



Strategies for Establishing Quality Home Learning Environments to Promote Children's Early Numeracy Learning

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How to cite this paper: Yiran Xu. (2023). Strategies for Establishing Quality Home Learning Environments to Promote Children's Early Numeracy Learning. *The Educational Review, USA*, 7(8), 1059-1066. DOI: 10.26855/er.2023.08.003

Received: July 28, 2023

Accepted: August 25, 2023

Published: September 18, 2023

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Abstract

Environmental factors, such as home learning environments (HLEs), is associated with children's early numeracy development. In this essay, how to effectively promote children's early numeracy learning in home and preschool through the establishment of high-quality HLEs is the focus. This essay begins by revealing some extant research results. Firstly, both home literacy environment and home numeracy environment are conducive to children's early numeracy development. Furthermore, high-quality HLE can reduce the impact of family risk factors on children's numeracy development. Finally, some recommendations concerning HLE that promote children's early numeracy development are proposed. First, in terms of home numeracy environment, home numeracy activities, such as playing games, math talk, and scaffolding guidance are encouraged. Meanwhile, family-school partnership can strengthen the math talk at home. Second, regarding home literacy environment, reading picture books to children is encouraged to improve children's numeracy development. Third, parental positive attitudes through family-school partnership are encouraged to be established.

Keywords

Home learning environment, Early numeracy learning, Family-school partnership

1. Introduction

Environmental factors, including socioeconomic status, the quality of HLE, and the quality of preschool education, are associated with children's early numeracy development (Soto-Calvo et al., 2020a). The quality of HLE is the focus of this essay. Specifically, issues concerning HLE will be discussed first – the relationship between numeracy home environment, literacy home environment and children's early numeracy skills, and the mediating role of HLE in alleviating effect of family risk factors. After that, recommendations corresponding to these issues are provided for parents, namely (1) encouragement of play-based mathematics activities and scaffolding guidance for advanced mathematical talk, (2) effective ways to read to children, (3) positive attitudes and high academic expectations for children's numeracy learning. These recommendations can be realized through positive family-school partnerships. That is, teachers can provide knowledge on how to improve children's numeracy skills so that children's learning is consistent in both the informal and formal settings of home and school.

2. Rationale

The home environment plays one important role in children's early numeracy development (Ramani, 2020). Children's numeracy experience at home is associated with their early numeracy development (Ramani, 2020). Furthermore, parents should provide their children with a good mathematical start in the years before they start school, as children's mathematical skills and knowledge at their preschool entry predict later mathematics and reading achievement, and those who start kindergarten behind often struggle to catch up with their peers (Lange et al., 2021). Families continue to play an important role in children's early numeracy development, even after children begin preschool. Research suggests that interaction between home and preschool influences children's behavior and development (Galindo & Sheldon, 2012). Specifically, school-home connection can be seen in parental involvement at home, including home numeracy/literacy activities and quality of interaction between parents and children around numeracy/literacy activities (Galindo & Sheldon, 2012). Current research has demonstrated that parental involvement at home is associated with children's performance in preschool (Galindo & Sheldon, 2012; Lange et al., 2021). However, parents in fact tend to focus more on literacy-related activities than on math-related activities at home (Berkowitz et al., 2015). They perceive children's literacy ability as a family–teacher shared responsibility, whereas they believe that preschool, rather than themselves, should take the primary responsibility in supporting children's numeracy learning (Berkowitz et al., 2015). The above facts suggest that it is worthwhile to investigate how to effectively promote children's numeracy learning with parental involvement due to the effectiveness of the home learning environment and the parents' neglect in developing children's numeracy skills at home.

3. Debates and Issues

One issue in early childhood education is how to promote children's mathematical knowledge and skills prior to the start of formal schooling, including during preschool (Gervasoni & Perry, 2015). Children's mathematical knowledge levels and attitudes towards mathematics diverge before they start preschool (Gervasoni & Perry, 2015). From the perspective of mathematical achievement and future career development, the divergence in early mathematical knowledge and attitudes should be taken into account. First, children's numeracy skills at preschool entry are associated with later mathematics attainment (Soto-Calvo et al., 2020b), and early numeracy skills are strongly correlated with later academic mathematics achievement (Susperreguy & Davis-Kean, 2016). Second, the level of numeracy skill is relevant to employment opportunities, affecting individuals' socioeconomic status (Levine et al., 2010). Third, with the increasing demand for a scientifically and technologically advanced workforce, there is a consensus that individuals should master high-level mathematical skills (Levine et al., 2010).

