Unpacking the Role of Parents in Shaping Early Numeracy: A Quantitative Study of Mathematical Play Frequency

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ABSTRACT

Early mathematics plays a crucial role in shaping children's cognitive and problem-solving skills, and parents' perceptions significantly influence how mathematical experiences are introduced at home. This study explores the relationship between parents' perceptions and early mathematics exposure among children in Kuala Selangor, Selangor. Grounded in the principles of constructivist theory, the research employed a quantitative survey method, using a structured questionnaire adapted from the Parents' Play Belief Scale (PPBS) and Home Mathematics Environment (HME). Data were collected from 189 parents via Google Forms, and a pilot study was conducted to ensure instrument validity and reliability, with Cronbach's alpha values of .892 (Parents' Perceptions) and .959 (Early Mathematics) indicating strong internal consistency. The findings revealed a moderate, positive, and significant correlation between parents' perceptions and early mathematics ($r = .371$, $p < .001$), suggesting that more favorable parental attitudes are associated with greater engagement in home-based numeracy practices. However, independent samples t-tests indicated no significant differences in perceptions and early mathematics exposure across demographic groups. The results underscore the importance of empowering parents through strategic collaboration with educators to promote play-based and contextual learning at home. This study contributes to the growing literature on early childhood education in Malaysia by highlighting the critical role parents play in shaping foundational mathematics skills. It calls for stronger parental support mechanisms aligned with national curricula, such as the Kurikulum Standard Prasekolah Kebangsaan (KSPK) and Program Literasi dan Numerasi (PLaN). These findings advocate for a holistic, home-school partnership model that supports early mathematical development and fosters lifelong learning readiness.

Keywords: Parental, mathematical, quantitative, early childhood, early education

INTRODUCTION

In today's modern and challenging educational era, formal education alone is no longer sufficient to support the holistic development of children. Education plays a crucial role in building a quality generation that will become the nation's future leaders, and this effort must begin early in a child's life. Early education lays the foundation

for cognitive, emotional, and social development including early mathematics learning (Chen, 2025). According to Jahreie (2022), early exposure to basic knowledge and skills prepares children to transition into formal education, especially at the preschool level.

Early mathematics learning typically begins between the ages of four and six, during the Taska and Tadika stages (Farah & Suziyani, 2023). This early exposure allows children to engage with real-world experiences such as recognizing numbers, understanding money, identifying shapes, and grasping concepts of day and night. Ningsih et al. (2024) define mathematics as the study of patterns, structure, quantity, space, and change, making it a fundamental subject in daily life, from counting money to solving problems logically.

Mathematical understanding in early childhood is best fostered through play-based learning, which not only makes the experience enjoyable but also enhances comprehension. Activities like counting objects, recognizing shapes, or measuring ingredients at home provide children with meaningful learning opportunities. Osman and Mohamed (2023) emphasize that early numeracy skills such as number recognition, sequencing, and basic operations should be cultivated through active exploration and play. Elmey et al. (2025) emphasise the importance of parental involvement in ensuring students' skills to enhance and increase their knowledge, particularly in early mathematics.

Parental involvement plays a vital role in supporting early mathematics at home. However, implementing effective play-based learning at home can be challenging without proper guidance. Mansor et al. (2021) found that home-based learning often lacks effectiveness due to difficulties in selecting appropriate methods and evaluating outcomes. Therefore, collaboration between parents and educators is essential to ensure that children receive continuous and enjoyable exposure to mathematics. Interactive games, for example, have been shown to help children recognize and pronounce numbers more quickly (Nurdiyana et al., 2021). According to Rozi et al. (2025), developing strong early numeracy foundations calls for an all-encompassing, cooperative approach that incorporates knowledgeable parental participation, well-trained educators, and contextually appropriate play techniques.

As children naturally learn through play, it is crucial for parents to create a conducive learning environment at home. This learning should be facilitated by both educators and parents as active co-learners. Such approaches help children develop foundational mathematics skills in a context that mirrors their daily life laying the groundwork for stronger academic achievement in the future.

LITERATURE REVIEW

The Importance of Early Mathematics Learning

Early childhood education lays the foundation for lifelong learning, especially in areas such as numeracy, which influences a child's ability to think logically and solve problems. According to Zippert et al. (2021), early exposure to basic knowledge and skills including mathematics prepares children for formal schooling. Mathematics learning in early childhood typically begins between ages four and six, where children encounter numbers, time, shapes, money, and quantities through daily experiences (Farah & Suziyani, 2023; Ningsih et al., 2024). Mathematics is a discipline that teaches children how to understand structure, quantity, space, and logical operations. These foundational concepts are not only essential for academic success but also influence children's ability to manage everyday tasks such as measuring, budgeting, or sequencing events (Osman & Mohamed, 2023). As such, early mathematics learning must be implemented through approaches that are meaningful and age-appropriate.

