Cognopolis
Revista de educación y pedagogía
Vol. 4(3), 63-78, 2026
https://doi.org/10.62574/nwyd3789

Innovative pedagogical practices for strengthening logical-mathematical thinking in early childhood

Prácticas pedagógicas innovadoras para el fortalecimiento del pensamiento lógico-matemático en la primera infancia

Carlos Luis Bacusoy-Sánchez
carlos.bacusoy@unesum.edu.ec
Universidad Estatal del Sur de Manabí. Jipijapa, Manabí, Ecuador
https://orcid.org/0009-0001-2751-4576

Ibeth Haydee Parrales-Pincay
ibeth.parrales@unesum.edu.ec
Universidad Estatal del Sur de Manabí. Jipijapa, Manabí, Ecuador
https://orcid.org/0009-0001-5053-8357

Sandra María Cevallos-Solorzano
sandra.cevallos@uees.edu.ec
Universidad Estatal del Sur de Manabí. Jipijapa, Manabí, Ecuador
https://orcid.org/0009-0003-5367-8771

Ana María Moran-Macias
ana.moran@unesum.edu.ec
Universidad Estatal del Sur de Manabí. Jipijapa, Manabí, Ecuador
https://orcid.org/0009-0006-1734-5306

ABSTRACT

The purpose of this article is to analyse innovative pedagogical practices for strengthening logical-mathematical thinking in early childhood, with an emphasis on the Ecuadorian education system. To this end, a descriptive documentary design based on the feasibility-study modality was employed, reviewing fifteen academic sources on pedagogical practices for early mathematical development, which were systematised in comparative matrices according to type of study, context and results. The findings show that the most effective practices combine the manipulation of concrete materials, structured play, narrative and limited technological mediation, and the resolution of everyday problems, with the teacher's intentional mediation as a determining factor. Based on this diagnosis, a four-component strategy is proposed: concrete materials, numerical board games, narrative/technological mediation and contextualised problem-solving, which is low-cost and highly feasible institutionally, and can be evaluated using indicators such as tasks solved independently and the spontaneous use of mathematical vocabulary.

Descriptors: education management; basic and general education subjects; mathematics teaching. (UNESCO Thesaurus)

RESUMEN

El presente artículo tiene como propósito analizar las prácticas pedagógicas innovadoras para el fortalecimiento del pensamiento lógico-matemático en la primera infancia, con énfasis en el sistema educativo ecuatoriano. Para ello, se empleó un diseño documental descriptivo con modalidad de proyecto factible, revisando quince fuentes académicas sobre prácticas pedagógicas para el desarrollo matemático temprano, sistematizadas en matrices comparativas según tipo de estudio, contexto y resultados. Los hallazgos evidencian que las prácticas más efectivas combinan manipulación de materiales concretos, juego estructurado, mediación narrativa y tecnológica limitada, y resolución de problemas cotidianos, con la mediación intencional del docente como factor determinante. A partir de este diagnóstico se propone una estrategia de cuatro componentes: materiales concretos, juegos de mesa numéricos, mediación narrativa/tecnológica y resolución de problemas contextualizados, de bajo costo y alta viabilidad institucional, evaluable mediante indicadores de tareas resueltas de manera independiente y uso espontáneo del vocabulario matemático.

Descriptores: gestión de la educación; materias de enseñanza básica y general; enseñanza de las matemáticas. (Tesauro UNESCO)

Received: 18/06/2026. Reviewed: 21/07/2026. Accepted: 19/08/2026. Published: 01/09/2026.
Research Articles

INTRODUCTION

Within this framework, logical-mathematical thinking is one of the cognitive competencies that becomes structured earliest in child development, since it is based on processes of classification, seriation, correspondence and counting that children learn from their earliest years of life. Early childhood (from birth to 6 years of age) is a decisive window of opportunity for the consolidation of these foundations, since the plasticity of this stage favours the construction of numerical and spatial schemas that will support formal mathematical learning in basic education (Fisher et al., 2013).

