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Parents' and Teachers' Practices, Beliefs, and Communication of Early Mathematics Learning

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Supplementary Materials: Data, Materials, Preregistration [see Index of Supplementary Materials]

Abstract

Prior research showed that US parents engage children in numeracy versus spatial or pattern activities more frequently, and that children receive more literacy versus numeracy instruction. We examined Hong Kong parents' and teachers' frequency of engaging children in learning activities, their beliefs about the fixedness of math ability, and frequency of school-home communication about children's learning across learning domains. A total of 154 parents (68.8% women; 96.1% Chinese) and 89 teachers (80.9% women; 89.9% Chinese) of kindergarten children completed an online survey. We found that (a) both parents and teachers engaged children in numeracy versus pattern activities more frequently; (b) parents' and teachers' fixedness beliefs about math ability did not predict their frequency of providing math activities; (c) compared to math, parents and teachers engaged children in language activities more frequently, and ethics and aesthetics activities less frequently; (d) teachers versus parents were more likely to report school-home communication. The findings extend prior research on home math environments and reveal ways in which parents and teachers can strengthen children's math learning.

Keywords

home math environment, early math learning, school-home communication, math practice, math belief

Children's early mathematics experiences at home and school lay the foundation for their later achievement (Daucourt et al., 2021; Duncan et al., 2007; Eason et al., 2022). Despite the importance of early math experiences, parents (US[1]: Napoli & Purpura, 2018) and teachers (US: Bachman et al., 2018) tend to engage children in numeracy learning less frequently compared to literacy learning. Furthermore, prior research has shown that the frequency of home math activities varies by math topic (US: Rittle-Johnson et al., 2015; Zippert & Rittle-Johnson, 2020) and parents' belief of fixedness of math ability (US: Muenks et al., 2015). Given that many of the prior studies were conducted in North America or Europe (e.g., Canada: LeFevre et al., 2009; Belgium: Mutaf Yildiz et al., 2018), less is known about children's early math experiences beyond the Western culture. In the Trends in International Mathematics and Science Study (TIMSS, 2019), Hong Kong ranked 49 out of 52 internationally in their frequency of home math activities (Ellis et al., 2023), suggesting the need for more research to delineate early math practices in this region. Consequently, conducting additional research in Hong Kong contributes insights into the diversity of early learning environments, and inform inclusive and equitable practices that promote child development.

In the present study, we examined Hong Kong parents' and teachers' practices, beliefs, and communication about early math and other domains of learning. Specifically, we tested the effects of topic (numeracy vs. spatial vs. pattern), adult (parent vs. teacher), and adults' beliefs about the fixedness of math ability on their frequency of provisioning early math activities. We also examined parents' and teachers' school-home communication about children's learning, including the frequency, method, and content of information communicated to identify ways in which this communication can be strengthened to promote children's math learning. To provide a broader context of early childhood education and care, we also compared the frequency of activities and school-home communication on math versus other learning domains (i.e., language, ethics, physical, social, aesthetics) as outlined in the local curriculum guide (Curriculum Development Council [CDC], 2017).

Early Math Learning and Instruction

Compared to reading and attention skills, early math skills at school entry are a powerful predictor of children's later achievement in math (US: Duncan et al., 2007; US: Watts et al., 2014) as well as in reading and science (US: Claessens & Engel, 2013). However, studies have found that preschool and kindergarten teachers provide language and literacy instruction two to ten times more frequently than math instruction (US: Howes et al., 2008; Mazzocco et al., 2024), potentially due to misconceptions and lack of resources and pedagogical knowledge in early math education (Germany: Jenßen et al., 2022; US: Lee

1) We indicate the country where the study was conducted in our in-text citation to provide the context of the research studies and aid interpretation of the empirical findings.

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& Ginsburg, 2009). In addition to the limited time spent on math instruction, early math teaching practices may also be misaligned with children's needs. Despite the variability in math topics observed in preschool classrooms, prior research has shown that teaching mainly focuses on basic numerical content (US: Scalise et al., 2025), even when children already have a firm grasp of the content (US: Engel et al., 2013).

One of the topics that is critical for children's later achievement yet rarely practiced in early childhood is patterning—skills in predicting and constructing sequences or structures. These skills are moderately correlated with verbal ability, working memory, and executive function, and significantly predict children's later math knowledge and skills, including algebra proficiency (Singapore: Lee et al., 2011; US: Fyfe et al., 2017; Rittle-Johnson et al., 2019). However, a recent study showed that while 69% of observed preschool classroom math activities involved counting, only 13% involved patterning (US: Scalise et al., 2025). This pattern of focus on numeracy relative to other math subdomains among preschool-aged children is replicated in studies of math at home: Parents report engaging children in numeracy activities one to two times a week, but pattern activities only two to three times a month (US: Zippert et al., 2020). Together, these findings demonstrate the importance of early math skills, but also the relative lack of classroom instructional time, especially on advanced math skills such as patterning, in early childhood education settings.

Home Math Environment

Beyond the explicit math instruction that children receive in childcare and school contexts, children's home math environment (HME) provides exposure to math-related beliefs, activities, and interactions (Eason et al., 2022). Early research on the HME demonstrated significant, positive associations between parents' frequency of engaging their young children in number-related activities at home (e.g., counting, playing board games, measuring ingredients while cooking) and children's concurrent math knowledge and fluency (Canada: LeFevre et al., 2009). Systematic reviews and meta-analyses further show that the associations between HME and children's math skills have small to moderate effect sizes (e.g., Daucourt et al., 2021; Dunst et al., 2016; Eason et al., 2022). Despite evidence of an overall association between the HME and children's math development, there remains considerable variability across individual samples and studies (e.g., De Keyser et al., 2020; Ellis et al., 2023). Several theoretical models posit that caregivers' math-related beliefs (also termed "math cognitions") regarding math attitudes, beliefs about learning, and child-specific beliefs and expectations directly affect their provisioning of math experiences at home (e.g., Eason et al., 2022; Elliott & Bachman, 2018; Sonnenschein & Dowling, 2019). For example, caregivers who believe that their child's math abilities are more malleable (versus stable or fixed) may be more likely to provide opportunities to learn and practice math skills in their home (US: Muenks et al., 2015).

Given the associations between HME and children's math outcomes as well as the heterogeneity in these associations across cultures, an important next step is to investigate the nature of the HME in specific cultures (Hornburg et al., 2021). Most prior research on the HME has been limited to Western countries (Eason et al., 2022; Ellis et al., 2023; Hornburg et al., 2021; c.f. China: Lu et al., 2025a, 2025b; Yang et al., 2023, 2025; Hong Kong: Huang et al., 2017; Zhu & Chiu, 2019). However, children's HME experiences are "culturally situated", such that characteristics of their cultures directly affect their informal math learning experiences (Hunter & Civil, 2021; Latine US: Swirbul & Melzi, 2024). Indeed, a recent large-scale investigation of the HME across 54 countries or regions found variability in both the frequency of HME experiences and its association with children's math achievement (Ellis et al., 2023). To broaden our understanding of the many related factors that contribute to children's math development, more research is needed that considers the HME in the contexts of culture and parental beliefs as well as in combination with school-based learning opportunities.

