The relation between home numeracy activities and Chinese children's early math skills

Introduction and Literature review

- **Mathematics** skills play a crucial role in children's cognitive development and academic success (Rajić, 2019).
- **Early childhood** is an important period for learning mathematics (Aunio & Niemivirta, 2010).
- **The home learning environment** significantly shapes children's mathematical abilities (Huang et al., 2017). Specifically, parent-child interactions and activities at home have been found to profoundly impact children's early math learning (Starkey & Klein, 2000).
- **Formal numeracy activities** are activities in which parents purposefully and directly teach their kids math, which can be further classified into number skill activities (e.g., practicing simple sums) and book activities (e.g., reading math storybooks).
- **Informal numeracy activities**, such as playing number board gamed and measuring ingredients when cooking, include number application and game activities (LeFevre et al., 2009).

There is inconsistency in existing literature regarding how formal and informal numeracy activities are associated with children's early math skills (LeFevre et al., 2009; LeFevre et al., 2010; Huang et al., 2017; Young-Loveridge, 2004).

Hypothesis

H: There is a positive correlation between the frequency of home numeracy activities and children's early math learning outcomes in Hong Kong.

Methods

Sample:

Sample: Participants were 159 children (mean age =59.3 months, SD = 3.0 months) and their parents.

Measure:

Home numeracy activities. Parents reported their participation in 24 numeracy-related activities (LeFevere et al., 2009; Zhang et al., 2020).

These activities can be divided into four dimensions:

1. formal number skill activities (10 items*, e.g., counting objects)
2. formal number book activities (4 items, e.g., reading number storybooks)
3. informal number application activities (5 items, e.g., having your child wear a watch)
4. informal number game activities (5 items, e.g., playing number card games).

*One item ("playing with number fridge magnets") was deleted because of its low factor loading. Confirmatory factor analysis showed that a four-factor measurement model had a good fit to the data: $\chi 2$ (222) = 353.575 ($p < .01$), CFI = .914, TLI = .902, RMSEA = .061, SRMR = .071.

Math performance: Children's math performance was rated by parents with two items (e.g., "Compared to other children in the same class, this child's math performance is"). The item was scored from 1 (Very Poor [Bottom 10%]) to 5 (Very Good [Top 10%]).

Data analysis: A regression model was used to explore the relationship between home numeracy activities and children's math performance.

Ethical considerations: Informed consent, confidentiality and anonymity, voluntary participation, privacy, and data protection.

Results

Descriptives

	formal number skill activities	formal numeracy book activities	informal game activities	informal application activities	math performance	Gender	Family income	Age
N	159	159	159	159	158	159	139	146
Mean	2.458	1.776	1.870	1.703	3.434	0.491	11.755	59.336
Median	2.556	2.000	2.000	1.800	3.000	0.000	12	60.000
Standard deviation	0.768	0.893	0.843	0.871	0.759	0.501	3.016	4.143
Minimum	0.111	0.000	0.000	0.000	2.000	0.000	2	52
Maximum	3.778	3.500	3.800	3.600	5.000	1.000	20	73

Linear Regression

Model Fit Measures

Model	R	R^2
1	0.409	0.167

Model Coefficients - math performance

Predictor	Estimate	SE	t	p
Intercept	0.842	0.925	0.910	0.365
formal number skill activities	0.239	0.120	1.996	0.048
formal numeracy book activities	0.022	0.118	0.188	0.851
informal game activities	0.045	0.129	0.350	0.727
informal application activities	0.060	0.118	0.511	0.610
Gender	0.042	0.123	0.338	0.736
Family income	0.019	0.021	0.908	0.365
Age	0.025	0.015	1.678	0.096

Number skill activities, book activities, game and application activities **together significantly predicted** children's math performance, $R^2 = .409$, $F(7, 128) = 3.667$, $p = .001$.
However, **only number skill activities were a significant predictor** ($B = 0.239$, $\beta = 0.246$, $p = 0.048$). Other activities, including book activities ($B = 0.022$, $\beta = 0.026$, $p = 0.851$), game ($B = 0.045$, $\beta = 0.051$, $p = 0.727$) and application activities ($B = 0.06$, $\beta = 0.069$, $p = 0.610$), **were not significant predictors.**

Discussion:

Number skill activities acted as a significant predictor but other activities including book, game and application activities had no statistically significant effect.

Contribution:

- This research advances our knowledge of the **complex interplay** between a variety of home numeracy activities and early childhood math learning.
- The strong correlation between formal activities and children's math performance underscores the importance of structured numeracy exercises. It highlights educators' vital role in enhancing children's math skills through formal activities.
- The **absence of a direct correlation** for **informal numeracy** activities prompts researchers to **explore other factors** and mechanisms that might be at play in shaping children's math learning outcomes.
- Parents and educators can still engage in these activities as they can promote positive parent-child relationships, foster a love for math, and provide opportunities for informal learning and exploration.

Limitation:

- **Self-reporting** measures were used, which could lead to the possibility of social desirability bias (Fisher & Katz, 2000).
- Additionally, the **cross-sectional design** only provides a snapshot of the relationship between parent-child numeracy activities and children's math performance at a specific time point, **limiting the ability to draw causal inferences or examine how these relationships may change over time.**

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