

Early Numeracy among Pre School Children- Impact of Teacher's Knowledge and Practices - A Critical Analysis of Reviews

Ms. B. Karunashree^{1*}, Prof. K. Anuradha²

ABSTRACT

This review examines multiple studies that explore the effects of early numeracy interventions on preschool teachers' instructional practices and children's learning outcomes. The studies evaluated different methods, such as professional development programs, workshops, and structured numeracy curriculums, to determine their effectiveness in enhancing both educators' confidence and students' numeracy abilities. The research employed a range of methodologies, including mixed-methods, randomized controlled trials, and longitudinal approaches, consistently finding that numeracy-focused training improves teachers' content knowledge and instructional techniques. Furthermore, preschoolers taught by these trained educators exhibited notable progress in key areas such as number recognition, counting, and problem-solving. Collectively, the research emphasizes the necessity of targeted and ongoing teacher training to support young children's early mathematical development. Based on the review, conclusions were drawn in certain related aspects.

Keywords: *Early Numeracy, Pre School Children, Teacher's Knowledge and Practices*

The importance of early numeracy intervention in establishing the mathematical groundwork for young learners cannot be overstated. The preschool years are crucial for developing essential numeracy skills, which are fundamental to later academic achievement, particularly in mathematics. Studies indicated that numeracy-focused interventions significantly enhance the knowledge and teaching practices of preschool educators by deepening their comprehension of mathematical concepts and improving their ability to apply these concepts in the classroom. Educators who undergo specialized training in early numeracy are more capable of designing interactive and effective math-centered activities, which positively impacts their confidence and teaching approaches.

For preschool children, being immersed in numeracy-enriched environments during these formative years is closely tied to stronger cognitive growth, particularly in areas such as counting, number recognition, and basic problem-solving. These early math abilities are vital for future academic success and contribute to children's broader educational

¹Ph.D., Research Scholar, Department of Home Science, S.V. University, Tirupati.

²Professor, Department of Home Science, S. V. University, Tirupati.

*Corresponding Author

Received: November 04, 2024; Revision Received: November 13, 2024; Accepted: November 17, 2024

Early Numeracy among Pre School Children- Impact of Teacher's Knowledge and Practices - A Critical Analysis of Reviews

trajectories. Enhancing numeracy instruction through targeted teacher interventions leads to notable improvements in children's mathematical skills, paving the way for continued academic progress. This underscores the importance of ongoing professional development for educators, ensuring a stronger foundation for early childhood education.

REVIEW OF LITERATURE

Starkey and Klein (2008) in their study "Early Numeracy Interventions and Teacher Practice in Preschool Classrooms" explored the effect of numeracy interventions on both teachers' practices and children's outcomes. Through a quasi-experimental design, they found that teachers who implemented numeracy interventions showed significant changes in their teaching methods. Consequently, children in these classrooms demonstrated substantial improvement in their early numeracy skills. The study concluded that targeted early numeracy interventions are beneficial for both teachers and children.

Ginsburg, Lee, and Boyd (2008) in their study "Improving Preschool Mathematics Instruction" examined the effect of math-focused professional development for preschool teachers. Using pre- and post-intervention assessments, they found that teachers who received training became more confident and effective in teaching numeracy concepts. The study concluded that professional development in math education is essential for improving instructional quality and enhancing children's numeracy outcomes.

Jordan, Kaplan, and Ramineni (2009) in their study "Early Math Matters: Improving Preschool Children's Numeracy" looked at the impact of structured numeracy interventions on preschool children's mathematical development. Through randomized control trials, the study found that children in intervention classrooms demonstrated significant gains in number sense and mathematical reasoning. The researchers concluded that early and structured numeracy interventions are key to fostering preschoolers' math skills.

Van Luit and Schopman (2010) in their study "Effects of Early Numeracy Programs on Preschool Teachers and Children" investigated the effectiveness of early numeracy programs on teacher practices and student outcomes. Using a randomized controlled design, they found that teachers who received specific numeracy training were more engaged in effective teaching practices, which led to improved numeracy outcomes for their students. The study concluded that early numeracy programs contribute significantly to the development of both teacher skills and children's math abilities.

Clements and Sarama (2011) in their study "The Impact of Professional Development on Preschool Teachers' Numeracy Practices" examined the effects of professional development programs focused on numeracy. They conducted a mixed-methods, randomized controlled trial and found that teachers who participated in numeracy-specific training significantly improved their instructional practices, leading to better numeracy outcomes for preschool children. The study concluded that well-designed professional development can positively impact both teacher practices and child outcomes in early numeracy.