The teaching of logical-mathematical thinking in early years education, however, risks becoming a mechanical exercise of repeating numbers with no meaning for the child. Contemporary evidence, by contrast, points to guided play and active exploration, in which children progressively construct mathematical notions through the manipulation of concrete materials and interaction with their peers; in this regard, Cohrssen et al. (2016) showed that play-based mathematical activities positively change both the attitudes and the practices of early childhood educators towards the teaching of this area.

Given that Ecuador has its own particular features in relation to the teaching of logical-mathematical thinking in early childhood, the available evidence needs to be critically and contextually reviewed; Bojorque et al. (2018) evaluated, through a quasi-experimental design applied in Ecuadorian institutions, whether the Building Blocks programme strengthened kindergarten children's numerical competencies, and found that significant improvements in these competencies followed its implementation; Reyes-Cedeño et al. (2019) likewise documented, based on a study carried out with preschoolers in the city of Pasaje, that practices related to early mathematical thinking in Ecuador still show limitations in terms of specific teacher training and the availability of appropriate teaching materials.

International research, however, has systematically documented a range of innovative strategies that could enrich pedagogical practice in Ecuador. Zhang et al. (2023), through a literature review, established that the use of illustrated books in the teaching of mathematics improves the understanding of numerical and spatial concepts when it is combined with the teacher's intentional mediation; Almulhim and Fujita (2026) reported that the interactive reading of mathematical stories increases children's active participation in reasoning processes during the kindergarten stage.

In line with this view, Morell-Ruiz et al. (2026) show that brief training in numerical estimation during preschool education strengthens the link between approximate numerical representation and formal symbolic representation (a relevant aspect in preparing children for later school arithmetic). Logical-mathematical thinking in early childhood, therefore, cannot be regarded merely as curricular content, but rather as a competency integrated into language, symbolic play and social interaction; accordingly, Petrou and Panaoura (2022) found that preschool educators and families hold different beliefs about the role of play in early mathematics learning, which shapes how these activities are implemented in the classroom.

In other words, this study does not seek to settle the theoretical debate on children's cognitive development, but rather to provide an operational bridge between international evidence and everyday teaching practice in the Ecuadorian classroom. From this standpoint, the relevance of the study lies in the fact that the foundations of logical-mathematical thinking built during early childhood shape later academic achievement trajectories (Ramani and Siegler, 2011), since structured play activities reduce gaps in numerical knowledge between children of different socioeconomic levels.

In light of the above, the purpose of this article is to analyse innovative pedagogical practices for strengthening logical-mathematical thinking in early childhood, with an emphasis on the Ecuadorian education system.

METHODOLOGY

In line with the objective of this study, it is structured as a descriptive documentary design supported by the feasibility-study modality. The descriptive documentary component allowed for the systematisation and description of the published scientific evidence on pedagogical practices for the development of logical-mathematical thinking in early childhood; the feasibility-study component guided the construction of a proposal of teaching strategies adapted to the reality of early years classrooms in Ecuador.

To this end, academic sources indexed in databases related to mathematics education and developmental psychology were reviewed (empirical studies, systematic reviews, intervention programmes applied in early years and preschool education). Fifteen sources were selected that met the criterion of thematic relevance, declared methodological rigour and correspondence with the educational level under study; priority was also given to sources that explicitly described the context in which the pedagogical practice described was applied, since without this information it was not possible to determine whether each strategy was relevant to institutional conditions in Ecuador.

As an analytical technique, documentary analysis was used, through which the following elements were extracted from each source: type of study, geographical context, population served, components of the pedagogical practice and main results reported. This information was organised into comparative matrices in order to identify common patterns and recurring strategies across the studies reviewed. For this reason, the feasibility-study phase was developed in three steps: first, a needs assessment based on the documentary review; second, the design of the proposed teaching strategies based on the systematised evidence; third, the definition of criteria for pedagogical feasibility, taking into account the resources usually available in early years institutions in Ecuador.

RESULTS

Three main categories of findings emerged from the documentary analysis: those related to the teaching resources and materials used; those related to the reported effects on the development of logical-mathematical thinking; and those related to the teaching and institutional conditions that facilitate this development. Table 1 summarises the reviewed studies with the greatest empirical weight for the design of the proposal.