School-Home Communication

Most parents of young children are not professionally trained early childhood educators or child development specialists. Prior research has shown that parents' knowledge of general child development varies considerably and predicts the quality and frequency of parental engagement with their children (US: Leung & Suskind, 2020; China: Zhong et al., 2020). One opportunity to promote parents' knowledge and children's development is to foster consistent *school-home communication*, or information communicated from early childhood educators to families regarding general child development and learning trajectories, specific classroom goals and targeted concepts, and/or specific feedback about their individual child's learning and performance. For example, sharing information about children's performance at school and ideas for home learning activities can help parents provide home learning experiences that complement school instruction, leading to improved early learning outcomes among young children (US: Sonnenschein et al., 2021; US: Young et al., 2023). A review further highlights that school outreach in enhancing family engagement through reports, resources, and activities (e.g., reports from teachers, home learning activities, home visits, parent workshops) can positively impact children's learning (Van Voorhis et al., 2013). Most prior research has focused on school-home communication from educators to families; however, families may also communicate to educators the strengths and challenges in their child's learning. Indeed, families may have deeper insight on their child's abilities in applied contexts than educators, such as everyday interactions involving math (e.g., cooking and mealtimes, counting home objects together, recognizing numbers contextualized in grocery stores and street signs; Zippert & Ramani, 2017).

Despite the benefits of school-home communication between educators and families, little is known about how to effectively support it, in part because there is a lack of prior research on school-home communication about math (Eason et al., 2022). Parents of preschoolers who received more frequent communication from their child's teacher about children's general learning and development reported more frequent engagement in home learning and numeracy activities (US: Lin et al., 2019). Questions such as how the frequency and type of school-home communication vary across domains of development (e.g., math and literacy versus social development), and whether domain-specific communication patterns relate to families' home math learning practices remain open. Understanding the quantity, quality, and domain-specificity of school-home communication is crucial for future research that aims to strengthen this communication to promote children's math learning across contexts. As informed by the existing research on the role of school in supporting parents' home practices (e.g., Lin et al., 2019; Sonnenschein et al., 2021), we focused on the communication from school to home in the current study.

Hong Kong Context

Given the focus in prior research on children's early mathematical development in Western contexts, it is critical to examine patterns of findings in non-Western contexts because math learning is culturally situated and shaped by local practices (Chan et al., 2026; Hunter & Civil, 2021). Similar to studies from the Western countries (US: Dunst et al., 2016; Canada; LeFevre et al., 2009) and China (Lu et al., 2025a), Hong Kong children from higher-resourced families with more learning materials participated in home numeracy activities more frequently, and the frequency of home numeracy activities predicts children's early numeracy skills, self-efficacy in math, and in term later math achievement (Zhu & Chiu, 2019). Furthermore, Hong Kong parents who believe that math is a process of inquiry versus rote memorization engage children in home numeracy activities more frequently, and the activity frequency is positively associated with children's math interest (Cheung et al., 2023), suggesting that parent beliefs influenced their home math practices and children's outcomes.

Although the effect of HME on children's math achievement and interest is observed across cultures, the ways that HME and its effect emerge have been found to vary both within and between cultures. For example, Hong Kong parents engage children in counting more frequently compared to reading math-related books (Cheung & Leung, 2019), demonstrating variations in frequency by math topic and type of activities. Furthermore, Hong Kong parents' frequency of engaging their child in activities that involve arithmetic operations or measurements significantly and positively predicts children's later math fluency, but the frequency of activities that involve counting and mapping between numerical representations does not (Ouyang & Chan, 2025). Similarly, Hong Kong mothers' frequency of engaging their child in number skill activities and fathers' frequency of engaging their child in number games and application activities predict their child's math abilities; however, mothers' frequency of engaging their child in informal number activities does not relate to their child's math skills (Huang et al., 2017).

These findings, while in contrast with studies of Western children (Canada: Daucourt et al., 2021; LeFevre et al., 2009), are replicated in Chinese samples, with consistent evidence of engaging in formal numeracy activities predicting children's math skills, and little evidence for the impacts of informal or indirect activities (Yang et al., 2023).

Together, these studies contribute findings to the international research on HME (e.g., Ellis et al., 2023), and suggest evidence of the influence of parent beliefs and practices on children's math learning in Hong Kong. These studies also suggest some similarities and clear differences from research conducted in Western contexts, prompting the need for additional research that examines how Hong Kong parents' home math practices may vary by math topic (i.e., numeracy, spatial, pattern) and adult belief (i.e., fixedness beliefs).

Beyond the informal experiences at home, Hong Kong children also engage in math activities at kindergarten offered to three- to six-year-olds. To promote children's holistic development, the Education Bureau in Hong Kong issued the Kindergarten Education Curriculum Guide (CDC, 2017) that outlines learning objectives and pedagogical principles not only for early math, but also language (i.e., English, Chinese), ethics (e.g., moral), physical (e.g., motor), social, and aesthetics (e.g., arts, creativity) development. In the current study, we surveyed both parents' and teachers' practices as well as their reports of school-home communication on math and other domains of learning. Consequently, we aimed to provide insights into Hong Kong children's early math experiences to inform global research.

The Current Study

We conducted a survey study with kindergarten parents and teachers in Hong Kong. Our specific research questions (RQs) and the corresponding hypotheses were as follows:

1. Does the frequency of math activities differ by topic (numeracy vs. spatial vs. pattern), adult (parent vs. teacher), and their beliefs about children's math ability?

We hypothesized that the frequency of numeracy activities would be higher than that of spatial or pattern activities, and that teachers would engage children in math activities more frequently compared to parents. We also hypothesized that parents and teachers with more fixed ability beliefs about math would engage children in math activities less frequently.

2. Does the frequency of activities differ by learning domain (math vs. language vs. ethics vs. physical vs. social vs. aesthetics) and adult (parent vs. teacher)?

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We hypothesized that the frequency of language activities would be higher than that of math activities. We planned to explore additional contrasts, without a priori directional hypotheses.

> 3. Does the school-home communication (i.e., the information parents receive from their child's school) differ by learning domain (math vs. language vs. ethics vs. physical vs. social vs. aesthetics) as reported by parents and teachers?

We explored the differences in school-home communication across learning domains as reported by parents and teachers. Although families might also have a rich understanding of their child's abilities from their interactions at home (Zippert & Ramani, 2017), in the present study, we defined school-home communication as communication from early educators to families of young children. This decision was rooted in the research on the role of school in supporting parents' home practices and our interest in what families hear about their child's learning and activities that occur at school.

> 4. How can school-home communication and math resources be strengthened to support parents and teachers in promoting children's math learning?

We explored (a) the frequency and types of school-home communication, and (b) parents' and teachers' suggestions on ways to strengthen communication and math resources.