Home learning environment (HLE) is a term that includes parental attitude towards learning, the availability of home learning resources, as well as the quality and quantity of home experiences that facilitate learning (Soto-Calvo et al., 2020a). In general, HLE is beneficial for children's numeracy attainment and development of numeracy skills (Soto-Calvo et al., 2020a). In this essay, strategies related to HLE are proposed to improve children's early numeracy skills, and three issues corresponding to these strategies will be discussed first: (1) What is the relationship between different literacy experience at home and children's numeracy outcomes? (2) What is the relationship between different numeracy experience at home and children's early numeracy outcomes? (3) What is the mediating role of HLE in mitigating the negative impact of family risk factors on children's numeracy development?

3.1 Relationship between Home Literacy Environment and Children's Numeracy Development

Theoretically, literacy skills (particularly phonological and vocabulary skills) underlie children's early numeracy development. For instance, phonological awareness is correlated with children's mathematical attainment (see Purpura et al., 2011); vocabulary is associated with mathematical development through the acquisition of mathematical vocabulary (Purpura & Logan, 2015). These findings reveal the interrelation between numeracy and literacy skills.

Characteristics of home literacy environment encompass literacy materials in the home, frequency of storybook reading, parental literacy ability, etc. (Napoli & Purpura, 2018). Home literacy experience can be divided into two different types, namely code-focused and meaning-focused home literacy experiences (Soto-Calvo et al., 2020b). During code-focused home literacy activities, children are taught about letters and words. The focus during these activities is on phonological and orthographic aspects of language, e.g., identifying the features of the printed word (Soto-Calvo et al., 2020b). For meaning-focused home literacy experience, activities prioritize enjoyment and focus on sharing meaning of oral and written language concerning mathematics (Soto-Calvo et al., 2020b). A typical meaning-focused home literacy activity is shared book reading. During shared reading process, children can increase their mathematical talk and usage

of mathematical language, which is positively related to children's development of mathematical skills (Alfes et al., 2021). For instance, in Levine et al. (2010)'s study, when parents exposed their children more to mathematical language during shared reading, the children tended to achieve better mathematical skill development, e.g., better knowledge of cardinal meaning of the number word. As for code-focused home literacy experiences, for example, Soto-Calvo et al. (2020b)'s study reveal that interactive code-focused literacy experiences were associated with counting and number transcoding.

However, some studies assert that the relationship between home literacy environments and children's numeracy skills is not evident (e.g., Segers et al., 2015). One plausible explanation is that code-focused literacy experiences have a stronger relationship with children's numeracy skills than meaning-focused literacy experiences (Manolitsis et al., 2013; Napoli & Purpura, 2018). Nonsignificant results in research may be attributed to the focus on code-focused items rather than meaning-focused items in home literacy dice (Soto-Calvo et al., 2020b).

In conclusion, home literacy environment can be conducive to children's early numeracy development, which is supported by a large body of relevant research (see Soto-Calvo et al., 2020b).

3.2 Relationship between Home Numeracy Environment and Children's Numeracy Development

Home numeracy environment includes formal and informal activities. Formal activities refer to parents consciously teaching numeracy-related knowledge, including practicing simple sums and teaching children to calculate and count objects (Skwarchuk et al., 2014; Son & Hur, 2020). Informal activities concentrate on play and enjoyment, and mathematical content in these activities becomes incidental (Skwarchuk et al., 2014). Examples can be counting money and playing with calculators (Manolitsi et al., 2013). Many studies (e.g., Skwarchuk et al., 2014; Napoli & Purpura, 2018; Manolitsi et al., 2013) have proved that numeracy learning experiences at home can predict children's numeracy skills. For instance, in Napoli and Purpura's study (2018), the frequency of home numeracy practice was associated with children's numeracy skills in preschools, e.g., numerical comparison and one-to-one correspondence.