Table 1. *Documentary analysis.*

Author(s) and year	Type of study	Context	Main contribution
Bojorque et al. (2018)	Quasi-experimental study	Ecuador	The Building Blocks programme significantly improves the numerical competencies of kindergarten children.
Fisher et al. (2013)	Experimental study	United States	Guided play favours the acquisition of geometric knowledge in preschoolers.
Ramani and Siegler (2011)	Quasi-experimental study	United States	Numerical board games reduce the knowledge gap between children of different socioeconomic backgrounds.
Trawick-Smith et al. (2017)	Observational study	United States	Block play with teacher and peer interaction strengthens mathematical learning.
Koç et al. (2026)	Exploratory pilot study	Turkey	Board games improve early mathematical reasoning in preschoolers.
Morell-Ruiz et al. (2026)	Experimental study	Sweden	Number-line estimation training strengthens the early symbolic numerical pathway.
Reyes-Cedeño et al. (2019)	Evaluative study	Ecuador	Teaching practices for early mathematical thinking in Ecuador show limitations in training and materials.
Peralbo-Uzquiano et al. (2020)	Virtual intervention study	Spain	A virtual programme improves cognitive flexibility, inhibitory control and basic mathematical skills.
Chen (2026)	Systematic review	International	Tablet games promote early mathematical learning when combined with teacher mediation.
Zhang et al. (2023)	Systematic literature review	International	The use of illustrated books favours the understanding of mathematical concepts in early teaching.

Source: Own elaboration (2026).

As shown in Table 1, the evidence indicates that the most effective pedagogical practices for strengthening logical-mathematical thinking in early childhood are those that combine the manipulation of concrete materials with the teacher's intentional mediation (Fisher et al., 2013; Trawick-Smith et al., 2017). It is also clear that the studies carried out specifically in Ecuador show this both in terms of the potential of structured programmes and in terms of gaps in teaching staff training (Bojorque et al., 2018; Reyes-Cedeño et al., 2019).

With regard to play as a teaching resource, Cohrssen et al. (2016) specifically show that game-based mathematical activities positively change teachers' attitudes towards the teaching of this area. Nergård (2023) shows that preschool-aged children make genuine mathematical arguments during free-play activities when the educator recognises and pedagogically capitalises on these opportunities for spontaneous reasoning. With regard to construction play, Trawick-Smith et al. (2017) showed that the complexity of the structures built, peer interaction and the presence of replica materials have a differential effect on the mathematical learning achieved, so that simply having blocks in the classroom is not enough: the quality of the teacher's interaction during play also matters.

Regarding technological resources, Chen (2026) established that games on touch devices promote early mathematical learning when they are mediated by teachers and subject to age-appropriate time limits; without such mediation, the effect on mathematical reasoning tends to be weak. In this respect, Peralbo-Uzquiano et al. (2020) likewise confirmed that a virtual intervention programme simultaneously improves cognitive flexibility, inhibitory control and basic mathematical skills in preschool-aged children, indicating a close relationship between executive functions and the development of logical-mathematical thinking.

With regard to narrative and literary resources, Zhang et al. (2023) showed that the use of illustrated books with mathematical content increases the

understanding of numerical and spatial concepts when the teacher asks guiding questions during reading; Almulhim and Fujita (2026) found that the interactive reading of mathematical stories increases kindergarten children's active participation in collective reasoning processes. With regard to the specific teaching strategies documented in the literature, Table 2 systematises the categories identified together with their corresponding empirical basis.