Method

Participants

We separately recruited Hong Kong parents and teachers by sharing the study information through social media and local kindergartens between April and December 2023. A total of 154 parents and 89 teachers of kindergarten children (three to six years of age) from across 18 districts of Hong Kong completed the survey. All participants were contacted and verified by a member of the research team. Additional 13 parents and two teachers completed the survey but were excluded from the analyses because their child or students were not enrolled in Kindergarten Years 1 to 3 (i.e., nursery, first grade).

Among the 154 parents, 68.8% were identified as women. The parents' average age was 35.89 years (*SD* = 5.74). The majority of the parents were Chinese (96.1%), and had obtained a bachelor or graduate degree (52.6%). Among the 89 teachers, 80.9% were identified as women. Their average age was 35.54 years (*SD* = 8.99). Similar to the participating parents, the majority of the teachers were Chinese (89.9%) and had obtained a bachelor or graduate degree (79.8%; see Supplementary Materials, Table A1 for detailed sample demographics). The ethnic composition of the sample was similar to that of the Hong Kong population (91.6% Chinese). The education level of the sample was higher

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than that of the Hong Kong population (35.2% obtained a post-secondary degree; Census and Statistics Department, 2021).

Procedure

All participants received the study information through social media or colleagues in early childhood education. Participants reviewed the study information and consented to participate prior to completing the Qualtrics survey. Within the survey, participants first identified whether they were a parent or teacher of kindergarten children, and their child's or students' study level. Next, participants reported their practices and needs in supporting children's math and other domains of learning, beliefs about the fixedness of children's math ability, and school-home communication. At the end of the survey, we collected participants' demographic and contact information, followed up to verify the participants through email or by phone call, then distributed a $50 Hong Kong Dollar e-gift card (approximately $6 U.S. Dollar). The median survey completion time was 7.85 minutes; 225 (92.6%) of the participants completed the survey in Chinese whereas the remaining participants 18 (7.4%) completed the survey in English, consistent with the ethnicity of the participants. The procedure was approved by the Ethics Committee at the Education University of Hong Kong.

Measures

Survey questions were first compiled or written in English, translated into Chinese, then back-translated to English to ensure the translation accuracy. We first designed the survey for parents then adjusted the questions and instructions for teachers to ensure consistency between the two parallel versions of the survey. An example of the adjustments was changing "my child" in the parent survey to "children" in the teacher survey. We detailed the adjustments using brackets in text and tables, and reported specific items and their descriptive statistics in Supplementary Materials (Table A2).

Math Activities

We administered the Math Support Questionnaire (Zippert & Rittle-Johnson, 2020) to measure parents' and teachers' frequency of engaging children in math activities. We asked participants, "In the past month, how often did you and your child [class] engage in the following activities?" The questionnaire included 25 items together covered three early math topics: numeracy (9 items; e.g., "count items"), spatial (7 items; e.g., "draw maps or plans"), and pattern (9 items; e.g., "figure out what comes next in a pattern"). The participants rated the frequency of each item on a six-point scale (1 = never, 6 = daily). For Item 25, "play hand or movement games that involve patterns (e.g., Miss Mary Mack, the hokey-pokey)", we added a video and replaced the examples in the Chinese version to ensure that the local parents and teachers understood the item. The overall questionnaire (α = 0.90) and each of the subscales (numeracy: α = 0.74, spatial: α = 0.75, patten: α = 0.86) had acceptable to excellent reliability. We used the frequency rating at the item level as the dependent variable in the analyses to address RQ1.

Fixedness Beliefs About Math Ability

We administered the Parental Beliefs about Ability Fixedness Scale (Muenks et al., 2015) to measure participants' beliefs about the fixedness of math ability. The scale included six items. A sample item was, "My child's [Children's] math ability is innate and will never change." We asked participants to "rate the degree to which you agree with each statement" on a six-point scale (1 = strongly disagree, 6 = strongly agree). The reliability of the scale was acceptable (α = 0.77). We used the average score across the six items as a fixed effect to address RQ1.

Learning Domain Activities

To measure participants' frequency of engaging children in various activities across learning domains, we included six items, one for each domain (intellect: math, intellect: language, ethics, physical, social, aesthetics), as outlined in the *Kindergarten Education Curriculum Guide* (CDC, 2017). We asked, "In the past month, how often did you and your child [class] engage in activities that support the following domains of learning? Activities may include playing, reading, cooking, discussion, watching shows, shopping, etc." For each learning domain, we provided examples of relevant concepts and skills as outlined in the Curriculum Guide. The sample item for math was "Intellect: Math (For example, number, quantity, shape, size, pattern, measurement)" and the sample item for language was "Intellect: Language (For example, listening, speech, reading, writing)". Participants rated the frequency of each item on a six-point scale (1 = never, 6 = daily). The reliability across the six items was acceptable (α = 0.83). We used the frequency rating at the item level as the dependent variable to address RQ2.

School-Home Communication Across Learning Domains

To measure school-home communication, we asked both parents and teachers whether families receive information about children's learning in each domain. Sample questions were, "Do you [parents] hear from your child's [their child's] school about the following aspects of his/her math skills development? (a) performance at school, (b) specific skills they are learning at school, and (c) ways to support learning at home" Participants responded yes (1) or no (0) for each of the three aspects across the six domains. The reliability (KR-20, Kuder-Richardson 20) across the 18 items was α = 0.91. We used the binary response at the item level as the dependent variable for RQ3.

Understanding and Enhancing School-Home Communication and Resources for Math Learning

We asked participants a series of closed- and open-ended questions to explore how school-home communication and math resources can be strengthened to help them promote children's math learning. Specifically, we asked participants the frequency in which parents receive information from school on children's math learning (1 = never, 6 = daily). We also asked participants to rate parents' knowledge and perceived importance of their child's math learning (five items) on a six-point scale (1 = strongly disagree, 6 = strongly agree). A sample question was, "I [Parents] know the specific types of math skills (e.g., counting, arithmetic, shape, pattern) that my [their] child is learning at school." The reliability of these five items was acceptable (α = 0.80).

Finally, we asked participants (a) how they communicate about children's math learning, (b) how can the communication be strengthened to help parents better understand their child's math learning, (c) what challenges have they faced when supporting children's math learning, and (d) what resources would help them support children's math learning. For Questions (a) and (d), we provided options for participants to select all that apply. For Questions (b) and (c), we generated data-informed codes to categorize participants' open-ended short responses. Specifically, an author who is an experienced kindergarten teacher reviewed the open-ended responses (e.g., don't know where to begin, don't know children's developmental trajectory, no teaching materials, no time) and generated summary codes based on the responses (e.g., teaching difficulties, time limitation). Through iterative discussion among the team, we revised the codes with the goal to inform future intervention research. For example, we differentiated "teaching difficulties" into lack of knowledge versus lack of resources, because the former suggested the need for additional adult training whereas the latter suggested the need for additional instructional materials. We then aligned the codes between parent and teacher responses to aid comparison between the two groups. Two members of the team coded all the responses, and the percentage agreement was 90.1%. The discrepancies were reviewed and resolved by a third member of the team prior to reporting the frequency of the responses for RQ4.

