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Strengthening Logical Thinking in Children Aged 5-6 Years Through BUMIKA Geometry: A Classroom Action Research Study

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Abstract: Logical thinking in early childhood underpins children's ability to compare quantities, organize sequences, classify objects, and reason about number. This study examined the development of logical-thinking skills in children aged 5–6 years through BUMIKA Geometry, a manipulative learning medium that integrates counting, sequencing, comparing, and classifying activities using geometric pieces, a sorting box, and a stacking tower. The study used participatory classroom action research in one Group B classroom at TK Tunas Harapan 1 Ciputat, Indonesia. Twelve children participated in two iterative cycles consisting of planning, action, observation, and reflection. Cycle I comprised six meetings and Cycle II four meetings. Data were collected through structured observation, classroom interviews, field documentation, and learning records, then analyzed descriptively using quantitative percentages and qualitative reduction, display, and interpretation. The mean logical-thinking score increased from 40.28% at pre-action to 51.37% in Cycle I and 76.91% in Cycle II, an overall gain of 36.63 percentage points. Cycle II averages were 78.40% for comparing, 78.65% for sequencing, 74.91% for classifying, and 76.82% for counting. Qualitative evidence indicated greater independence, participation, and sustained attention after the Cycle II classroom-management revision. The findings suggest that an integrated, concrete, play-oriented medium can support logical-thinking practice in authentic early-childhood classrooms. Because the study involved a single class without a comparison group, the results should be interpreted as within-class improvement rather than causal evidence.

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INTRODUCTION

Early mathematical and logical competencies develop rapidly during the preschool years and form part of the foundation on which later formal learning is built. Fine-grained developmental evidence shows that young children acquire number, quantity, comparison, and related numeracy skills progressively rather than as a single unitary ability (Litkowski et al., 2020). Longitudinal research also indicates that preschool mathematical abilities are associated with later arithmetic performance, alongside executive-function skills that help children maintain goals, shift strategies, and regulate attention (Akhavein et al., 2023). These findings position early logical-mathematical experiences as an important area for deliberate pedagogical support, particularly when they are aligned with the developmental capacities of young children.

For children aged five to six years, learning is especially productive when abstract relations are made visible through concrete actions and playful exploration. Research on preschool mathematics has demonstrated that systematic early mathematics instruction can improve children's mathematical knowledge (Clements & Sarama, 2008), while a meta-analysis of concrete manipulatives found that physical representations can support mathematics learning when their use is closely tied to the concepts being taught (Carbonneau et al., 2013). Guided-play evidence likewise shows benefits for early mathematics and shape knowledge when adults structure the environment and learning goal without removing children's agency (Skene et al., 2022). In geometry specifically, guided play has been shown to support preschoolers' shape knowledge more effectively than either free play or purely didactic instruction in some contexts (Fisher et al., 2013).

Logical thinking in early-childhood education is broader than the recognition of numerals. It involves detecting similarities and differences, ordering objects according to a rule, forming categories, coordinating number with quantity, and using these relations to solve simple problems. Spatial and assembly experiences are relevant because they provide children with observable relations among shape, size, orientation, and quantity; preschool spatial assembly performance has been associated with early mathematics skills (Verdine et al., 2014). Play-based learning progressions further emphasize that mathematical reasoning develops in interaction with the contexts in which children act, communicate, and receive guidance (Cutting & Lowrie, 2023). Consequently, a learning medium intended to strengthen logical thinking should invite repeated manipulation, comparison, explanation, and reorganization of objects rather than only worksheet completion.

The initial classroom condition in the present study showed a clear need for such experiences. In Group B2 at TK Tunas Harapan 1 Ciputat, children experienced difficulty distinguishing closely related sizes, arranging geometric objects in a specified order, classifying objects according to more than one attribute, and coordinating counting with sets of objects. The pre-action mean across the logical-thinking indicators was 40.28%. Classroom observation also indicated that learning activities were relatively teacher-centered and relied heavily on children's worksheets, with limited use of concrete media that required children to investigate relationships directly. This combination of low baseline performance and limited manipulative experience motivated the search for a more interactive classroom intervention.