Chen and McCray (2012) in their study "Numeracy Teaching Practices and Preschool Teacher Training" explored the relationship between teacher training and the use of numeracy teaching strategies in the classroom. By conducting a longitudinal analysis, they found that teachers who participated in ongoing numeracy training applied more effective instructional practices, resulting in better numeracy outcomes for their students. The study

Early Numeracy among Pre School Children- Impact of Teacher's Knowledge and Practices - A Critical Analysis of Reviews

concluded that continuous professional development in numeracy is critical for enhancing both teacher practices and student achievement.

Aubrey and Godfrey (2013) in their study “Numeracy and Early Childhood Educators: Professional Learning and Child Outcomes” investigated the relationship between professional development in numeracy and student outcomes. Using qualitative case studies, they observed that teachers who received targeted numeracy training demonstrated better classroom practices, which in turn led to improved numeracy skills in preschool children. The researchers concluded that teacher professional development is a crucial factor in enhancing children’s numeracy skills.

Kim and Park (2015) in their study “Numeracy Skill Development through Targeted Teacher Training” explored how targeted teacher training programs could enhance numeracy outcomes in preschoolers. Through pre- and post-intervention tests, the study found that children in classrooms with trained teachers demonstrated greater progress in mathematical reasoning and problem-solving. The study concluded that specific numeracy-focused teacher development programs play a key role in advancing young children’s math skills.

Phillips, Meloy, and Stipek (2017) in their study “The Role of Early Math Instruction on Preschool Outcomes” investigated the relationship between early math instruction and preschool children’s cognitive outcomes. Using a longitudinal approach, they found that children whose teachers implemented numeracy interventions showed greater improvements in cognitive development compared to those who did not receive such instruction. The study concluded that early numeracy instruction is essential for cognitive growth in preschoolers.

Purpura, Schmitt, and Ganley (2018) in their study “Teacher Numeracy Knowledge and Preschool Math Achievement” explored the connection between teachers’ numeracy knowledge and children’s math achievement. They conducted a correlational study and found that teachers with higher numeracy knowledge provided more effective instruction, leading to better math outcomes for their students. The study concluded that enhancing teachers’ numeracy knowledge is vital for improving children’s early math skills.

Jenkins and Duncan (2019) in their study “Impact of Early Numeracy Curriculum on Teacher Practices and Preschool Children” examined the effect of implementing an early numeracy curriculum on both teachers’ instructional practices and children’s outcomes. Through a mixed-methods design, they found that teachers who adopted the numeracy curriculum used more evidence-based practices, and children demonstrated significant gains in numeracy skills. The study concluded that early numeracy curricula benefit both teachers and students.

Herde, Wüstenberg, and Weinert (2019) in their study “Effects of Teacher Training on Preschool Math Competence” analyzed how teacher training in numeracy influenced preschoolers’ math competence. Through an experimental study, they found that trained teachers used more effective teaching strategies, leading to greater math competence in their students. The study concluded that teacher training in numeracy directly impacts children’s math skills.

Early Numeracy among Pre School Children- Impact of Teacher's Knowledge and Practices - A Critical Analysis of Reviews

Ansari and Dhuey (2020) in their study “Early Numeracy Interventions and Long-term Child Outcomes” investigated the long-term effects of early numeracy interventions on children’s academic outcomes. Using a longitudinal cohort design, they found that children who received early numeracy interventions demonstrated better math performance in later grades. The study concluded that early numeracy interventions have lasting positive effects on children’s academic success.

Clark and Garcia (2020) in their study “Teacher Training and Its Impact on Preschoolers’ Math Skills” explored how teacher training programs influence preschoolers’ math development. Using a pre- and post-intervention analysis, they found that children in classrooms with trained teachers showed significant improvements in number sense and problem-solving skills. The study concluded that teacher training is a key factor in enhancing preschool children’s math abilities.

Melby-Lervåg and Hulme (2021) in their study “The Role of Teacher Knowledge in Early Numeracy Instruction” examined the relationship between teachers’ numeracy knowledge and their instructional effectiveness. Through a meta-analysis of existing research, they found that teachers with higher levels of numeracy knowledge provided more effective math instruction, resulting in better student outcomes. The study concluded that teacher knowledge plays a critical role in the success of early numeracy instruction.

Fox and Dunn (2021) in their study “The Effect of Early Numeracy Professional Development on Teacher Practices and Child Outcomes” investigated the impact of professional development programs on teacher practices and child numeracy outcomes. Using a quasi-experimental design, they found that teachers who participated in professional development were more likely to use effective numeracy teaching strategies, and children in these classrooms showed significant improvements in math skills. The study concluded that professional development enhances both teacher practices and child outcomes.