However, the nonsignificant correlation between home numeracy experiences and children's numeracy development is also found in few studies (e.g., Missall et al., 2015). The nonsignificant results may be accounted for how the family numeracy environment is assessed. Formal and informal home numeracy practices serve different types of children's numeracy skills. Specifically, formal numeracy activities predict children's symbolic number system knowledge, while informal home numeracy practices predict children's non-symbolic arithmetic (Skwarchuk et al., 2014). However, previous studies have not comprehensively measured home numeracy environment and children's numeracy competence (Cheung et al., 2020). It leads to the fact that children's numeracy competence after informal/formal numeracy activities has improved, but the corresponding numeracy skills were not tested, leading to the nonsignificant results.

Overall, even though the nonsignificant correlation indeed exists in few studies due to assessment issues, it can be concluded that home numeracy environment can benefit the development of children's numeracy skills.

3.3 Families' Risk Factors Affect Children's Numeracy Learning, with Mediating Function of HLE

Risk factors are defined as biological and environmental conditions that increase the likelihood of adverse outcomes (Kluczniok, 2017). Family risk factors include low parental education, single-parent household, and low income of families (Kluczniok, 2017). Extant studies have found that a negative relationship between family risk factors and children's mathematics achievement is pronounced in early childhood, and that the negative impact may not diminish even in formal schooling (Kluczniok, 2017). In this essay, the impact of parental educational level and family income on children's numeracy learning will be discussed in detail. Furthermore, whether HLE (including home numeracy environment) mediates the negative impact of risk factors on children's numeracy learning will also be evaluated.

3.3.1 Effect of Families' Income and Parental Education Level

In general, children from low-income backgrounds lag behind their peers from middle and high-income backgrounds in mathematical knowledge (Ramani & Siegler, 2011). However, income-related differences in mathematics knowledge do not include all numeracy skills, and the difference is found in symbolic number skills, e.g., identifying written numbers and solving arithmetic problems (Ramani et al., 2015). Furthermore, in limited research concerning the role of parental education level on children's numeracy skills, one common finding is that children with more educated parents tend to have better numeracy competence (e.g., Cheung et al., 2020). However, cultural factors should be considered when evaluating the effect of parental education level. For instance, a study by LeFevre et al. (2010) reveals that parental education level had a positive correlation to children's performance on numeracy evaluation among Greek families, but no such correlation was observed among Canadian families.

3.3.2 Potential Mediating Effect of HLE

A consistent finding in related studies suggests that high-quality HLE can reduce the impact of family risk factors on children's numeracy development (e.g., Mistry et al., 2010; Kluczniok, 2017). However, these studies are inconsistent in selection of risk factors and in explaining the mechanism underlying the mediating function of HLE in influencing family risk factors (Kluczniok, 2017). For instance, Mistry et al. (2010) found that the adverse effects of exposure to cumulative social and family risk factors could be alleviated by family support factors, including parental warmth/responsiveness. From the perspective of Mistry et al. (2010), a feasible explanation is that the affective relationship between children and parents affects children's developmental domains, which stems from the ecological theory that stresses the importance of children's proximal environment and their interaction with others. As for in Cheung et al. (2020)'s study, a positive home numeracy environment can benefit the numeracy skills of children from low-income backgrounds and children with low parental education levels. The underlying mechanism lies in the positive effect of home numeracy activities on children's numeracy outcomes (Cheung et al., 2020).

Though risk factors and mechanism explanation vary in different studies, one thing is for sure – HLE can alleviate the negative effect of family risk factors on children's numeracy development.

4. Leading Learning

With sufficient background knowledge concerning the effectiveness of HLE on children's early numeracy development, the key question is how to establish beneficial HLE for children's mathematics learning at home with the help of a family-school partnership. The emphasis on family-school partnership in this essay is based on the belief that children's development and academic achievement are constituted by the overlapping influence of home and school (Epstein, 2001). In other words, providing children with strong and consistent supports both in and out school can benefit their school achievement, and these supports can be achieved by school initiatives that promote a strong partnership between school and families (Epstein, 2001). This idea has been proved by previous empirical research. For instance, Sheldon et al. (2010) showed that schools could improve parental ability to help children in mathematics-related activities at home. Galindo and Sheldon (2012) also found that schools' efforts in parental engagement in children's learning at home can predict children's numeracy achievement in preschool. With regard to the topic of this essay, how schools and teachers act to help parents provide beneficial HLE will be explicitly explained.