Play-Based Learning in Early Childhood Education

Children naturally integrate learning and play in their daily lives. When asked what they enjoy the most, many children consistently report that play is their favorite activity. This is supported by Naldo et al. (2023), who found that play-based learning stimulates creativity and problem-solving as children use their imagination and interact with toys and peers. Through play, they experiment, take risks, and explore abstract ideas in concrete ways. Despite this, in many educational environments, play and structured learning are still separated. Play is

relegated to breaks or outdoor sessions, while academic instruction is limited to classroom activities. However, recent pedagogical models recognize play as a central medium for learning, particularly for young children.

Play enables the development of imagination, curiosity, social skills, and emotional regulation. Vygotsky (1978) emphasized that even formal learning settings can incorporate role play and imaginary scenarios to help children internalize new concepts (Smolucha & Smolucha, 2021). Devi (2022) further asserts that play-based learning should reflect children's cultural backgrounds and lived experiences, making learning more relevant and engaging. Teachers and caregivers must design learning environments that are physically and psychologically stimulating. Whether inside or outside the classroom, children learn best when they can explore freely, ask questions, and manipulate materials (Yannier et al., 2021).

Benefits of Play in Early Numeracy

Play is not only enjoyable but also educational. It allows children to express emotions, develop motor skills, and understand their environment. Khasanah and Purnamasari (2023) found that role play is an effective method for introducing number concepts and developing counting skills in everyday contexts. Children exposed to learning through play tend to show higher engagement, motivation, and cognitive development compared to those in traditional settings.

Play-based learning also supports communication and language development, enhances fine and gross motor skills, and fosters collaboration. According to Janius (2023) and Adipat (2021), children taught through game-based strategies demonstrated better understanding across various subjects. Overall, play improves physical health, emotional resilience, and learning readiness making it a holistic and effective educational approach.

Teaching Strategies in Early Mathematics

Effective early mathematics teaching strategies involve interactive and student-centered methods. Thomas and Mahmud (2021) emphasize the role of digital play-based learning in creating an active, collaborative environment that encourages student participation. Game elements embedded in lessons improve concept retention and engagement. Constructivist strategies highlighted by Voon and Amran (2021) support exploratory and collaborative learning. In group settings, children build new knowledge by combining prior understanding with new insights. Social and kinesthetic activities enhance their ability to work in teams, communicate effectively, and solve problems creatively. The social constructivist model also shifts the teacher’s role to that of a facilitator. Scaffolding, a temporary support provided by adults or more capable peers, is particularly effective in helping children build independence in solving mathematical problems (Kusmaryono & Wijayanti, 2020). These strategies highlight the importance of adapting lessons to individual learner needs, including varying intelligences and learning styles.

Parental Involvement in Early Mathematics Learning

Parental engagement is a critical factor in children's academic and personal success. The Ministry of Education Malaysia (MOE) has integrated parent-school partnerships into national initiatives such as the Malaysia Education Blueprint 2013-2025 and the Literacy and Numeracy (PLaN) Program (Kementerian Pendidikan Malaysia, 2025). These initiatives emphasize the role of parents in reinforcing early learning, particularly in numeracy. Azharuddin and Bakar (2023) emphasize the importance of sustained parental involvement both at home and within the community. Parents are a child’s first teacher, especially in the early years before formal education begins. Apriyanti (2020) agree that the parent’s role in guiding children through early learning has grown increasingly vital.

Research by Yu et al. (2022) found that children whose parents are actively involved in their learning display higher self-esteem, stronger motivation, and better academic performance. Learning through play at home not only boosts cognitive skills but also strengthens emotional bonds and supports overall development. Parental involvement ensures that children have access to supportive, rich learning environments outside the classroom, ultimately laying the foundation for future success.

METHODOLOGY

Research Design

This study adopted a quantitative research design to examine the relationship between parents' perceptions and early mathematics learning among children in the Kuala Selangor District. A survey method was utilized as it allows for the systematic collection of data from a large number of respondents, facilitating generalization and statistical analysis.

Population and Sample

The target population for this research consisted of parents residing in the Kuala Selangor District, Selangor, who have children in the early childhood education stage (preschool to early primary). Using purposive sampling, a total of 189 parents participated in the study. This sample size was deemed appropriate for quantitative analysis and was selected based on accessibility and relevance to the research objectives.