Analytic Approach

Preliminary Analyses

First, we conducted descriptive and correlation analyses to examine the data distribution and to inform primary analyses. The results of the correlation analyses suggested different associations among the variables for parents versus teachers, which were explored further in the primary analyses.

Primary Analyses

To address RQ1, we conducted a series of multilevel linear regression models with the frequency of math activities at the item level as the dependent variable, and math topic (Model 1.1), adult (Model 1.2), or belief about math ability (Model 1.3) as the focal fixed effects. We first tested each factor separately to examine their individual effect, then together to examine their independent effects in the presence of other factors (Model 1.4). Informed by the preliminary analyses, we also tested the Topic × Adult interaction to explore whether parents' versus teachers' frequency of math activities differed by the math topic (Model 1.5). The Intra-Class Correlations for participant (ICC = 0.202) and item (ICC = 0.220) were above the recommended 0.07 threshold for applying multilevel modeling (Niehaus et al., 2014). Therefore, we included the random intercepts for participant and item to account for their cross structure (i.e., the same items were given to all participants).

To address RQ2, we conducted a multilevel linear regression model with the frequency of activities at the item level as the dependent variable, and learning domain and adult as the focal fixed effects (Model 2.1). We also tested the Domain × Adult interaction to explore potential parent versus teacher differences across domains (Model 2.2). Given that the ICC for participant was 0.419, we estimated the random intercept for participant. Because learning domain comparison was a focus of our RQ, we included the learning domain as a fixed effect in the model.

To address RQ3, we conducted a multilevel logistic regression model with school-home communication at the item level as the dependent variable, and learning domain and adult as the focal fixed effects (Model 3.1). We added the Domain × Adult interaction to explore the potential differences in parent versus teacher responses across domains (Model 3.2). Because there were three school-home communication items per domain (ICC = 0.099) and the same items were given to all participants (ICC = 0.328), we included the random intercept for both factors in the models.

We took a mixed-methods approach to address RQ4. Specifically, for the close-ended questions, we reported the descriptive statistics of participants' responses. For the open-ended questions, we coded the responses and illustrated the frequency of each response category. All quantitative analyses were conducted in RStudio (RStudio Team, 2020); the multilevel models were conducted using the *lme4* package (Bates et al., 2015).

We made two notable deviations from our pre-registration, both related to RQ4. First, the order of this question was moved from second to fourth, to allow for grouping and reporting of the quantitative results from RQs 1 to 3. Second, we broadened RQ4 to include the open-ended responses on school-home communication and math resources. This change allowed us to complement the quantitative analyses with qualitative findings and enriched our results to inform future research. The analysis plan was pre-registered (https://osf.io/ed865), and the study materials, final dataset, and analysis output are publicly available on the Open Science Framework (https://osf.io/yv9ue).

Results

Preliminary Results

We averaged response ratings across items within each questionnaire or subscale, reported the descriptive statistics, and noted three observations from the correlation statistics (Table 1).

Table 1

Descriptive and Correlation Statistics of Focal Variables by Parent and Teacher

Statistics or Variable	M:N	M:S	M:P	FB	LD	SHC	MLC	MLKI
Descriptive Statistics for Parents								
M (*SD*)	3.84 (0.68)	3.35 (0.77)	2.68 (0.83)	2.67 (0.83)	4.38 (0.88)	0.60 (0.29)	2.92 (1.20)	4.67 (0.74)
Min-Max	1.67-6	1-6	1-6	1-4.17	2-6	0-1	1-6	2-6
Skewness/Kurtosis	-0.19 / 1.26	-0.13 / 0.64	0.26 / 0.52	-0.34 / -0.87	-0.31 / -0.40	-0.34 / -0.79	0.44 / -0.54	-0.60 / 0.34
Correlation Statistics for Parents (Upper Triangle) and Teachers (Lower Triangle)								
M:N	–	0.47***	0.40***	0.07	0.44***	0.23**	0.14	0.14
M:S	0.59***	–	0.63***	0.05	0.13	0.12	0.11	-0.13
M:P	0.72***	0.78***	–	0.16*	-0.02	0.13	0.21**	0.02
FB	-0.17	-0.04	-0.08	–	-0.13	-0.11	0.08	-0.10
LD	-0.09	-0.10	-0.23*	0.20	–	0.11	-0.09	0.34***
SHC	-0.10	-0.18	-0.24*	0.05	0.24*	–	0.37***	0.32***
MLC	0.15	-0.01	0.07	0.09	0.20	0.41***	–	0.18*
MLKI	0.18	0.17	0.17	-0.05	0.07	0.14	0.11	–
Descriptive Statistics for Teachers								
M (*SD*)	4.07 (0.76)	4.01 (0.81)	3.12 (0.87)	2.27 (0.72)	4.68 (0.66)	0.81 (0.22)	3.17 (1.07)	4.74 (0.67)
Min-Max	1.78-6	1.86-6	1.11-6	1-4	3.17-6	0.28-1	2-6	1-6
Skewness/Kurtosis	-0.24 / 0.56	-0.18 / -0.18	-0.12 / 0.36	0.39 / -0.53	0.34 / -0.73	-0.83 / -0.57	0.94/ 0.35	-2.33/ 9.83

Note. M:N = Math: Numeracy; M:S = Math: Spatial; M:P = Math: Pattern; FB = Fixedness Beliefs; LD = Learning Domain; SHC = School-Home Communication; MLC = Math Learning Communication; MLKI = Math Learning Knowledge and Importance; *SD* = Standard Deviation; Min = Minimum; Max = Maximum.
$^{*}p < .05$. $^{**}p < .01$. $^{***}p < .001$.

First, the correlations between the three topics of math activities were moderate to high (0.40 < *r*s < 0.78), suggesting that they captured related yet distinct aspects of math activities. Second, parents who engaged children in learning domain activities more versus less frequently also engaged children in numeracy activities more frequently (r = 0.44) and rated their knowledge and perceived importance of math learning higher (r = 0.34), but these associations were not significant among teachers. Third, parents who reported a higher versus lower level of school-home communication engaged children in numeracy activities more frequently (r = 0.23) and rated their knowledge and perceived importance of math learning higher (r = 0.32), but these associations were not significant among teachers. Together, the preliminary analyses suggested some associations among the variables, and differences between parent versus teacher responses, warranting further investigation. We reported descriptive statistics of each item by parent and teacher in Supplementary Materials (Table A2).

Primary Results

RQ1: Frequency of Math Activities

We conducted a series of multilevel models to test whether the frequency of math activities varied by math topic, adult role, and adult beliefs about the fixedness of math ability (Table 2).