4.1 Introducing Home Numeracy Activities, Especially for Low-income Families

Current research results prove the mediating effect of HLE on remedying the impact of low-income backgrounds on children's numeracy skills (e.g., Kluczniok, 2017; Cheung et al., 2020). Meanwhile, home numeracy environment is shown to be beneficial for children's early numeracy skills. Therefore, establishing beneficial home numeracy environment, including engaging in informal numeracy activities, can work as a viable option for families, especially those from low-income backgrounds. Specifically, this essay recommends play-based mathematics activities and advanced math talks.

4.1.1 Playing Games

Why playing games could be one optimal strategy for families will be explained as follows. First, compared to formal activities, informal numeracy activities, including playing games, are engaging and enjoyable, which may be more appropriate for fostering the numeracy development of children (Ramani & Scalise, 2020). Second, games can be regarded as one inexpensive and convenient tool for supporting children's mathematics learning (Lange et al., 2021), suggesting that it can be an affordable way for low-income families to adopt. Specifically, board games, cards, dominoes, and dice games that are normally seen in families' lives can all become numeracy learning tools. Third, playing games provide consistent learning opportunities across the setting of home and school (Lange et al., 2021). This consistency benefits children's mathematics learning by encouraging children to apply their numeracy skills in different settings and with different co-learners (Lange et al., 2021). Moreover, concrete examples and clear ideas during playing games in schools can provide a reference for parents; for teachers, games can be easily integrated into classroom activities as they are also practiced by children at home (Lange et al., 2021). Fourth, academic research supports the effectiveness of playing the game at home. For instance, playing board games with children at home is related to children's counting ability during preschool (Benavides-Varela et al., 2016). In addition, activities like shape and color matching games (Ramani & Scalise, 2020), and linear number board games (Lange et al., 2021; Ramani & Siegler, 2011) have also been proved to benefit children's numeracy development.

4.1.2 Math Talk and Scaffolding Guidance

From sociocultural perspective, the quality of interaction between parents and children during mathematics-related activities also affects children's learning (Ramani & Scalise, 2020). That is, parents can provide scaffolding techniques to assist their children, such as asking questions, providing guidance on how to complete activities, and providing timely feedback on children's performance (Gauvain, 2001). However, in extant research concerning play-based mathematics activities at home, the performance of parental guidance is unstable, changing every time they played games with children (Ramani & Scalise, 2020; Lange et al., 2021). The instability of parents' performance may impact the actual effectiveness of parental guidance in children's numeracy knowledge (Ramani & Scalise, 2020). As such, with this issue in mind, schools can take measures to maximize the practical effectiveness of parental guidance. A more detailed explanation is provided below.

Furthermore, math talk occurs when parents play games with their children. Quality rather than quantity of math talk may predict the development of children's numeracy skills (Son & Hur, 2020). There are two types of talk. *Basic mathematical talk*, including counting and number recognition, may provide learning opportunities for children to consolidate basic mathematical skills (Son & Hur, 2020). *Advanced mathematical talk*, including arithmetic and measurement, challenges young children's learning trajectories and advances further mathematical development (Son & Hur, 2020). Advanced math talks rather than basic math talks foster children's numeracy skills development (Son & Hur, 2020). However, relying on Vandermaas-Peeler et al. (2012)'s observation, while playing board games at home with their children, parents are more likely to engage in the talk about identifying numbers or counting rather than the talk about advanced number concepts, including comparing the magnitude of numbers or adding and subtracting numbers. It implies that parents naturally utilize the basic math talk rather than advanced math talk during mathematics-related activities, which may not be sufficient to enhance children's numeracy development. Therefore, it is recommended that parents should introduce advanced mathematical talk through scaffolding guidance as described above (Vandermaas-Peeler et al., 2012). For instance, parents ask their children "Who has more fruit?" to compare the number magnitudes.