Table 2. *Categories identified through the documentary analysis.*

Category	Pedagogical practice	Basis
Guided play with concrete materials	Manipulation of blocks, geometric shapes and counting materials with teacher mediation	Fisher et al. (2013); Trawick-Smith et al. (2017)
Board and numerical table games	Use of board games with dice and numbered tracks to strengthen counting and the comparison of quantities	Ramani and Siegler (2011); Koç et al. (2026)
Narrative and literary resources	Interactive reading of stories and illustrated books with mathematical content, accompanied by guiding questions	Zhang et al. (2023); Almulhim and Fujita (2026)
Mediated technological resources	Limited use of digital applications and games with active teacher accompaniment	Chen (2026); Peralbo-Uzquiano et al. (2020)
Problem-solving in a playful context	Presentation of everyday problem situations that children solve through seriation and counting	Torres-Peña et al. (2025)
Numerical estimation and spatial representation	Number-line estimation activities and graphical representation of quantities	Morell-Ruiz et al. (2026)

Source: Own elaboration (2026).

As Table 2 shows, the practices with the strongest empirical support combine a manipulative component (that is, concrete materials) with a dialogic component (the teacher's verbal mediation during the activity). Thus, Torres-Peña et al. (2025) showed that solving everyday problems through seriation and counting strengthens mathematical thinking in preschool when situations are presented in contexts meaningful to the child. Petrou and Panaoura (2022), for their part, showed that educators' and families' beliefs about the value of play in mathematics learning determine how often, and how well, these activities are carried out at home and in the classroom; without a shared understanding of this value, innovative practices tend to be implemented sporadically.

Taken together, these results show that the most effective pedagogical practices do not depend on a single resource, but rather on the intentional articulation of concrete materials, structured play, narrative and sustained teacher mediation over time. The systematised results thus indicate that the strengthening of logical-mathematical thinking in early childhood has international empirical support. Ecuador-specific evidence (although small in volume), however, agrees that it is necessary to strengthen teacher training and the availability of teaching materials as prerequisites for the implementation of these practices (Bojorque et al., 2018; Reyes-Cedeño et al., 2019).

PROPOSED TEACHING STRATEGIES

Based on the diagnosis documented above, teaching strategies are proposed below for strengthening logical-mathematical thinking in early years classrooms in Ecuador under a feasibility-study approach, structured around four interrelated components: manipulation of concrete materials; structured play with mathematical intentionality; narrative and technological mediation; and problem-solving in everyday contexts. In this order, the first component, the manipulation of concrete materials, stems from the fact that logical-mathematical thinking in early childhood is built through the physical action on objects before it becomes consolidated as abstract thought; permanent mathematics corners should therefore be set up in the classroom (blocks, geometric shapes, counting materials and simple balance scales) that children can access at certain times of the day under guidance (Fisher et al., 2013; Trawick-Smith et al., 2017). This measure responds directly to what Fisher et al. (2013) and Trawick-Smith et al. (2017) showed: that the manipulation of blocks and concrete materials, together with teacher interaction, significantly strengthens early mathematical learning.

The second component, in turn, is the systematic inclusion of board games and numerical board games in weekly curricular planning. Dice games should have fixed time slots during the day, during which children count, compare quantities and practise numerical correspondence in a playful and socially shared way. This

strategy is based on the findings of Ramani and Siegler (2011) that this type of game reduces the gap in numerical knowledge between children of different socioeconomic levels (a condition of socioeconomic heterogeneity present in many Ecuadorian classrooms), while Koç et al. (2026) showed that board games also strengthen more complex mathematical reasoning, beyond counting.

The third component concerns the narrative and technological mediation of mathematical learning. Stories and illustrated books with mathematical content need to be selected and included in daily reading routines, with questions that the teacher asks before, during and after reading, as documented by Zhang et al. (2023) and Almulhim and Fujita (2026). Similarly, early mathematics digital applications should only be used briefly and always under the teacher's mediation (Chen, 2026; Peralbo-Uzquiano et al., 2020), which Chen (2026) and Peralbo-Uzquiano et al. (2020) considered necessary for these resources to have positive effects on mathematical reasoning and executive functions.

The fourth component, in turn, is problem-solving in everyday contexts that are real for the child (for example, distributing materials among classmates, ordering objects by size or colour, or working out how many items are missing to complete a set); as documented by Torres-Peña et al. (2025), seriation and counting are strengthened more when they are practised within real problem situations rather than decontextualised exercises. Brief numerical estimation activities are also included (Morell-Ruiz et al., 2026): training in number-line estimation strengthens the pathway linking approximate numerical representation with formal symbolic representation.