Table 2

Beta Coefficients, Standard Errors, and 95% Confidence Intervals for the Coefficients in Multilevel Models Predicting Frequency of Math Activities

Variable	Model 1.1 *B* (*SE*) [95% CI]	Model 1.2 *B* (*SE*) [95% CI]	Model 1.3 *B* (*SE*) [95% CI]	Model 1.4 *B* (*SE*) [95% CI]	Model 1.5 *B* (*SE*) [95% CI]
Intercept	3.92 (0.18)*** [3.59, 4.26]	3.29 (0.15)*** [2.99, 3.58]	3.52 (0.20)*** [3.13, 3.91]	3.68 (0.23)*** [3.24, 4.12]	3.76 (0.23)*** [3.32, 4.20]
Topic: Spatial	-0.33 (0.26) [-0.83, 0.17]	–	–	-0.33 (0.26) [-0.83, 0.17]	-0.49 (0.26) [-0.99, 0.01]
Topic: Pattern	-1.09 (0.24)*** [-1.55, -0.62]	–	–	-1.09 (0.24)*** [-1.55, -0.62]	-1.17 (0.24)*** [-1.63, -0.70]
Adult: Teacher	–	0.43 (0.09)*** [0.25, 0.60]	–	0.44 (0.09)*** [0.26, 0.62]	0.24 (0.10)* [0.04, 0.43]
Fixedness Beliefs	–	–	-0.03 (0.05) [-0.14, 0.08]	0.03 (0.05) [-0.07, 0.14]	0.03 (0.05) [-0.07, 0.14]
Spatial × Teacher	–	–	–	–	0.44 (0.07)*** [0.29, 0.58]
Pattern × Teacher	–	–	–	–	0.22 (0.07)** [0.08, 0.36]
Marginal R^2	0.103	0.020	0.000	0.123	0.126
Conditional R^2	0.426	0.423	0.423	0.427	0.430

Note. Topic: Spatial and Pattern were binary variables with numeracy as the reference group; Adult: parent = 0, teacher = 1.
*p < .05. **p < .01. ***p < .001.

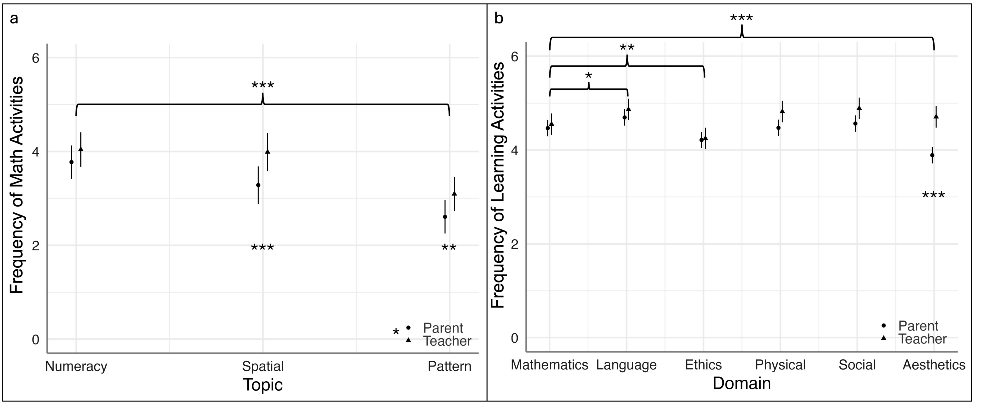
We found that parents and teachers engaged children in pattern activities less frequently compared to numeracy activities (B = -1.09, SE = 0.24, p < .001; Model 1.1). On average, parents and teachers engaged children in numeracy activities almost once a week, but in pattern activities only about once or twice per month.

Next, we found that teachers conducted math activities more frequently compared to parents (B = 0.43, SE = 0.09, p < .001; Model 1.2). Parents' and teachers' fixedness beliefs about math ability did not significantly predict their frequency of math activities, p = .588 (Model 1.3). Combining all three factors in one model revealed that the aforementioned effects of pattern activities and teacher remained significant (ps < .001; Model 1.4).

Finally, we added the Topic × Adult interaction to explore whether the frequency of numeracy, spatial, and pattern activities varied between parents versus teachers. We found that whereas parents and teachers did not differ in their frequency of numeracy activities, teachers engaged children in spatial (B = 0.44, SE = 0.07, p < .001) and pattern activities (B = 0.22, SE = 0.07, p = .002) more frequently compared to parents (Model 1.5; Figure 1a).

Figure 1

Frequency of (a) Math Activities by Topic and Adult or (b) Learning Activities by Domain and Adult



Note. The main effect of adult is denoted next to the legend. The main effect of the math topic or learning domain is denoted above the estimates. The simple effect of the interaction is denoted below the estimates. The error bars represent 95% confidence intervals. *Figure 1a* indicates that both parents and teachers engaged children in numeracy activities more frequently compared to pattern activities. Compared to parents, teachers engaged children in spatial and pattern activities more frequently. *Figure 1b* indicates that compared to math activities, parents and teachers engaged children in language activities more frequently, and ethics and aesthetics activities less frequently. Compared to parents, teachers engaged children in aesthetics activities more frequently.

*p < .05. **p < .01. ***p < .001.

RQ2: Frequency of Learning Domain Activities

We conducted two multilevel models to examine the effects of learning domain and adult on frequency of learning activities (Table 3). We found that compared to math activities, adults engaged children in language (*B* = 0.26, *SE* = 0.08, *p* < .001) and social activities (*B* = 0.19, *SE* = 0.08, *p* = .014) more frequently but ethics (*B* = -0.27, *SE* = 0.08, *p* < .001) and aesthetics activities (*B* = -0.31, *SE* = 0.08, *p* < .001) less frequently. Furthermore, teachers engaged children in learning activities more frequently compared to parents (*B* = 0.30, *SE* = 0.11, *p* = .006; Model 2.1).

Table 3

Beta Coefficients, Standard Errors, and 95% Confidence Intervals for the Coefficients in Multilevel Models Predicting Frequency of Learning Domain Activities

	Model 2.1		**Model 2.2**	
Variable	***B* (*SE*)**	**[95% CI]**	***B* (*SE*)**	**[95 %CI]**
Intercept	4.39 (0.08)***	[4.23, 4.55]	4.47 (0.09)***	[4.29, 4.64]
Domain: Language	0.26 (0.08)***	[0.11, 0.41]	0.23 (0.09)*	[0.04, 0.41]
Domain: Ethics	-0.27 (0.08)***	[-0.42, -0.12]	-0.25 (0.09)**	[-0.44, -0.07]
Domain: Physical	0.10 (0.08)	[-0.05, 0.25]	0.01 (0.09)	[-0.18, 0.19]
Domain: Social	0.19 (0.08)*	[0.04, 0.33]	0.10 (0.09)	[-0.09, 0.28]
Domain: Aesthetics	-0.31 (0.08)***	[-0.46, -0.16]	-0.58 (0.09)***	[-0.76, -0.39]
Adult: Teacher	0.30 (0.11)**	[0.09, 0.51]	0.08 (0.15)	[-0.20, 0.37]
Language × Teacher	–	–	0.09 (0.16)	[-0.22, 0.39]
Ethics × Teacher	–	–	-0.05 (0.16)	[-0.35, 0.25]
Physical × Teacher	–	–	0.26 (0.16)	[-0.04, 0.57]
Social × Teacher	–	–	0.24 (0.16)	[-0.06, 0.54]
Aesthetics × Teacher	–	–	0.74 (0.16)***	[0.43, 1.04]
Marginal R^2	0.052		0.064	
Conditional R^2	0.462		0.476	

Note. Domain: language, ethics, physical, social, and aesthetics were binary variables with math as the reference group; Adult: parent = 0, teacher = 1.
**p* < .05. ***p* < .01. ****p* < .001.