A growing Indonesian early-childhood literature supports the use of concrete and game-based media for related cognitive outcomes. Puzzle-based activities have been used to develop logical thinking in five- to six-year-olds (Amalia et al., 2024), and Montessori materials have supported observation of logical and symbolic thinking through size comparison, classification, ordering, and pattern tasks (Rahmadhani & Surbakti, 2022). Geometry-carpet activities have also been implemented through classroom action research to strengthen young children's cognitive performance (Asmianti & Hidayah, 2019). Similarly, lotto media have been associated with improved logical-mathematical thinking (Hanifah & Alam, 2019), and colored wooden blocks have been examined as a medium for logical-thinking development in children aged 5-6 years (Gilano et al., 2024).

The relevance of geometric media is particularly strong for tasks that combine visual discrimination with quantitative and relational reasoning. Indonesian research has reported the use of geometry concepts to support mathematical logic (Citrowati, 2019), while more recent work has found gains in preschool cognitive performance after geometry play (Fitriyani et al., 2025). Other media-development studies illustrate how visually engaging, manipulable resources can be designed to embed logical reasoning in meaningful themes (Dewi et al., 2023). These studies collectively support the pedagogical principle that children benefit when they can handle, sort, arrange, and discuss objects rather than only view symbolic representations.

Despite this supportive literature, the interventions reviewed for the present study tend to emphasize particular materials or a narrower subset of skills. BUMIKA Geometry was designed to integrate four recurring logical-thinking processes within one manipulable system. The name BUMIKA abbreviates counting, sequencing, comparing, and classification. The medium combines features of a sorting box and a stacking tower with geometric pieces that vary in shape, color, size, and quantity. Children can therefore compare large and small objects, construct ordered series and patterns, sort by one or more attributes, and count sets within a common play environment. This integration represents the practical novelty of the intervention rather than a claim that any one component is theoretically new.

Accordingly, this study aimed to document how children's logical-thinking performance changed across iterative classroom action-research cycles using BUMIKA Geometry and to identify classroom-process changes that accompanied those gains. The study focused on four observable domains comparing, sequencing, classifying, and counting and used reflection after Cycle I to revise the classroom procedure before Cycle II. The contribution is therefore twofold: empirical documentation of within-class change across the four domains, and a practice-oriented account of how an integrated manipulative medium can be embedded in daily early-childhood teaching. Because the design did not include randomization or a comparison group, the study is framed as evidence of classroom improvement rather than a definitive test of causal effectiveness.

RESEARCH METHOD

The study employed participatory Classroom Action Research (CAR), following the recurring sequence of planning, action, observation, and reflection associated with the Kemmis-McTaggart tradition (Kemmis et al., 2014). CAR was selected because the research problem concerned improvement of an ongoing classroom practice rather than estimation of a population-level treatment effect. The study was conducted in Group B2 at TK Tunas Harapan 1, Ciputat, Tangerang Selatan, Indonesia, during the first semester of the 2025/2026 school year. Preliminary observation took place on 3-4 August 2025, while the action phase was conducted during October 2025. Two action cycles were completed: Cycle I consisted of six meetings and Cycle II of four meetings. Each cycle was planned collaboratively, implemented in the classroom, observed, and then reviewed before the subsequent cycle.

The participants were 12 children aged 5-6 years enrolled in Group B2. The classroom teacher served as a collaborative partner during the action process, while the researcher prepared the learning plans, facilitated the intervention, and conducted observation with the teacher. This article reports only aggregate results to avoid unnecessary disclosure of child-level identifiers.

BUMIKA Geometry is a concrete learning medium developed from the functional principles of a sorting box and a stacking tower. It contains colorful geometric pieces of different forms and sizes and permits tasks that can be varied by rule. In comparing tasks, children identified larger versus smaller pieces and more versus fewer objects. In sequencing tasks, children arranged pieces according to size, color, quantity, or a teacher-specified pattern. Classification required grouping by shape, color, size, or quantity, while counting activities linked spoken number words to visible sets and simple changes in quantity. The

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instructor first modeled the rule, then invited children to manipulate the pieces and explain or demonstrate their choices.