It should also be noted that the proposal is built on pedagogical differentiation, since the activities described above can be adjusted in terms of complexity according to each child's level, so that the intervention is not applied uniformly to a group that is naturally heterogeneous in its learning pace. Specific activities that can be integrated into the daily routine include: a classroom market, in which children act out buying and selling situations that require counting and matching;

a tallest-tower building challenge, in which children compare quantities and heights using mathematical language; and a numbered story (an adapted interactive reading), in which each page includes a brief counting or comparison question. This type of activity is consistent with the work of Nergård (2023), who showed that children produce genuine mathematical arguments during free play when the teacher recognises and capitalises on these opportunities.

In order to clarify the feasibility of implementation, Table 3 organises the proposal into sequential phases, indicating activities, those responsible and the estimated timeframe.

Table 3. *Sequential phases of the proposal.*

Phase	Main activity	Responsible party	Estimated duration
Diagnosis	Identification of the group's level of development in logical-mathematical thinking through structured observation	Classroom teacher	2 weeks
Resourcing and awareness-raising	Organisation of the mathematics corner and initial teacher workshop on the mediation of mathematical play	Pedagogical coordination	2 weeks
Implementation	Development of the proposal's four components within the classroom's daily routine	Classroom teacher	1 academic term
Technological and narrative mediation	Incorporation of interactive reading and limited use of digital applications	Classroom teacher	Throughout the term
Monitoring and adjustment	Evaluation of the group's progress in counting, seriation and problem-solving tasks	Pedagogical coordination	At the close of each two-month period

Source: Own elaboration (2026).

It should be noted that the proposal put forward focuses on low-cost materials that are easy to make, which makes it more feasible for early years institutions with limited resources (a common situation in many Ecuadorian contexts, as shown by Reyes-Cedeño et al. (2019) with regard to the availability of teaching materials in preschools). In this sense, the feasibility of the proposal rests mainly on teacher training and the intentional organisation of classroom space rather than on the acquisition of costly resources; both quantitative and qualitative

indicators should be used in evaluating the proposal (the number of counting and sequencing tasks children solve independently; the frequency with which mathematical vocabulary is used spontaneously during free play; and teachers' perceptions of the group's progress). This monitoring system allows the strategies to be adjusted progressively, flexibility being a guiding principle of the feasibility-study approach.

DISCUSSION

The systematised results of this study allow us to discuss, first, that guided play is central to logical-mathematical thinking in early childhood; it is indeed the case that the international literature confirms the effectiveness of play-based practices (Fisher et al., 2013; Ramani and Siegler, 2011; Trawick-Smith et al., 2017), but this effectiveness does not stem solely from having materials available; it stems from how the teacher structures and mediates the experiences. This is also what Nergård (2023) documented: genuine mathematical arguments occur during free play only if the educator recognises them pedagogically.

Second, the relationship between teachers' and families' beliefs about the value of mathematical play and the quality of its effective implementation needs to be discussed; Petrou and Panaoura (2022) showed that this relationship is direct: when educators and families share a positive appreciation of play as a means of learning mathematics, the corresponding practices are implemented more frequently and consistently. This relationship is particularly relevant for Ecuador, where initial teacher training in early years education does not always include specific teaching strategies for logical-mathematical thinking (Reyes-Cedeño et al., 2019).

The evidence reviewed also allows us to discuss the place of technological resources within a balanced pedagogical proposal. Chen (2026) and Peralbo-Uzquiano et al. (2020) agree that digital resources are effective only when accompanied by active teacher mediation and time limits. The proposal presented here therefore includes technological mediation as a limited,

complementary component rather than as the main focus of the intervention, so as not to displace the central role of play with concrete materials and direct social interaction.