Adding the Domain × Adult interaction revealed that the significant differences between math versus language (*B* = 0.23, *SE* = 0.09, *p* = .016), ethics (*B* = -0.25, *SE* = 0.09, *p* = .007) and aesthetics learning activities (*B* = -0.58, *SE* = 0.09, *p* < .001) remained, but the differences between math versus social and parents versus teachers were no longer significant, *p*s > 0.300. Furthermore, the Domain × Adult interaction revealed that teachers engaged children in aesthetics activities more frequently compared to parents (*B* = 0.74, *SE* = 0.16, *p* < .001; Model 2.2, Figure 1b). This finding suggested that the main effect of adult might have been driven by the differences in teachers' versus parents' frequency of aesthetic activities.

RQ3: School-Home Communication

We conducted two multilevel logistic models to examine the effects of learning domain and adult on school-home communication (Table 4). We found that compared to math, parents and teachers were more likely to report school-home communication about language (*B* = 0.36, *SE* = 0.15, p = .017) and social learning (*B* = 0.30, *SE* = 0.15, p = .047) but less likely report such communication about physical (*B* = -0.37, *SE* = 0.15, p = .013) and aesthetics learning (*B* = -0.98, *SE* = 0.15, p < .001). In particular, compared to math, parents and teachers reported that they were 1.44 times more likely to have school-home communication about language learning and 1.35 times more likely about social learning, but 31% less likely about physical learning and 62% less likely about aesthetics learning. Teachers were 7.52 times more likely to report school-home communication compared to parents (*B* = 2.02, *SE* = 0.33, p < .001; Model 3.1).

Table 4

Beta Coefficients, Standard Errors, and Exponents of the Coefficients in Multilevel Logistic Models Predicting School-Home Communication

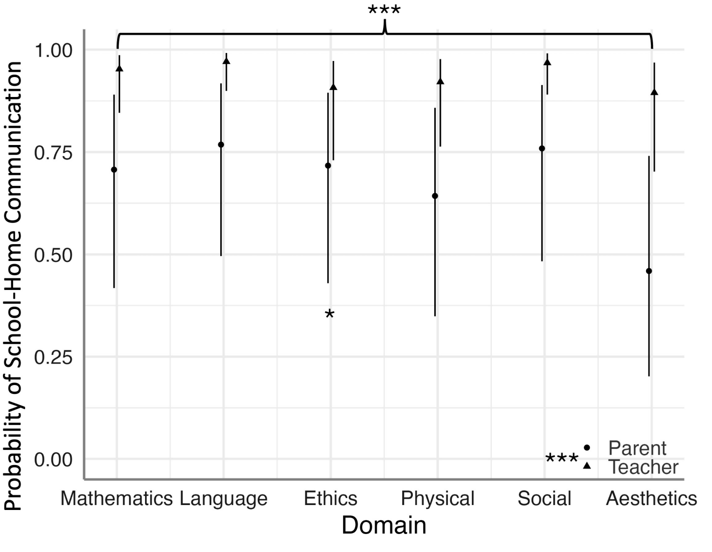
	Model 3.1		Model 3.2	
Variable	***B* (*SE*)**	**exp(*B*)**	***B* (*SE*)**	**exp(*B*)**
Intercept	0.90 (0.62)	2.47	0.88 (0.62)	2.41
Domain: Language	0.36 (0.15)*	1.44	0.32 (0.18)	1.37
Domain: Ethics	-0.19 (0.15)	0.83	0.05 (0.18)	1.05
Domain: Physical	-0.37 (0.15)*	0.69	-0.29 (0.18)	0.75
Domain: Social	0.30 (0.15)*	1.35	0.27 (0.18)	1.30
Domain: Aesthetics	-0.98 (0.15)***	0.38	-1.04 (0.18)***	0.35
Adult: Teacher	2.02 (0.33)***	7.52	2.12 (0.40)***	8.35
Language × Teacher	–	–	0.18 (0.34)	1.20
Ethics × Teacher	–	–	-0.77 (0.32)*	0.46
Physical × Teacher	–	–	-0.25 (0.32)	0.78
Social × Teacher	–	–	0.14 (0.34)	1.15
Aesthetics × Teacher	–	–	0.18 (0.32)	1.20
Marginal R^2	0.108		0.112	
Conditional R^2	0.691		0.694	

Note. Domain: language, ethics, physical, social, and aesthetics were binary variables with math as the reference group; Adult: parent = 0, teacher = 1.
$^{*}p < .05$. $^{**}p < .01$. $^{***}p < .001$.

When adding the Domain × Adult interaction, the effects of aesthetics and teacher remained significant. Furthermore, the differences between parent versus teacher reported school-home communication differed between math and ethics learning. An interaction plot revealed that teachers were more likely to report school-home communication versus parents across all learning domains except ethics (Model 3.2; Figure 2).

Figure 2

The Probability of School-Home Communication by Learning Domain and Adult



Note. The main effect of adult is denoted next to the legend. The main effect of the learning domain is denoted above the estimates. The simple effect of the interaction is denoted below the estimates. The error bars represent 95% confidence intervals. Teachers were more likely to report school-home communication compared to parents in all domains except ethics. Parents and teachers were less likely to report school-home communication on aesthetics compared to math learning.
**p* < .05. ****p* < .001.