Instrumentation

Data were collected through a Google Form questionnaire consisting of three sections:

1. Demographic Information - including age, gender, educational background, and number of children.

2. Parents' Beliefs on Play and Learning - items adapted from the *Parents' Play Belief Scale* (PPBS) developed to assess parents' beliefs about the role of play in child development.

3. *Home Mathematics Environment* (HME) - adapted from the Home Mathematics Environment Survey, which measures the frequency and types of mathematical activities practiced at home. The adaptation of these instruments ensured content validity and relevance to the local context, and permission for adaptation was considered where applicable. All items were translated into Bahasa Melayu to enhance clarity and comprehension among respondents.

Pilot Study

Prior to the main data collection, a pilot study was conducted involving 30 parents who met the same criteria as the target respondents. The aim of the pilot study was to test the reliability and clarity of the questionnaire items. Feedback from the pilot respondents was used to improve item phrasing and structure. The reliability analysis showed acceptable internal consistency, with Cronbach's alpha values exceeding 0.70 for all main constructs, indicating that the instrument was suitable for use in the actual study (refer table 1).

Data Collection Procedure

The finalized survey was disseminated via *Google Form* and shared through parent groups, school networks, and community platforms within the Kuala Selangor District. Participation was voluntary and anonymous, and the data collection spanned a period of four weeks to ensure sufficient response rates.

Data Analysis

The collected data were analyzed using Statistical Package for the Social Sciences (SPSS) software. Descriptive statistics (mean, frequency, percentage) were used to summarize demographic data and response patterns. Inferential statistics, including correlation analysis and independent sample t-tests, were conducted to explore the relationship between parents' beliefs, home mathematics environment practices, and perceptions of early mathematics learning.

Table 1 Reliability Analysis

Construct	Cronbach alpha	No. of Items
Perception of Parents	.892	20
Early Mathematics	.959	24

RESULT

Descriptive Analysis

Table 2 Demographic of Respondents

Category		N	%
Gender	Male	85	45
	Female	104	55
Age	21 - 30 year	149	78.8
	31 - 40 year	26	13.8
	41-50 year	13	6.9
	51 above	1	0.5
Academic	SPM	47	24.9
	Diploma	60	31.7
	Degree	57	30.2
	Master/PhD	25	13.2
Income	< RM 2000	109	57.7
	RM2001 - RM4000	51	27.0
	RM4001 - RM6000	19	10.1
	RM6000 above	10	5.3
Gender of Children	Male	109	57.7
	Female	80	42.3
	0 -12 month	24	12.7
	1 - 2 year	42	22.2
	2 - 3 year	20	10.6
	3 - 4 year	23	12.2

Age of Children	4 - 5 year	20	10.6
	5 - 6 year	60	31.7

Analysis Table 3

Independent Samples Test for Independent Variable

	t(df)	Sig.	Mean Difference	95% CI for Mean Difference
Perception of Parents	0.14 (189)	.891	0.25	[-3.29, 3.78]

For Parents' Perceptions, Levene's Test indicates equal variances can be assumed ($p = 0.878$). The independent samples t-test result $t(185) = 0.137$, $p = 0.891 > 0.05$ shows no statistically significant difference between the compared groups. This implies that the perceptions of parents toward early mathematics do not differ significantly across the tested groupings.

Table 4 Independent Samples Test for Dependent Variable

	t(df)	Sig.	Mean Difference	95% CI for Mean Difference
Early Mathematics	0.25 (189)	.800	0.58	[-3.97, 5.14]

For Early Mathematics, Levene's Test also indicates that equal variances can be assumed ($p = 0.137$). The t-test result $t(182) = 0.253$, $p = 0.800 > 0.05$ again shows no significant difference in early mathematics exposure based on the groups compared. In both variables, the confidence intervals for the mean differences include zero, reinforcing the conclusion that there are no statistically significant group differences.

Table 5 Correlation Analysis for IV and DV

Variable		Perception of Parents	Correlation Matrix
Perceptions of Parents	Pearson Correlation (r)	1	.371**
	Sig. (2-tailed)		<.001
	N	189	189
Early Mathematics	Pearson Correlation (r)	>371**	1
	Sig. (2-tailed)	<.001	
	N	189	189

The analysis revealed a moderate positive correlation between parents' perceptions and early mathematics practices, $r = .371$, $p < .001$. This means that as parents' positive perceptions about early mathematics increase, so does their engagement or support in early mathematics activities at home. This statistically significant relationship suggests that parents who value or understand the importance of early mathematics are more likely to support and encourage mathematics learning for their children during the early years. This finding aligns with previous research which highlights the influence of parental beliefs and involvement on early childhood learning outcomes.