The limitations of the evidence reviewed with respect to its direct applicability to Ecuador must also be considered. Most of the systematised studies were carried out in high-income contexts (the United States, Sweden or Turkey) (Fisher et al., 2013; Morell-Ruiz et al., 2026; Koç et al., 2026), where institutional conditions, technological availability and teacher training differ considerably from those found in many Ecuadorian early years institutions, so that the uncritical transfer of these strategies without contextual adaptation could undermine their effectiveness.

The approach proposed here therefore focuses on low-cost materials and practices that are easy for teachers to implement (Bojorque et al. (2018) evaluated the Building Blocks programme applied specifically in Ecuadorian kindergartens and found significant improvements in numerical competencies when the programme is adapted to the real conditions of the local classroom). It is also relevant here how solving everyday problems can be seen as a legitimate space for mathematics learning from an early age: Torres-Peña et al. (2025) showed that sequencing and counting are strengthened more when practised in real problem situations; this supports the methodological choice made to include, within the proposal, a specific problem-solving component set in everyday contexts rather than relying solely on decontextualised structured exercises.

Contrary to a purely instrumental view of mathematical thinking, the evidence reviewed supports a relational and narrative perspective according to which numerical understanding is also built through language and dialogic interaction with adults. Zhang et al. (2023) and Almulhim and Fujita (2026) established that the interactive reading of mathematical content improves conceptual understanding when the teacher poses guiding questions, which is why the narrative dimension has been included within our proposed framework.

With regard to logical-mathematical thinking and executive functions, it is important to bear in mind that classroom teaching strategies do not operate in isolation from children's overall cognitive development; in this respect, Peralbo-Uzquiano et al. (2020) showed that an intervention programme simultaneously improves cognitive flexibility, inhibitory control and basic mathematical skills, which means that the activities proposed in the present study, which require planning, turn-taking and self-regulation during play, could generate cognitive benefits beyond the strictly mathematical domain.

It is also important to mention the role of families in consolidating logical-mathematical thinking outside the classroom; Petrou and Panaoura (2022) likewise found that parents, like educators, hold different beliefs about what mathematical play means, which suggests that the proposed approach could perhaps be strengthened with simple guidelines for families on how to use everyday home situations (cooking or going shopping) to practise counting and comparing quantities.

It is worth discussing, finally, what methodological contribution the feasibility-study approach makes in relation to the exclusively descriptive or evaluative studies reviewed; most of the systematised evidence only documents the effects of programmes already implemented in other contexts, whereas the feasibility-study modality used in the present study allows a further step to be taken by translating this evidence into a concrete proposal that is adapted to, and evaluable in, Ecuador (this is what distinguishes the present work from the purely descriptive reviews in the literature [Chen, 2026; Zhang et al., 2023]).

CONCLUSION

In light of this objective, it is concluded that the innovative pedagogical practices analysed (guided play, manipulation of concrete materials, limited narrative and technological mediation, and the resolution of everyday problems) have international empirical support for strengthening logical-mathematical thinking during early childhood, but this support requires a deliberate process of

adaptation to the Ecuadorian education system, in terms of institutional conditions, teacher training and the availability of materials suited to the country. It is also concluded that the effectiveness of these practices does not depend on any single resource, but rather on the intentional articulation between the manipulative component and the dialogic component of teacher mediation, the combination with the greatest documented impact on children's mathematical reasoning. In line with the above, the proposal formulated under a feasibility-study approach translates this evidence into four articulated, evaluable components whose feasibility depends mainly on teacher training and the organisation of classroom space, rather than on the availability of costly resources.

FUNDING

Non-monetary

CONFLICT OF INTEREST

There is no conflict of interest with individuals or institutions associated with the research.

ACKNOWLEDGMENTS

To the Universidad Estatal del Sur de Manabí (UNESUM).