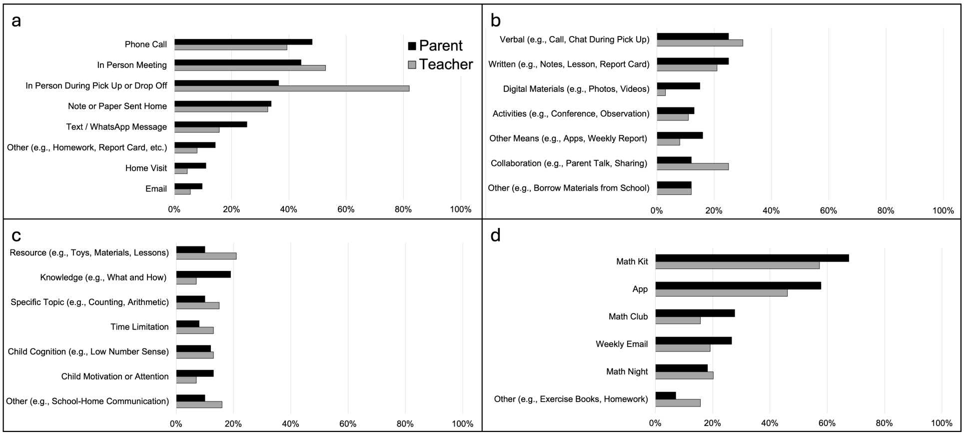
RQ4: Adults' Perspectives on School-Home Communication and Resources for Math Learning

We found that both parents (M = 2.92, SD = 1.20) and teachers (M = 3.17, SD = 1.07) reported that parents received information about math learning from their child's school approximately two to three times a month. Both parents (M = 4.67, SD = 0.74) and teachers (M = 4.74, SD = 0.67) agreed that parents had some knowledge about children's math learning and thought that it's important for parents to know and support children's math learning (Tables 1 and A2).

Regarding school-home communication, over 30% of parents and teachers reported that they communicated about children's math learning through phone calls, meetings, and notes or papers from school (Figure 3a). To further strengthen school-home communication, 20-30% of parents and teachers suggested more verbal and written communication through existing means. On one hand, 15% of parents also suggested more digital materials (e.g., photos, videos) from teachers to better understand their child's learning at school. On the other hand, 25% of teachers suggested more collaboration and parent involvement through parent education, and sharing of their child's learning at home (Figure 3b).

Figure 3

The Percentage of Parents and Teachers Reported Certain (a) Means to Communicate About Children's Math Learning, (b) Ways to Strengthen Communication, (c) Challenges They Have Faced, and (d) Resources That They Need to Promote Children's Math Learning



Furthermore, we found that 19% of parents reported a lack of knowledge (e.g., don't know how) as a challenge in supporting their child's math learning, whereas 21% of teachers reported a lack of resources (e.g., materials, lesson plan; Figure 3c). Over 50% of parents and teachers thought that math kits would help them support children's math learning. Over 45% of parents and teachers also reported that digital math applications would be helpful (Figure 3d).

Discussion

We set out to examine Hong Kong parents' and teachers' practices, beliefs, and communication of early math, with the goals of advancing our knowledge of children's learning

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environments and informing math learning practices at home. To provide a broader context of early childhood development, we also examined the relative frequency of activities and school-home communication on math compared to other learning domains. First, we found that both parents and teachers engaged children in numeracy activities more frequently compared to pattern activities. Compared to parents, teachers engaged children in math activities more frequently and this effect was driven by their higher frequency of spatial and pattern activities. However, parents' and teachers' fixedness beliefs about math ability did not predict their frequency of providing math activities. Second, compared to math activities, parents and teachers engaged children in language activities more frequently, and ethics and aesthetics activities less frequently. Third, teachers were more likely to report school-home communication compared to parents in all domains except ethics; parents and teachers were less likely to report school-home communication on aesthetics compared to math learning. Finally, our mixed-methods analyses revealed ways in which early math learning and school-home communication can be strengthened.

Math Practices and Environments

Contrary to prior research (US: Muenks et al., 2015) and our hypothesis, Hong Kong parents' and teachers' fixedness belief of math ability did not predict their frequency of engaging children in math activities. One potential explanation is that parents and teachers in our sample generally believed that children's math ability is partially malleable, restricting the variability for its association with math practices. In fact, compared to parents in the US, Asian parents are more likely to believe that intelligence can be increased through practice and efforts (Chen & Stevenson, 1995). Therefore, it is possible that other aspects of adult beliefs or attitudes, such as beliefs about learning process (HK: Cheung et al., 2023), are more predictive of the early math practices among Hong Kong parents and teachers. Indeed, prior research with Chinese parents of preschoolers found evidence for socioeconomic differences in parents' math value beliefs (China: Lu et al., 2025a; China: Pan et al., 2018), in contrast to research with Western samples (LeFevre et al., 2010).

Consistent with prior findings among US parents (Zippert & Rittle-Johnson, 2020), both Hong Kong parents and teachers engage children in numeracy activities more frequently compared to pattern activities. In both the US and Hong Kong, parents engage children in numeracy activities once or twice a week, and engage in pattern activities two to three times a month. Given the importance of patterning skills in later math achievement (e.g., US: Fyfe et al., 2017; Singapore: Lee et al., 2011), the significant difference in the frequency of numeracy versus pattern activities suggests that parents and teachers should extend beyond basic numeracy and better support pattern learning. Even within subdomains of numeracy, parents and teachers reported that they engage children in basic rote activities, like counting, two to three times a week, but other

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playful number application activities (e.g., reading number books or playing number games) only two to three times a month, consistent with the discrepancy between basic versus contextualized and advanced math talk or activities by parents (HK: Cheung et al., 2023; US: Gunderson & Levine, 2011; US: DePascale et al., 2021; China: Yang et al., 2025) and math instruction in classroom (e.g., US: Engel et al., 2013; US: Scalise et al., 2025).

How can research inform and support parents' and teachers' practices to go beyond basic numeracy and advance children's math thinking? Given that teachers reported higher frequency of spatial and pattern activities, one possibility is to facilitate school-home communication and collaboration. In fact, 19% of parents reported a lack of knowledge in supporting children's math learning and 25% of teachers suggested parent education as a means to strengthen school-home communication. To address these needs, researchers and parent educators can provide parent training on math skills development and ways to support this development at home (US: Leung & Suskind, 2020; China: Zhong et al., 2020). Researchers can also identify effective ways to facilitate school-home communication. This may help parents better understand children's skill levels and help teachers effectively share suggestions for home activities that align with school instruction (US: Lin et al., 2019; Van Voorhis et al., 2013; Young et al., 2023), leading to additive effects of home math learning beyond school instruction (Daucourt et al., 2021; Eason et al., 2022). School-home education and collaboration, through materials such as math kits or digital applications as suggested by parents and teachers, are a promising path forward to promote aligned early math learning across contexts.

Math Versus Language and Other Domains

Compared to math, parents and teachers engaged children in activities that support language learning more frequently and ethics and aesthetics learning less frequently. These domain differences may stem from parents' and teachers' beliefs about the relative importance of different domains. For instance, parents of young children believe that language and literacy is more important than early math (US: Blevins-Knabe et al., 2000; Cannon & Ginsburg, 2008; c.f., Missall et al., 2015). Observational studies in early childhood education contexts also find that language and literacy instruction occur significantly more frequently than math instruction (US: Bachman et al., 2018; Hofer et al., 2013; Mazzocco et al., 2024). Given the significant, positive associations between school-home communication, parents' frequency of numeracy activities, and their knowledge and perceived importance of early math learning (Table 1), interventions designed to promote parents' knowledge of early math development, potentially through school-home communication, may help increase parents' early math practices and eventually enhance children's math performance.