Cycle I established the basic play routine and gave children repeated opportunities to use BUMIKA across the four logical-thinking domains. Reflection showed that children who were waiting for their turn could become distracted and, in some instances, disrupted peers who were using the medium. The Cycle II procedure therefore retained BUMIKA as the core medium but added structured companion tasks for children waiting for a turn, including child worksheets and theme-related drawing or painting. This revision was intended to reduce idle waiting, stabilize attention, and allow the child using BUMIKA to work with fewer distractions.

Logical thinking was assessed through structured classroom observation covering comparing, sequencing, classifying, and counting. The observation rubric used four developmental categories: not yet developed, emerging, developing as expected, and very well developed. The instrument-development appendix reports screening of 20 initial items; two items did not meet the item-validity criterion, leaving 18 retained items. The final retained-item scale showed very high internal consistency (Cronbach's alpha = .987). Observation data were supported by classroom field notes, interview information from the classroom teacher, and documentation of the learning activities. Triangulating these sources enabled the quantitative pattern to be interpreted alongside changes in engagement, independence, and classroom behavior.

Quantitative analysis was descriptive. For each stage, scores were converted to percentages and summarized using class averages. Because the number and structure of observations differed across stages, interpretation focused on percentage scores rather than raw totals. Change was calculated in percentage points from pre-action to Cycle I, from Cycle I to Cycle II, and across the full action sequence. Qualitative records were condensed according to the research focus, organized around the four logical-thinking domains and classroom-process observations, and interpreted during reflection. The method section of the underlying study specified an action-completion benchmark of 71%; Cycle II was terminated after the overall class mean exceeded that benchmark and the classroom process was judged sufficiently stable for the purposes of the CAR cycle.

RESULT AND DISCUSSION

A. Results

1. Baseline Logical-Thinking Profile

Before the intervention, the overall mean logical-thinking score was 40.28%, indicating that the class had substantial room for development across the targeted indicators. The comparing domain averaged 40.63%, and the counting domain averaged 42.19%. Classroom records showed that children often confused similar sizes, had difficulty maintaining a specified order when several pieces were involved, and sometimes grouped objects inconsistently when more than one attribute was relevant. Counting was more successful when children touched objects one by one but became less reliable when the quantity changed or when children had to retain the result mentally. These observations supported the decision to introduce a concrete medium that made size, order, category, and quantity simultaneously visible.

2. Cycle I: Initial Improvement and Reflection

After six Cycle I meetings, the overall class mean increased to 51.37%, representing an 11.09-percentage-point improvement from the pre-action stage. Domain averages were 50.30% for comparing, 52.08% for sequencing, 51.39% for classifying, and 52.60% for counting. Children increasingly understood how the geometric pieces could be compared, arranged, grouped, and counted, but many still required demonstrations or prompts. The most persistent difficulties involved sustaining attention through multistep instructions and applying a rule independently when several attributes were present.

Qualitative reflection identified a procedural issue that was not captured by the score alone. Because BUMIKA was used in turns, children waiting to participate could lose focus, talk with nearby peers, or attempt to join the activity before their turn. This sometimes distracted the child currently completing a BUMIKA task. Consequently, the research team revised the second cycle by providing meaningful companion work during waiting periods. The objective was not to replace the manipulative activity, but to improve the conditions under which it was used.

3. Cycle II: Consolidation of Logical-Thinking Performance

Following four additional meetings in Cycle II, the overall mean reached 76.91%. The domain means were 78.40% for comparing, 78.65% for sequencing, 74.91% for classifying, and 76.82% for counting. The strongest class-level outcomes were therefore observed in comparing and sequencing, although all four domains showed substantially higher performance than in Cycle I. At the child level, overall Cycle II percentages ranged from 73.26% to 82.29%, so every child's composite score was above the 71% benchmark used in the method section.

Observation notes also documented qualitative changes. Children were increasingly able to select appropriate pieces, follow the requested rule, and complete BUMIKA tasks with less direct assistance. Waiting children were more consistently occupied by the companion activity, which made the classroom more orderly and reduced interruptions. The improvement in Cycle II therefore coincided with both repeated exposure to the logical-thinking tasks and a more supportive classroom-management arrangement.