DISCUSSION

The findings of this study reveal a moderate positive and significant relationship between parents' perceptions and early mathematics exposure among children in the Kuala Selangor District, $r = .371$, $p < .001$. This result is consistent with past research which emphasizes the important role of parental beliefs and involvement in fostering early numeracy development (Elliott, 2021).

From the background of this study, it was highlighted that formal schooling alone is insufficient in nurturing holistic development in children. The home environment and parental involvement serve as key contributors to a child's early learning, especially in foundational subjects like mathematics. As emphasized by Downton et al. (2020), early exposure to basic mathematical concepts such as numbers, shapes, patterns, and measurements is vital for preparing children for formal education.

The results also support earlier studies showing that play-based learning at home facilitated by supportive and aware parents can significantly enhance children's mathematical understanding (Farah & Suziyani, 2023; Nurdiyana et al., 2021). When parents perceive early mathematics as valuable and engaging, they are more likely to provide meaningful learning experiences through daily activities, such as counting objects, identifying shapes, or comparing sizes at home (Maisarah & Syaza, 2021).

Furthermore, the significant correlation found aligns with the constructivist learning approach, where children learn best through hands-on activities and interactions with their environment, guided by adults who understand the learning process (Janius et al., 2023; Kusmaryono & Wijayanti, 2020). In this context, parents become facilitators, reinforcing school-taught concepts and extending them into everyday life.

However, the literature also shows that not all parents are confident or equipped to support their children's mathematical development at home. Some parents face challenges in selecting suitable resources, maintaining engagement, or understanding how to use play as a tool for learning (Bhamani et al., 2020; Panaoura, 2021). This study further reinforces the need for teacher-parent collaboration, as well as guidelines or training for parents to effectively implement math-based play at home.

Despite the moderate strength of the correlation, the findings emphasize a key takeaway: Parents' positive perception matters. Their mindset influences the learning environment at home, and in turn, the child's early experiences with mathematics. This aligns with national efforts such as the Program Lite rasi dan Numerasi (PLaN) launched by the Ministry of Education Malaysia, which highlights the importance of parental engagement in early numeracy development (Kementerian Pendidikan Malaysia, 2025).

In conclusion, this study contributes to the growing body of evidence that parents are essential partners in early childhood education, especially in building a strong foundation in mathematics. Future programs and policies should aim to empower parents with both knowledge and practical tools to support their children's numeracy growth from an early age.

CONCLUSION

This study provides compelling empirical evidence that parents' perceptions play a significant role in shaping the frequency and quality of mathematical play and early numeracy experiences among preschool children. Grounded in constructivist theory and supported by highly reliable instruments (Cronbach's alpha = .892 for parental perceptions; .959 for early mathematics), the findings reveal a moderate, positive, and statistically significant relationship between parents' beliefs and the home mathematics environment ($r = .371$, $p < .001$). This indicates that parents who value early mathematics and view play as an essential learning medium are more likely to engage their children in meaningful, context-based numeracy activities such as counting, comparing, recognizing patterns, and exploring shapes in everyday situations.

Notably, the absence of significant differences across demographic variables suggests that positive parental perceptions towards early mathematics transcend gender, educational background, and socioeconomic status. This highlights a universal potential for strengthening early numeracy development through targeted parental

empowerment rather than relying solely on demographic advantages. The results strongly support the constructivist and play-based learning perspectives, confirming that young children construct mathematical understanding most effectively through guided interaction, exploration, and scaffolding within authentic home contexts.

The novelty of this research lies in its integrated examination of parental play beliefs and the Home Mathematics Environment within a Malaysian context aligned with national initiatives such as the Kurikulum Standard Prasekolah Kebangsaan (KSPK) and the Program Literasi dan Numerasi (PLaN). By empirically linking parents' cognitive–affective orientations with the frequency of mathematical play, this study advances the literature beyond descriptive involvement to demonstrate how parental mindset functions as a key mechanism that activates learning-rich practices at home.

Overall, the study underscores that cultivating positive parental perceptions is not merely a supportive factor but a strategic leverage point for enhancing early mathematical foundations. Strengthening home–school partnerships, providing structured guidance on play-based numeracy, and equipping parents with practical pedagogical knowledge can systematically elevate children's early mathematical readiness and long-term learning trajectories. This holistic model positions parents as intentional co-educators and situates mathematical play as a powerful bridge between formal curriculum goals and children's lived experiences, thereby contributing a robust and contextually grounded framework for early childhood mathematics education in Malaysia.

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