The high pressure for academic success in Hong Kong (Ng, 2014) emerged in parents' and teachers' reports of practice and communication. Compared to math, both parents and teachers reported fewer activities in the non-academic domains of ethics and aesthetics, and a lower likelihood of school-home communication about aesthetics. One potential direction for future research is to identify intersections of multiple domains and to promote integrative learning (Clements et al., 2016). For example, Purpura and colleagues (2019) recommend that policies and practices should integratively promote both math and reading. Studies of US and Chinese families have shown that parents engage in frequent math talk during story book reading tasks (US and China: Yang et al., 2025). Beyond language and literacy, parents and teachers can also integrate math with ethics and aesthetics learning or vice versa. Prior research has shown that children's number knowledge serves as a foundation for fair sharing behaviors (Chernyak et al., 2016). Through discussion of fairness and equal sharing, children can further advance their understanding of division and fraction (Empson, 1999; Roberts, 2003). Similarly, music training can enhance children's proportional reasoning (Graziano et al., 1999) and patterning (Geist et al., 2012). Together, these examples suggest that as math can be integrated with literacy through shared reading, it can also be integrated with ethics and aesthetics through various everyday activities to promote holistic child development.

School-Home Communication

As shown in our results, parents and teachers reported school-home communication about math learning on average two to three times per month, leaving opportunity for improvement. Furthermore, across all domains except ethics, teachers reported a higher likelihood of school-home communication than parents. It is unclear what caused this discrepancy. It is possible that teachers over-reported their communications to parents (e.g., to fulfill social desirability regarding part of their job responsibilities). It is also possible that teachers' communications did not effectively reach parents. For example, over 80 percent of teachers reported communicating with parents during drop off and pick up times, whereas less than 40 percent of parents reported communicating at those times. This gap between teacher and parent report may partly be attributed to the fact that one teacher usually interacts with multiple families and reports their overall communication experiences across all families, whereas each parent would only have their own individual experiences of communication with the teacher. Nevertheless, the finding indicates that quick, verbal communication during the beginning and end of the school day may not be an effective method to reach parents of young children. Other forms of delayed or documented communication may be preferable. Indeed, over 20 percent of parents and teachers reported that additional written materials (e.g., notes, lessons, report cards) would strengthen this communication. Teachers further recommended more communication from parents about children's learning at home to enhance school-home collaboration. Future research should solicit teacher and parent feedback in the co-design of school-home communication supports (Chan et al., 2023; Eason et al., 2024; Simms et al., 2024) to ensure that methods of communication fit the needs of busy caregivers.

Limitations and Future Directions

Several limitations inform future directions. First, the Math Support Questionnaire (Zippert & Rittle-Johnson, 2020) and the Parental Beliefs about Ability Fixedness Scale (Muenks et al., 2015) were originally designed for parents in the US. We translated and made minimal adjustments to ensure the clarity of the questions for parents and teachers in Hong Kong. The questions might not fully capture the variation in practices and beliefs among Hong Kong parents and teachers. The participants' responses also might not provide a comprehensive picture of Hong Kong children's experiences at home or in school. However, adapting existing questionnaires across contexts allowed us to make direct comparisons with prior studies and between home versus school environments. The current study therefore served as an informative step in understanding Hong Kong children's early learning experiences as situated in the global context.

Second, given our focus on math, we followed the local curriculum guide to design parallel questions across learning domains but included limited questions on each domain. We made this decision to balance between collecting some data on overall early childhood education and ensuring the feasibility of questionnaire completion. Similarly, given our focus on school to home communication and its potential relation with home math practices, we did not include questions on the specific content of this communication or the reverse direction—home to school communication. An important future direction of this work is to include families' communication of their child's learning and abilities to their teacher (e.g., during family-teacher conferences, written communications, or other in-person conversations). Although we could not delve deeper into children's development across learning domains or school-home communication in the current study, the data nonetheless extended prior research on early math and provided information on parents' and teachers' practices of early math relative to other learning domains.

Third, the questionnaire method allowed us to reach a relatively large sample, but it was subject to social desirability bias and might not accurately reflect parents' and teachers' actual practices or beliefs. Prior research has demonstrated consistency between parents' questionnaire reports versus time diaries of math activities (Bachman et al., 2020). However, in one study, parents' report of numeracy activities was not significantly correlated with observed home numeracy talk, yet both uniquely predicted aspects of children's calculation ability (Mutaf Yildiz et al., 2018). Future research using multiple methods is needed to enrich and advance our understanding of children's early math experiences as well as the relations between these experiences and math performance.

Finally, although our sample included families and teachers from all 18 districts of Hong Kong, the participants' education level appeared higher than that of the Hong Kong population, potentially limiting the generalizability of our results. Future research should examine the potential variations in early math practices and school-home communication across levels of socio-economic status. Furthermore, we recruited independent samples of parents and teachers to provide sufficient power for statistical comparisons on children's early math experiences at home versus school. Although it is possible that our sample included some overlap between individual children's parents and their teachers, an important future direction is to recruit a matched sample of teachers and parents associated with the same children. This approach allows us to accurately compare parent- versus teacher-reported practices at the individual child level, further delineating the associations among home math practices, school instruction, home-school communication, and child learning outcomes. In turn, matched data would provide insights into developmental mechanisms and malleable factors that can be leveraged to promote children's learning within their ecological system.

Conclusion

Through both quantitative and qualitative analyses, we identified strengths and potential areas for improvement in early math practices among Hong Kong parents and teachers. The study provided valuable information on Hong Kong children's experiences in math versus other domains, and pointed to future directions in sharing knowledge with parents, designing and disseminating resources with educators, and facilitating school-home communication. Future research in this area can help parents and teachers build a collaborative support system that effectively promotes children's math learning across contexts.

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Author Contributions: *Jenny Yun-Chen Chan*: conceptualization, methodology, formal analysis, investigation, data curation, writing-original draft, writing-review and editing, visualization, supervision, funding acquisition; *Nicole R. Scalise*: conceptualization, methodology, writing-original draft, writing-review and editing; *Shirley Yuen Man Tsang*: data curation, writing-original draft, writing-review & editing, project administration; *Hailey Hoi Lam Cheng*: methodology, writing-original draft, writing-review & editing.

Preregistration: The analysis plan was pre-registered (https://osf.io/ed865).

Data Availability: The study materials, final dataset, and analysis output are available on the Open Science Framework (https://osf.io/yv9ue).

Supplementary Materials

The Supplementary Materials contain the following items:

- The preregistration for the sudy (Chan & Scalise, 2024S)
- The study materials, final dataset, and analysis output (Chan, 2026S)

Index of Supplementary Materials

Chan, J. Y.-C., & Scalise, N. R. (2024S). *Math learning support at home and in classroom* [Preregistration]. OSF Registries. https://osf.io/ed865

Chan, J. Y.-C. (2026S). *Math learning support at home and in classroom* [Study materials, final dataset, and analysis output]. OSF. https://osf.io/yv9ue

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