4.1.3 Strengthening Math Talk at Home through Family-school Partnership

Epstein (2016) proposed six types of involvement that schools can adopt to involve families in children's learning—parenting, communicating, volunteering, learning at home, decision-making, and collaborating with the community. Specifically, *parenting* refers to helping all families create a supportive family environment for children; *communicating* means establishing effective two-way communication between school and home about school programs and children's progress; *decision-making* includes parental involvement in school decision-making and developing parent leaders (Epstein, 2016).

Parenting can be used to strengthen parental skills in guiding advanced math talks during numeracy activities. Specifically, activities such as workshops, videotapes, and computerized phone messages can be utilized to introduce approaches to parents in need (Epstein, 2016). Teachers should explain why parents should provide scaffolding guidance, and why they should talk about advanced numerical concept, even though advanced math talk may not be easy for parents to do. The reason for teachers' clarification is that parents are likely to be reluctant to accept the strategies if they are simply taught without explanation (Bragg et al., 2020). Furthermore, PTA/PTO can be established to exercise parental leadership in designing games that reflect home activities and cultures, thus making games more acceptable to other families (Lange et al., 2021).

4.2 Promoting Literacy Learning Environment by Reading Picture Books to Children

In terms of the research as mentioned earlier, meaning-focused learning experiences, including shared-book reading, can benefit children's early numeracy learning (see Levine et al., 2010). More specifically, children's literature can contribute to children's development of mathematical knowledge through illustrating concepts, asking mathematic problems, and stimulating enquiry into mathematics (Heuvel-Panhuizen & Boogaard, 2008). Thus, children can further study mathematics by taking children's literature as a starting point. As such, one relevant issue can be raised – how can parents act effectively when reading to their children so as to maximize the effectiveness of reading storybooks.

In addition to using picture books as a starting point for subsequent mathematics-related activities that highlight the content of the book, the focus of this essay is on the function of picture books themselves, i.e., the function of pictures. Pictures in books can motivate children to actively produce mathematics-related utterances during the reading process (Heuvel-Panhuizen & Boogaard, 2008). It may be beneficial for parents who do not have expertise in scaffolding children's learning. Furthermore, Elia et al. (2010) explicitly analyze the function of pictures in books designed for learning mathematics. Pictures in these books contain two different functions, namely representational function and informational function (Elia et al., 2010). Pictures with a representational function are an alternative 'description' to text; on the

other hand, in terms of pictures with an informational function, mathematical information can only be obtained from the pictures because the textual content is not informative enough (Elia et al., 2010). Elia et al. (2010)'s study reveals that pictures with a representational function stimulate mathematical thinking more than pictures with an informational function. It indicates that combining text and pictures of a similar content facilitates children's mental model construction (Schnotz, 2005). It provides the recommendation for parents to select high-quality picture books for numeracy learning. Parents are recommended to purchase children's literature with pictures semantically informing the text in books. That is, pictures in storybooks should correspond to the content of story, so that children can gain sufficient information from both pictures and corresponding content. Furthermore, the significant difference between pictures' representational function and informational function has practical implications for how to read to children effectively (Elia et al., 2010). For example, children are often not sufficiently engaged in mathematical thinking when they see pictures having representational function. In this situation, probing can be used to encourage children's mathematical thinking.

4.3 Effect of Parental Characteristics on Children's Numeracy Outcome

Current research reveals the importance of parental attitudes and expectations on children's numeracy performance and numeracy skills. Parents' attitudes and expectations are associated with their involvement in numeracy activities with their children (del Río et al., 2017). Specifically, parents who hold positive numeracy attitudes and higher expectations for their children's academic skills tend to more frequently engage in home numeracy activities with their children (del Río et al., 2017). Furthermore, parental numeracy attitudes directly predict children's numeracy outcomes (e.g., non-symbolic arithmetic and number system knowledge), while parental academic expectations indirectly explain children's numeracy outcomes (Skwarchuk et al., 2014). The direct relationship between parental attitudes and children's numeracy outcomes can be attributed to parents' frequent engagement in numeracy experiences with children due to their positive attitudes (Soto-Calvo et al., 2020a). However, in reality, parents do not realize their importance in children's numeracy development, as mentioned in the rationale section (Berkowitz et al., 2015). As such, relying on the real issue and academic research results, it is vital for parents to establish positive numeracy-related attitudes and academic expectations, therefore raising the frequency of home numeracy activities.