4. Cross-Cycle Change

Table 1. Overall logical-thinking progression across action-research stages

Stage	Meetings	Mean (%)	Change from previous stage (pp)
Pre-action	Baseline observation	40.28	—
Cycle I	6	51.37	+11.09
Cycle II	4	76.91	+25.54

Across the full action sequence, the class mean rose by 36.63 percentage points. The larger increment occurred between Cycle I and Cycle II (+25.54 points), after the classroom routine was revised and children had additional guided practice. The pattern is descriptive and should not be interpreted as an isolated treatment effect because the CAR design combines the medium, repeated practice, teacher scaffolding, and cycle-specific procedural improvement.

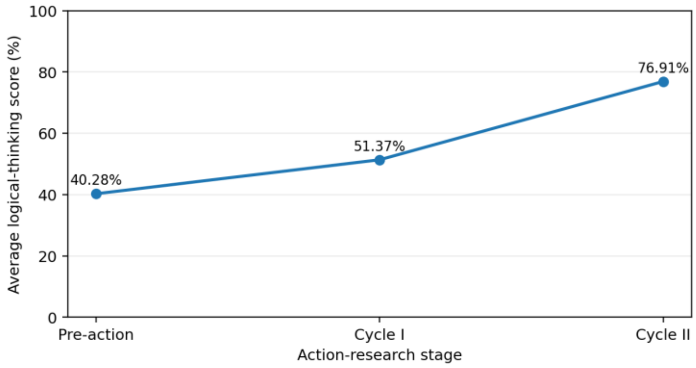

Figure 1. Mean logical-thinking percentage from pre-action through Cycle II.

Table 2. Logical-thinking domain averages in Cycles I and II

Domain	Cycle I (%)	Cycle II (%)	Change (pp)
Comparing	50.30	78.40	+28.10
Sequencing	52.08	78.65	+26.57
Classifying	51.39	74.91	+23.52
Counting	52.60	76.82	+24.22

B. Discussion

The findings show a consistent within-class rise in logical-thinking performance across the action-research sequence. The increase from 40.28% before intervention to 76.91% in Cycle II occurred across the four targeted domains rather than in a single skill. This pattern is theoretically plausible because BUMIKA does not treat comparing, sequencing, classifying, and counting as isolated worksheet items; instead, children manipulate visible objects whose attributes can be reorganized according to different rules. Concrete manipulation can reduce the distance between an abstract relation and the child's immediate action, provided that the adult explicitly connects the material to the mathematical idea (Carbonneau et al., 2013).

The results are also consistent with research on guided play and early geometry. Fisher et al. (2013) found that scaffolded playful exploration can support shape knowledge, and Skene et al. (2022) reported meta-analytic evidence favoring guided play for some early mathematics and spatial outcomes. BUMIKA shares several features with guided play: the teacher specifies a goal or rule, children retain agency in handling the material, feedback is immediate because pieces can be visibly compared or sorted, and discussion accompanies action. These features likely supported repeated sense-making rather than simple answer production.

The Indonesian studies used to contextualize this research point in the same direction. Puzzle activities have been linked to logical-thinking development (Amalia et al., 2024); Montessori materials allow children to work with size, classification, ordering, and symbolic relations (Rahmadhani & Surbakti, 2022); geometry-carpet media have been used successfully within a classroom action framework (Asmianti & Hidayah, 2019); and both lotto and colored wooden blocks have produced gains in logical-mathematical performance in early-childhood samples (Hanifah & Alam, 2019; Gilano et al., 2024). The present study extends this practice-oriented evidence by integrating four logical processes into a single medium and tracing improvement through iterative classroom reflection.

The relatively strong Cycle II outcomes for comparing and sequencing are noteworthy. Both skills are highly compatible with the physical affordances of geometric

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pieces: a child can place objects side by side to inspect size, then arrange them in a visible series. Spatial assembly and relational manipulation have broader links with early mathematics (Verdine et al., 2014), while geometry-based classroom activities can provide a natural context for distinguishing attributes and articulating rules (Citrowati, 2019; Fitriyani et al., 2025). The slightly lower classifying mean in Cycle II may reflect the greater cognitive demand of coordinating categories when several attributes are present, although the present design was not intended to test domain difficulty formally.

The marked improvement from Cycle I to Cycle II should not be attributed to the physical medium alone. The second cycle introduced a classroom-management change for children waiting to use BUMIKA. Providing a meaningful companion activity reduced idle time and distraction, allowing the active child to work more continuously and the teacher to distribute support more deliberately. This is a substantive CAR finding: the success of a manipulative resource depends on the learning ecology around it, including turn-taking, attention, pacing, and teacher scaffolding. In that sense, the intervention functioned as a combined material-and-routine system.