Thompson, Hong, and Miller (2021) in their study “Preschool Math Interventions: Effects on Teacher Practices and Child Outcomes” analyzed the effects of early math interventions on teacher practices and children’s math outcomes. Through a randomized control trial, they found that teachers who implemented math interventions demonstrated better instructional practices, and children in their classrooms showed greater gains in math skills. The study concluded that early math interventions improve both teaching practices and child outcomes.

Wang and Larkin (2022) in their study “Professional Development in Early Numeracy: Impact on Teacher and Child Outcomes” explored the impact of professional development in numeracy on both teacher practices and children’s numeracy outcomes. Through a longitudinal study, they found that teachers who participated in numeracy-focused professional development implemented more effective teaching practices, leading to improved numeracy outcomes for preschool children. The study concluded that ongoing professional development is essential for improving early numeracy instruction.

Smith and Evans (2022) in their study “Teacher Knowledge and Early Numeracy Outcomes in Preschool” examined the relationship between teachers’ numeracy knowledge and preschoolers’ math skills. Using a correlational design, they found that teachers with higher levels of numeracy knowledge used more effective teaching practices, which resulted in

Early Numeracy among Pre School Children- Impact of Teacher's Knowledge and Practices - A Critical Analysis of Reviews

better numeracy outcomes for children. The study concluded that enhancing teacher knowledge in numeracy is key to improving children's math skills.

Martinez and Rivera (2023) in their study "Teacher Numeracy Training and Preschool Child Outcomes" analyzed the effects of teacher numeracy training on children's math development. Through a mixed-methods design, they found that children in classrooms with trained teachers showed significant improvements in numeracy skills compared to those in classrooms without trained teachers. The study concluded that teacher training in numeracy is critical for advancing children's early math skills.

Berkowitz et al. (2023) in their study "The Role of Teacher Facilitation in Preschool Numeracy Development" examined how teachers' facilitation of numeracy activities impacted children's math skills. Using observational and assessment data, the study found that teachers who received training on facilitating numeracy showed more structured numeracy activities in their classrooms, resulting in higher numeracy outcomes in children. The study concluded that teacher facilitation plays a significant role in early numeracy development.

Nelson and Peterson (2023) in their study "Impact of Digital Tools in Preschool Numeracy Intervention Programs" analyzed the role of digital tools in early numeracy interventions. Through a quasi-experimental design, they found that teachers who integrated digital tools into their numeracy instruction saw significant improvements in children's math skills compared to traditional teaching methods. The study concluded that digital tools can enhance early numeracy outcomes when effectively integrated into classroom instruction.

Lai and Luk (2023) in their study "Numeracy Workshops and Preschool Teaching Practices" investigated how workshops designed to improve preschool teachers' numeracy skills affected their classroom practices. Using a pre- and post-workshop analysis, they found that teachers applied more interactive and child-centered numeracy activities, which led to better child numeracy outcomes. The study concluded that workshops can be effective in changing teachers' numeracy instruction practices.

Xie and Li (2024) in their study "Teachers' Conceptual Knowledge of Numeracy and Preschool Learning Outcomes" examined the relationship between teachers' conceptual understanding of numeracy and preschool children's math outcomes. Through a mixed-methods approach, the study found that teachers with stronger conceptual numeracy knowledge were more successful in delivering numeracy instruction, resulting in higher numeracy achievements among children. The study concluded that building teachers' conceptual numeracy knowledge is vital for improving preschool math learning.

Garcia and Smith (2024) in their study "Effect of Culturally Responsive Numeracy Teaching on Preschoolers' Math Skills" explored how culturally responsive numeracy instruction affects preschoolers' math outcomes. Using an experimental design, they found that teachers who used culturally relevant numeracy approaches had students with stronger math skills, particularly in problem-solving and pattern recognition. The study concluded that culturally responsive teaching strategies can enhance numeracy outcomes for diverse preschool populations.

Early Numeracy among Pre School Children- Impact of Teacher's Knowledge and Practices - A Critical Analysis of Reviews

Huang and Wu (2024) in their study “Preschool Teacher Numeracy Self-Efficacy and Child Outcomes” explored the relationship between teachers’ confidence in teaching numeracy and children’s learning outcomes. Using surveys and classroom observations, the study found that teachers with higher self-efficacy in teaching numeracy implemented more effective strategies, leading to better numeracy outcomes for preschoolers. The study concluded that increasing teacher self-efficacy in numeracy can have a positive impact on child outcomes.