4.3.1. Establishing Parental Positive Attitudes through Family-school Partnership

One way to build a good parental attitude and high academic expectation in children's numeracy learning is through two-way communication (Bragg et al., 2020), a type of involvement mentioned in Epstein (2016)'s book. In reality, there are two kinds of communication for teachers to interact with parents, namely one-way and two-way communication. One-way communication is widely used in school (Bragg et al., 2020), due to its convenience in informing parents about children's progress and school program. This essay argues that two-way communication is more suitable for changing parental attitudes and academic expectation than one-way communication. The explicit explanation is as follows. Clear, open, and respectful communication between families and teachers is fundamental for successful school-home partnerships, thereby increasing opportunities for students to learn mathematics (Emerson et al., 2012; Bragg et al., 2020). Two-way communication values the contributions of both parents and teachers (Bragg et al., 2020). During this kind of communication, teachers and families can communicate to ensure both parties hold high expectations and positive attitudes toward children's mathematics (Bragg et al., 2020). Specifically, through two-way communication, teachers can gain essential insights into students' lived experience. For instance, in conferences tailored to each family, teachers can acknowledge the insights or knowledge that different families hold, such as children's strengths and shortcomings in mathematics. As a result, teachers know how to evoke parents' awareness on the importance of their attitudes and expectations based on family situations (Bragg et al., 2020; Epstein, 2016).

5. Conclusion

The discussion shows that home literacy and numeracy environment can benefit children's numeracy development, though nonsignificant results indeed exist in some research due to assessment issues. Furthermore, HLE can mitigate the negative effect of family risk factors on children's numeracy development. In order to optimize the effectiveness of HLE, relevant strategies are proposed for parents to adopt. Specifically, playing numeracy games is regarded as one optimum choice for low-income families. During play-based mathematics activities, parents can facilitate children's numeracy learning by providing guidance for advanced math talk. However, due to a lack of knowledge concerning advanced math talk and scaffolding methods, parental involvement tends not to maximize the actual effectiveness of these two approaches. Therefore, teachers can provide parents with necessary advice through one involvement type

called parenting. Furthermore, parents can take advantage of picture books' characteristics (i.e., the features of pictures), knowing how to read effectively to children and choose high-quality story books. Moreover, positive parental attitudes and high academic expectations are conducive to developing children's numeracy skills. Compared to one-way communication, two-way communication that respects the views of teachers and parents is more effective in fostering parents' positive numeracy-related attitude and high academic expectations.