The developmental significance of the four domains also supports continued classroom attention. Preschool number and quantity knowledge develops in identifiable trajectories (Litkowski et al., 2020), and longitudinal evidence links early mathematical abilities with later arithmetic performance (Akhavein et al., 2023). Number-board research further illustrates that structured games can produce broad improvements in young children's numerical knowledge (Ramani & Siegler, 2008). BUMIKA should therefore be understood not as an endpoint but as one concrete environment for giving children repeated opportunities to reason about relations that later become increasingly symbolic.

Several limitations constrain interpretation. The sample comprised only 12 children from one classroom, and there was no comparison group, random assignment, or blinded assessment. Repeated exposure, maturation, teacher prompting, the Cycle II companion tasks, and increased familiarity with the assessment format may all have contributed to the observed gains. The study also lasted only two cycles, so persistence and transfer were not tested. Practical limitations reported during implementation included wear of the physical pieces, high enthusiasm that sometimes created competition for turns, variable session duration, and a reflection process centered on the classroom researcher and teacher rather than an independent academic observer.

Future research can strengthen the evidence base by testing BUMIKA across multiple schools with larger samples and a quasi-experimental or randomized comparison design. Follow-up measurement would help determine whether gains persist and transfer to unfamiliar materials. Process measures could separately quantify time-on-task, teacher prompts, peer interaction, and treatment fidelity. Finally, the logical-thinking instrument should be revalidated in a broader sample to examine dimensional structure as well as reliability. These steps would allow the current classroom-improvement evidence to develop into a stronger estimate of generalizable intervention effects.

CONCLUSION

This classroom action research documented a substantial improvement in the logical-thinking performance of 12 children aged 5–6 years after BUMIKA Geometry was integrated into classroom learning. The class mean increased from 40.28% at pre-action to 51.37% in Cycle I and 76.91% in Cycle II, with Cycle II performance reaching 78.40% in comparing, 78.65% in sequencing, 74.91% in classifying, and 76.82% in counting. The improvement was accompanied by greater independence and participation during concrete tasks. Reflection after Cycle I also showed that the organization of turn-taking mattered: structured companion activities for waiting children made the second-cycle learning environment more orderly and reduced distraction. The study therefore contributes a practical model in which one manipulative geometry medium integrates four logical-thinking processes while remaining compatible with play-oriented early-childhood pedagogy. At the same time, the design supports conclusions about improvement in this classroom, not causal effectiveness across settings. Larger multisite studies with comparison groups, follow-up assessment, and independent fidelity measurement are needed to establish whether the observed gains can be replicated and maintained. For practice, BUMIKA is most appropriately viewed as a structured opportunity for children to handle, compare, reorder, classify, count, explain, and revise their reasoning in an interactive learning environment.

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REFERENCES

Akhavein, K., Clark, C. A. C., Nelson, J. M., Espy, K. A., & Finch, J. E. (2023). The longitudinal contributions of preschool executive functions and early math abilities to arithmetic skills in elementary school. *Cognitive Development*, 68, 101388. https://doi.org/10.1016/j.cogdev.2023.101388

Amalia, D., Alwi, B. M., & Angriani, A. D. (2024). Analisis penggunaan media puzzle terhadap perkembangan berpikir logis anak usia 5–6 tahun. *NANAEKE: Indonesian Journal of Early Childhood Education,* 7(2), 170–181. https://doi.org/10.24252/nananeke.v7i2.41384

Asmianti, N., & Hidayah, A. N. (2019). Meningkatkan kemampuan kognitif anak melalui media karpet geometri. *Jurnal Riset Golden Age PAUD UHO*, 2(2), 167–176. https://doi.org/10.36709/jrga.v2i2.8367

Carbonneau, K. J., Marley, S. C., & Selig, J. P. (2013). A meta-analysis of the efficacy of teaching mathematics with concrete manipulatives. *Journal of Educational Psychology*, 105(2), 380–400. https://doi.org/10.1037/a0031084