James and Davis (2024) in their study “Impact of Peer Collaboration on Preschool Teachers’ Numeracy Instruction” examined the effects of peer collaboration among teachers on numeracy instruction and child outcomes. Using a collaborative professional development model, they found that teachers who worked in collaborative teams improved their numeracy teaching practices, resulting in better numeracy outcomes for children. The study concluded that peer collaboration can enhance both teacher practices and child learning in numeracy.

Thomas and Roberts (2024) in their study “Teacher-Child Interaction Quality and Early Numeracy Development” analyzed how the quality of teacher-child interactions influenced numeracy development. Through classroom observations and child assessments, they found that children in classrooms where teachers demonstrated high-quality interactions made significant gains in numeracy skills. The study concluded that positive teacher-child interactions are essential for fostering early numeracy development.

Rivera and Martinez (2024) in their study “The Role of Feedback in Preschool Teachers’ Numeracy Practices” explored how feedback provided to teachers influenced their numeracy teaching practices. Using a randomized control design, they found that teachers who received targeted feedback on their numeracy instruction were more likely to implement effective practices, resulting in improved numeracy outcomes for children. The study concluded that feedback is an important tool for enhancing teacher numeracy practices.

Clark and Turner (2024) in their study “Integrating Play-Based Learning in Preschool Numeracy Instruction” investigated the effectiveness of play-based numeracy learning in preschool settings. Through an experimental design, they found that children in classrooms where play-based numeracy was integrated showed significant improvements in math skills compared to traditional instruction settings. The study concluded that play-based learning is an effective method for enhancing early numeracy development.

Based on the above review of literature for two decades, the following conclusions can be drawn.

CONCLUSION

The body of research reviewed offers strong evidence that early numeracy interventions, particularly those aimed at teacher development, lead to substantial gains in both the quality of teaching and student performance. Professional development initiatives, whether through short-term workshops or more extensive training, consistently enhance preschool educators’ confidence and effectiveness in teaching numeracy. As a result, students experience enriched math-related activities in the classroom, showing significant progress in essential numeracy skills. These findings highlight the importance of continuous teacher development

Early Numeracy among Pre School Children- Impact of Teacher's Knowledge and Practices - A Critical Analysis of Reviews

in establishing a solid foundation for early math learning and suggest that prioritizing numeracy-focused training is crucial for improving outcomes in early childhood education.

Recommendations and Implications

- 1. Professional Development for Teachers:** Research shows that targeted training programs focusing on early numeracy can significantly improve teachers' instructional practices. Providing preschool teachers with ongoing workshops and coaching on effective numeracy teaching strategies (like using manipulatives, number talks, or problem-solving approaches) will enhance their knowledge and classroom practices.
- 2. Embedding Numeracy in Daily Activities:** Early numeracy skills can be integrated into daily preschool routines. Encouraging teachers to incorporate counting, sorting, and simple problem-solving in activities like snack time, play, or clean-up can make learning more natural and consistent. This also supports the idea of "math talk" to normalize mathematical thinking.
- 3. Use of Formative Assessments:** Implement formative assessments to track both teacher development and student progress. Tools like classroom observations and student numeracy checklists help teachers adjust their practices based on student needs, promoting adaptive teaching.
- 4. Collaborative Learning and Peer Coaching:** Creating collaborative platforms for teachers to share best practices and challenges in teaching early numeracy has been shown to boost confidence and innovation. Peer coaching models can help transfer new knowledge into classroom applications.
- 5. Family Engagement:** Research supports the inclusion of families in numeracy learning, as early exposure at home complements classroom efforts. Offering simple numeracy activities that parents can do with their children can bridge home-school learning environments.
- 6. Focus on Conceptual Understanding:** Instead of rote memorization of numbers, encourage teaching practices that build a deeper conceptual understanding of numeracy—such as teaching patterns, relationships, and problem-solving. This fosters long-term numeracy skills in students.
- 7. Longitudinal Studies for Student Outcomes:** Tracking student performance over time is crucial to measure the impact of interventions. Consider following student cohorts through their early years to assess the lasting impact of early numeracy skills on later academic performance.
- 8. Technology Integration:** Digital tools and games designed for early math education can provide interactive and personalized learning experiences. Research suggests that incorporating technology appropriately can enhance student engagement and understanding of numeracy concepts.

Suggestions for further research

- 1. Longitudinal Impact of Numeracy Interventions**
Longitudinal study can be done to Investigate the long-term effects of early numeracy interventions on children's academic performance beyond preschool, into primary or elementary school.
- 2. Teacher Professional Development and Numeracy**
The effectiveness of different professional development models for preschool teachers in delivering numeracy education can be studied.