References

- Alfes, C., Missall, K., & Artman Meeker, K. (2021). Shared Book Reading Effects on Number Naming in Preschoolers at Risk for Numeracy Delays. *Infants and Young Children*, *34*(2), 122-140. <https://doi.org/10.1097/IYC.000000000000187>.
- Benavides-Varela, S., Butterworth, B., Burgio, F., Arcara, G., Lucangeli, D., & Semenza, C. (2016). Numerical activities and information learned at home link to the exact numeracy skills in 5-6 years-old children. *Frontiers in Psychology*, *7*, 94. <http://dx.doi.org/10.3389/fpsyg.2016.00094>.
- Berkowitz, T., Schaeffer, M. W., Maloney, E. A., Peterson, L., Gregor, C., Levine, S. C., & Beilock, S. L. (2015). Math at home adds up to achievement in school. *Science (American Association for the Advancement of Science)*, *350*(6257), 196-198. <https://doi.org/10.1126/science.aac7427>.
- Bragg, L. A., Herbert, S., & Brown, J. P. (2020). Successful home-school collaboration: Let's talk about maths at home. *Australian Primary Mathematics Classroom*, *25*(3), 18-22. <https://doi.org/10.3316/informit.428875118076441>.
- Cheung, S., Dulay, K., & McBride, C. (2020). Parents' characteristics, the home environment, and children's numeracy skills: How are they related in low- to middle-income families in the Philippines? *Journal of Experimental Child Psychology*, *192*, 104780-104780. <https://doi.org/10.1016/j.jecp.2019.104780>.
- del Río, M. F., Susperreguy, M., Strasser, K., & Salinas, V. (2017). Distinct Influences of Mothers and Fathers on Kindergartners' Numeracy Performance: The Role of Math Anxiety, Home Numeracy Practices, and Numeracy Expectations. *Early Education and Development*, *28*(8), 939-955. <https://doi.org/10.1080/10409289.2017.1331662>
- Elia, I., van den Heuvel-Panhuizen, M., Georgiou, A. (2010). The role of pictures in picture books on children's cognitive engagement with mathematics. *European Early Childhood Education Research Journal*, *18*(3), 275-297.
- Emerson, L., Fear, J., Fox, S., & Sanders, E. (2012). Parent engagement in learning and schooling: Lessons from research. Western Creek, ACT: Australian Research Alliance for Children and Youth (ARACY).
- Epstein, J. L. (2001). *School and family partnerships: Preparing educators and improving schools*. Boulder, CO: Westview Press.
- Epstein, J. L. (2016). School, family, and community partnerships – caring for the children we share. *School, Family, and Community Partnerships* (2nd ed., Vol. 1), 389. <https://doi.org/10.4324/9780429493133>. Routledge.
- Galindo, C., & Sheldon, S. B. (2012). School and home connections and children's kindergarten achievement gains: The mediating role of family involvement. *Early Childhood Research Quarterly*, *27*(1), 90-103. <https://doi.org/10.1016/j.ecresq.2011.05.004>.
- Gauvain, M. (2001). *The social context of cognitive development*. New York, NY: Guilford Press.
- Gervasoni, A., & Perry, B. (2015). The impact on learning when families and educators act together to assist young children to notice, explore and discuss mathematics. In T. Meaney, O., Helenius, M.L. Johansson, T. Lange, A., Wernberg, (Eds.), *Mathematics Education in the Early Years*. Pp. 115-135. Springer.
- Heuvel-Panhuizen, M., & Boogaard, S. (2008). Picture Books as an Impetus for Kindergartners' Mathematical Thinking. *Mathematical Thinking and Learning*, *10*(4), 341-373. <https://doi.org/10.1080/10986060802425539>.
- Huntsinger, C. S., Jose, P. E., & Luo, Z. (2016). Parental facilitation of early mathematics and reading skills and knowledge through encouragement of home-based activities. *Early Childhood Research Quarterly*, *37*, 1-15. <https://doi.org/10.1016/j.ecresq.2016.02.005>.
- Kluczniok, K. (2017). *Early Family Risk Factors and Home Learning Environment as Predictors of Children's Early Numeracy Skills Through Preschool*.
- Lange, A. A., Brenneman, K., & Sareh, N. (2021). Using Number Games to Support Mathematical Learning in Preschool and Home Environments. *Early Education and Development*, *32*(3), 459-479. <https://doi.org/10.1080/10409289.2020.1778386>.
- LeFevre, J., Polyzoi, E., Skwarchuk, S. L., Fast, L., & Sowinski, C. (2010). Do home numeracy and literacy practices of Greek and Canadian parents predict the numeracy skills of kindergarten children? *International Journal of Early Years Education*, *18*, 55-70.
- Levine, S. C., Suriyakham, L. W., Rowe, M. L., Huttenlocher, J., & Gunderson, E. A. (2010). What Counts in the Development of Young Children's Number Knowledge? *Developmental Psychology*, *46*(5), 1309-1319. <https://doi.org/10.1037/a0019671>.