Citrowati, E. (2019). Penerapan konsep geometri dalam mengembangkan logika matematika di TK Melati Kabupaten Pasaman Barat tahun 2018. *Menara Ilmu,* 13(4). https://doi.org/10.33559/mi.v13i4.1305

Clements, D. H., & Sarama, J. (2008). Experimental evaluation of the effects of a research-based preschool mathematics curriculum. *American Educational Research Journal*, 45(2), 443–494. https://doi.org/10.3102/0002831207312908

Cutting, C., & Lowrie, T. (2023). Bounded learning progressions: A framework to capture young children's development of mathematical activity in play-based contexts. *Mathematics Education Research Journal*, 35, 317–337. https://doi.org/10.1007/s13394-022-00424-y

Dewi, M. P., Adhe, K. R., Maulidiyah, E. C., & Simatupang, N. D. (2023). Pengembangan media pop up book mitigasi bencana banjir terhadap kemampuan berfikir logis anak usia 5–6 tahun. *Lencana: Jurnal Inovasi Ilmu Pendidikan*, 1(2), 121–144. https://doi.org/10.55606/lencana.v1i2.1462

Dista, F. N. (2019). Penerapan pendekatan saintifik dalam mengembangkan berpikir logis anak usia 5–6 tahun di RA Takrimah Tungkop Aceh Besar. *Al-Athfal: Jurnal Pendidikan Anak,* 5(2), 217–236. https://doi.org/10.14421/al-athfal.2019.52-07

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

Fitriyani, L. F., Palenewen, E., & Satriana, M. (2025). Pengaruh bermain geometri untuk meningkatkan kemampuan kognitif anak usia 5–6 tahun. *Aulad: Journal on Early Childhood,* 8(1), 464–472. https://doi.org/10.31004/aulad.v8i1.1019

Gilano, F. S., Ningsih, S., Sodik, N. A. M., & Sumirat, E. M. (2024). Pengaruh permainan colored wooden blocks terhadap kemampuan berpikir logis anak usia 5–6 tahun. *Ceria: Jurnal Program Studi Pendidikan Anak Usia Dini,* 13(3), 335–353. https://doi.org/10.31000/ceria.v13i3.12425

Hanifah, M., & Alam, S. K. (2019). Pengaruh kemampuan berpikir logis matematis pada anak usia dini dengan menggunakan media pembelajaran lotto di kelompok B. *CERIA (Cerdas Energik Responsif Inovatif Adaptif),* 2(6), 302–308. https://doi.org/10.22460/ceria.v2i6.p302-308

Kemmis, S., McTaggart, R., & Nixon, R. (2014). The action research planner: Doing critical participatory action research. *Springer*. https://doi.org/10.1007/978-981-4560-67-2

Litkowski, E. C., Duncan, R. J., Logan, J. A. R., & Purpura, D. J. (2020). When do preschoolers learn specific mathematics skills? Mapping the development of early numeracy knowledge. *Journal of Experimental Child Psychology*, 195, 104846. https://doi.org/10.1016/j.jecp.2020.104846

Rahmadhani, E., & Surbakti, A. H. (2022). Analisis kemampuan berpikir logis anak usia dini melalui permainan Montessori. *Jurnal Obsesi: Jurnal Pendidikan Anak Usia Dini*, 6(5), 5079–5090. https://doi.org/10.31004/obsesi.v6i5.1894

Ramani, G. B., & Siegler, R. S. (2008). Promoting broad and stable improvements in low-income children's numerical knowledge through playing number board games. *Child Development,* 79(2), 375–394. https://doi.org/10.1111/j.1467-8624.2007.01131.x

Skene, K., O'Farrelly, C. M., Byrne, E. M., Kirby, N., Stevens, E. C., & Ramchandani, P. G. (2022). Can guidance during play enhance children's learning and development in educational contexts? A systematic review and meta-analysis. *Child Development*, 93(4), 1162–1180. https://doi.org/10.1111/cdev.13730

Verdine, B. N., Golinkoff, R. M., Hirsh-Pasek, K., Newcombe, N. S., Filipowicz, A. T., & Chang, A. (2014). Deconstructing building blocks: Preschoolers' spatial assembly performance relates to early mathematical skills. *Child Development*, 85(3), 1062–1076. https://doi.org/10.1111/cdev.12165