REFERENCES

Almulhim, M. G., & Fujita, T. (2026). Kindergarteners' engagement in mathematical thinking via the interactive reading of mathematical stories. *Mathematics Education Research Journal*. https://doi.org/10.1007/s13394-026-00560-9

Bojorque, G., Torbeyns, J., Van Hoof, J., Van Nijlen, D., & Verschaffel, L. (2018). Effectiveness of the Building Blocks program for enhancing Ecuadorian kindergartners' numerical competencies. *Early Childhood Research Quarterly, 44*, 231-241. https://doi.org/10.1016/j.ecresq.2017.12.009

Chen, J. (2026). A systematic review of using tablet games to promote early math learning in preschool settings: Effectiveness and influencing factors. *Educational Technology Research and Development, 74*(4), 2141-2167. https://doi.org/10.1007/s11423-026-10626-x

Cohrssen, C., Church, A., & Tayler, C. (2016). Play-based mathematics activities as a resource for changing educator attitudes and practice. *SAGE Open, 6*(2). https://doi.org/10.1177/2158244016649010

Fisher, K. R., Hirsh-Pasek, K., Newcombe, N., & Golinkoff, R. M. (2013). Taking shape: Supporting preschoolers' acquisition of geometric knowledge through guided play. *Child Development, 84*(6), 1872-1878. https://doi.org/10.1111/cdev.12091

Koç, H., Yıldız, E., & Karabekmez, S. (2026). A pilot and exploratory study on the effects of a board-game intervention on early mathematical reasoning in preschool children. *Frontiers in Psychology, 17*, Article 1862028. https://doi.org/10.3389/fpsyg.2026.1862028

Morell-Ruiz, M., Ternblad, E.-M., Tärning, B., Holmer, S., Haake, M., & Gulz, A. (2026). Number-line estimation training in preschoolers supports early mathematical development and is associated with a stronger approximate-to-symbolic numerical pathway. *Frontiers in Psychology, 17*, Article 1883264. https://doi.org/10.3389/fpsyg.2026.1883264

Nergård, B. (2023). Preschool children's mathematical arguments in play-based activities. *Mathematics Education Research Journal, 35*(Suppl. 1), 193-216. https://doi.org/10.1007/s13394-021-00395-6

Peralbo-Uzquiano, M., Fernández-Abella, R., Durán-Bouza, M., Brenlla-Blanco, J.-C., & Cotos-Yáñez, J.-M. (2020). Evaluation of the effects of a virtual intervention programme on cognitive flexibility, inhibitory control and basic math skills in childhood education. *Computers & Education, 159*, Article 104006. https://doi.org/10.1016/j.compedu.2020.104006

Petrou, P., & Panaoura, A. (2022). Play based activities for mathematical thinking at infancy: Nursery teachers' and parents' beliefs. *Journal of Childhood, Education & Society, 3*(2), 86-97. https://doi.org/10.37291/2717638X.202232171

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

Reyes-Cedeño, C. C., Rivas-Cun, H. I., Espinoza-Cevallos, C. E., & Rojas-García, C. R. (2019). Assessment of the practices for early mathematics thinking in preschools of Pasaje city, Ecuador. *European Journal of Educational Research, 8*(4), 1063-1070. https://doi.org/10.12973/eu-jer.8.4.1063

Torres-Peña, R. C., Peña-González, D., & Ariza-Echeverri, E. A. (2025). Mathematical thinking in preschool: Strengthening seriation and counting

through problem solving. *International Journal of Early Childhood, 57*, 379-401. https://doi.org/10.1007/s13158-024-00402-4

Trawick-Smith, J., Swaminathan, S., Baton, B., Danieluk, C., Marsh, S., & Szarwacki, M. (2017). Block play and mathematics learning in preschool: The effects of building complexity, peer and teacher interactions in the block area, and replica play materials. *Journal of Early Childhood Research, 15*(4), 433-448. https://doi.org/10.1177/1476718X16664557

Zhang, Q., Sun, J., & Yeung, W.-Y. (2023). Effects of using picture books in mathematics teaching and learning: A systematic literature review from 2000-2022. *Review of Education, 11*(1), Article e3383. https://doi.org/10.1002/rev3.3383

Copyright: 2026 By the authors. This article is open access and distributed under the terms and conditions of the Creative Commons Attribution-NonCommercial-ShareAlike 4.0 International (CC BY-NC-SA 4.0) license https://creativecommons.org/licenses/by-nc-sa/4.0/