- Manolitsis, G., Georgiou, G. K., & Tziraki, N. (2013). Examining the effects of home literacy and numeracy environment on early reading and math acquisition. *Early Childhood Research Quarterly*, 28(4), 692-703. <https://doi.org/10.1016/j.ecresq.2013.05.004>.
- Missall, K., Hojnoski, R. L., Caskie, G. I., & Repasky, P. (2015). Home numeracy environments of preschoolers: Examining relations among mathematical activities, parent mathematical beliefs, and early mathematical skills. *Early Education and Development*, 26(3), 356-376. <http://dx.doi.org/10.1080/10409289.2015.968243>.
- Mistry, R. S., Benner, A. D., Biesanz, J. C., & Clark, S. L. (2010). Family and social risk, and parental investments during the early childhood years as predictors of low-income children's school readiness outcomes. *Early Childhood Research Quarterly*, 25, 432-449.
- Napoli, A. R., & Purpura, D. J. (2018). The home literacy and numeracy environment in preschool: Cross-domain relations of parent-child practices and child outcomes. *Journal of Experimental Child Psychology*, 166, 581-603. <https://doi.org/10.1016/j.jecp.2017.10.002>.
- Purpura, D. J., & Logan, J. A. (2015). The nonlinear relations of the approximate number system and mathematical language to early mathematics development. *Developmental Psychology*, 51(12), 1717. <http://dx.doi.org/10.1037/dev0000055>.
- Purpura, D. J., Hume, L. E., Sims, D. M., & Lonigan, C. J. (2011). Early literacy and early numeracy: The value of including early literacy skills in the prediction of numeracy development. *Journal of Experimental Child Psychology*, 110(4), 647-658. <http://dx.doi.org/10.1016/j.jecp.2011.07.004>.
- Ramani, G. B. & Scalise, N. R. (2020). It's more than just fun and games: Play-based mathematics activities for Head Start Families. *Early childhood research quarterly*. DOI:10.1016/j.ecresq.2018.07.011.
- Ramani, G. B., & Siegler, R. S. (2011). Reducing the gap in numerical knowledge between low- and middle-income preschoolers. *Journal of Applied Developmental Psychology*, 32(3), 146-159. <https://doi.org/10.1016/j.appdev.2011.02.005>.
- Ramani, G. B., Rowe, M. L., Eason, S. H., & Leech, K. A. (2015). Math talk during informal learning activities in Head Start families. *Cognitive Development*, 35, 15-33. <https://doi.org/10.1016/j.cogdev.2014.11.002>.
- Schnotz, W. (2005). An integrated model of text and picture comprehension. *The Cambridge handbook of multimedia learning*, Edited by: Mayer, R.E. 49-69. Cambridge: Cambridge University Press.
- Segers, E., Kleemans, T., & Verhoeven, L. (2015). Role of Parent Literacy and Numeracy Expectations and Activities in Predicting Early Numeracy Skills. *Mathematical Thinking and Learning*, 17(2-3), 219-236. <https://doi.org/10.1080/10986065.2015.1016819>.
- Sheldon, S. B., Epstein, J. L., & Galindo, C. L. (2010). Not just numbers: Creating a partnership climate to improve math proficiency in schools. *Leadership and policy in schools*, 9(1), 27-48. <https://doi.org/10.1080/15700760802702548>.
- Skwarchuk, S., Sowinski, C., & LeFevre, J. (2014). Formal and informal home learning activities in relation to children's early numeracy and literacy skills: The development of a home numeracy model. *Journal of Experimental Child Psychology*, 121, 63-84. <https://doi.org/10.1016/j.jecp.2013.11.006>.
- Son, S. C., & Hur, J. H. (2020). Parental Math Talk During Home Cooking and Math Skills in Head Start Children: The Role of Task Management Talk. *Journal of Research in Childhood Education*, 34(3), 406-426. <https://doi.org/10.1080/02568543.2019.1704318>.
- Soto-Calvo, E., Simmons, F. R., Adams, A. M., Francis, H. N., Patel, H., & Giofrè, D. (2020b). Identifying the preschool home learning experiences that predict early number skills: Evidence from a longitudinal study. *Early Childhood Research Quarterly*, 28, 314-328.
- Soto-Calvo, E., Simmons, F. R., Adams, A., Francis, H. N., & Giofrè, D. (2020a). Pre-Schoolers' Home Numeracy and Home Literacy Experiences and Their Relationships with Early Number Skills: Evidence from a UK Study. *Early Education and Development*, 31(1), 113-136. <https://doi.org/10.1080/10409289.2019.1617012>.
- Susperreguy, M. I., & Davis-Kean, P. E. (2016). Maternal Math Talk in the Home and Math Skills in Preschool Children. *Early Education and Development*, 27(6), 841-857. <https://doi.org/10.1080/10409289.2016.1148480>.
- Vandermaas-Peeler, M., Ferretti, L., & Loving, S. (2012). Playing The Ladybug Game: parent guidance of young children's numeracy activities. *Early Child Development and Care*, 182(10), 1289-1307. <https://doi.org/10.1080/03004430.2011.609617>.