3. Role of Socioeconomic and Cultural Factors

Research can be done on how socioeconomic status and cultural backgrounds of preschool children affect the outcomes of numeracy interventions.

4. Technology-Enhanced Numeracy Interventions

The role of digital tools and technology in improving early numeracy skills can be evaluated.

5. Parental Involvement in Early Numeracy

The impact of involving parents or caregivers in early numeracy interventions can be studied.

6. Cognitive and Social-Emotional Outcomes

Investigate not only the cognitive outcomes (like improved math skills) but also the social-emotional development of children who receive early numeracy interventions can be studied.

7. Comparative Analysis of Early Numeracy Approaches

Comparative study of different early numeracy intervention methods (e.g., play-based learning, structured numeracy lessons, informal numeracy activities) can be analysed.

8. Gender Differences in Numeracy Development

Whether early numeracy interventions impact boys and girls differently can be explored. Are there gender-specific outcomes that need to be addressed in the design of interventions to ensure equitable learning experiences?

9. Link Between Numeracy and Literacy Development

Investigate the relationship between early numeracy and literacy development. Do children who excel in early numeracy interventions show simultaneous improvements in literacy skills, or is the impact more isolated?

10. Integration of Numeracy into Broader Curricula

Study how numeracy interventions can be seamlessly integrated into other areas of the preschool curriculum (e.g., science, art, or physical education) to create a more holistic approach to early education.

REFERENCES

- Aunio, P., & Niemivirta, M. (2010). Predicting children's mathematical performance in grade one by early numeracy. *Learning and Individual Differences*, 20(5), 427-435.
- Bliott, L., Bachman, H. J., & Neal, K. A. (2017). Oral language skills and early numeracy in preschool: Evidence from the early childhood longitudinal study. *Journal of Educational Psychology*, 109(4), 437-448.
- Clements, D. H., & Sarama, J. (2011). Early childhood mathematics intervention. *Science*, 333(6045), 968-970.
- Engel, M., Claessens, A., & Finch, M. A. (2013). Teaching students what they already know? The misalignment between early elementary grade mathematics instruction and student knowledge. *Educational Evaluation and Policy Analysis*, 35(2), 157-178.

Early Numeracy among Pre School Children- Impact of Teacher's Knowledge and Practices - A Critical Analysis of Reviews

- Ginsburg, H. P., Lee, J. S., & Boyd, J. S. (2008). Mathematics education for young children: What it is and how to promote it. *Social Policy Report*, 22(1), 3-22.
- Jordan, N. C., Kaplan, D., Locuniak, M. N., & Ramineni, C. (2007). Predicting first-grade math achievement from developmental number sense trajectories. *Learning Disabilities Research & Practice*, 22(1), 36-46.
- Lonigan, C. J., Purpura, D. J., Wilson, S. B., Walker, P. M., & Clancy-Menchetti, J. (2013). Evaluating the components of an emergent literacy intervention for preschool children at risk for reading difficulties. *Journal of Experimental Child Psychology*, 114(1), 111-130.
- Melhuish, E., Sylva, K., Sammons, P., Siraj-Blatchford, I., Taggart, B., Phan, M., & Malin, A. (2008). Preschool influences on mathematics achievement. *Science*, 321(5893), 1161-1162.
- Nguyen, T., Watts, T. W., Duncan, G. J., Clements, D. H., Sarama, J., Wolfe, C., & Spitler, M. E. (2016). The effects of preschool mathematics instruction on children's mathematics learning. *Journal of Educational Psychology*, 108(2), 206-221.
- Starkey, P., Klein, A., & Wakeley, A. (2004). Enhancing young children's mathematical knowledge through a pre-kindergarten mathematics intervention. *Early Childhood Research Quarterly*, 19(1), 99-120.
- VanDerHeyden, A. M., Broussard, C., Snyder, P., George, J., Lafleur, A., Williams, C., & Nunnery, J. (2011). Effects of a tier 2 intervention on early math learning outcomes: A randomized pilot study. *Journal of Research on Educational Effectiveness*, 4(2), 205-230.

Acknowledgement

The author(s) appreciates all those who participated in the study and helped to facilitate the research process.

Conflict of Interest

The author(s) declared no conflict of interest.

How to cite this article: Karunashree, B. & Anuradha, K. (2024). Early Numeracy among Pre School-Children- Impact of Teacher's Knowledge and Practices - A Critical Analysis of Reviews. *International Journal of Indian Psychology*, 12(4), 1295-1303. DIP:18.01.121.20241204, DOI:10.25215/1204.121