 43, 352–360. doi: 10.3102/0013189X14553660

Weisberg, D. S., Hirsh-Pasek, K., and Golinkoff, R. M. (2013). Guided play: where curricular goals meet a playful pedagogy. *Mind Brain Educ.* 7, 104–112. doi: 10.1111/mbe.12015

Zhang, X., Hu, B. Y., Zou, X., and Ren, L. (2020). Parent-child number application activities predict Children's math trajectories from preschool to primary school. *J. Educ. Psychol.* 112, 1521–1531. doi: 10.1037/edu0000457

Zippert, E. L., and Ramani, G. B. (2017). Parents' estimations of preschoolers' number skills relate to at-home number-related activity engagement: parents' estimates of Child's number skills. *Infant Child Dev.* 26:e1968. doi: 10.1002/icd.1968

Zippert, E. L., and Rittle-Johnson, B. (2020). The home math environment: more than numeracy. *Early Child. Res. Q.* 50, 4–15. doi: 10.1016/j.ecresq.2018.07.009