JOURNAL ON MATHEMATICS EDUCATION RESEARCH (J-MER)
Universitas Pendidikan Indonesia | e-ISSN 3047-1095 | ejournal-science.upi.edu/jmer

RESEARCH ARTICLE | Vol. 7, No. 2 (2026) | pp. 353-364

The Contribution of Teacher Instructional Management to Early Numeracy Achievement in 5-6-Year-Old Children

Muhamad Yusup Kurniansyah[1]* · Nabila Rafaeni[1] · Amelia Putri Kartika[1]

[1]Institut Darul Falah Bandung Barat, Indonesia
* Corresponding author: yusupkurniansyah@gmail.com

ABSTRACT

Teacher instructional management plays a vital role in fostering cognitive development and foundational mathematical competence during early childhood. This study examined the empirical contribution of teacher instructional management to children's early numeracy achievement in early childhood education (ECE) centers across West Bandung Regency. Employing a quantitative ex post facto correlational design, data were collected from 25 ECE teachers and 60 Group B children (aged 5–6 years) across 25 classrooms. To resolve the non-independence of nested data, individual child scores were aggregated to N = 25 classroom-level units. Teacher instructional management was measured using a validated 20-item Likert questionnaire. At the same time, children's early numeracy skills were evaluated using a Developmentally Appropriate Practice (DAP)-aligned observation sheet featuring concrete manipulatives and strong inter-rater agreement. Descriptive findings indicated that overall teacher instructional management fell into the "Good" category (M = 4.12, SD = 0.32), with instructional implementation achieving the highest mean (M = 4.28) and evaluation recording the lowest (M = 3.98). Children's numeracy performance reached the "Developing as Expected" stage (M = 3.08, SD = 0.39), with number recognition scoring highest (M = 3.25) and pattern recognition scoring lowest (M = 2.80). Simple linear regression analysis revealed that teacher instructional management significantly predicts early numeracy achievement ($\beta = .678$, $F(1, 23) = 19.59$, $p < .001$), explaining 46.0% of the variance ($R2 = .460$, $f2 = 0.852$). These results underscore that structured classroom management creates an essential pedagogical foundation for early mathematical learning. Early childhood educators are encouraged to strengthen reflective assessment logging and integrate concrete manipulatives to support complex numeracy skills such as patterning.

Keywords: instructional management; early numeracy; children aged 5–6 years; early childhood education

ARTICLE INFORMATION	Received	Revised	Accepted	Published
	Sep 24, 2026 ·	Nov 13, 2026	Nov 21, 2026	Nov 26, 2026
DOI	https://doi.org/10.17509/j-mer.v7i2.1480			

HOW TO CITE

Kurniansyah, M. Y., Rafaeni, N., & Kartika, A. P. (2026). The Contribution of Teacher Instructional Management to Early Numeracy Achievement in 5-6-Year-Old Children. *Journal on Mathematics Education Research*, *7*(2), 353–364. https://doi.org/10.17509/j-mer.v7i2.1480

OPEN ACCESS & COPYRIGHT

© 2026 Kurniansyah et al. Distributed under CC BY-SA 4.0
Reuse requires attribution and ShareAlike; authors retain copyright.

INTRODUCTION

Early numeracy skills serve as a crucial cognitive foundation during early childhood, laying the groundwork for formal mathematical learning and long-term academic success (Clements & Sarama, 2020). In early childhood education (ECE), early numeracy extends beyond rote counting, encompassing children's intuitive ability to reason logistically, discern spatial and quantitative relationships, and solve everyday problems (Kurniansyah et al., 2026; Suryana, 2021). Research demonstrates that young children who develop strong foundational math competencies such as number recognition, classification, seriation, quantity comparison, and patterning exhibit smoother educational transitions and higher academic trajectories (Sarama & Clements, 2019). Consequently, fostering early mathematical thinking prior to primary school requires structured pedagogical frameworks tailored specifically to the developmental characteristics of young learners.

In ECE classroom settings, the effectiveness of early numeracy stimulation depends heavily on teachers' instructional management, which encompasses systematic planning, play-based execution, and reflective evaluation (Ratnawati, 2021; Safitri et al., 2020). While previous studies have examined mathematical development in primary education (Dasan, 2025) or highlighted the influence of the home learning environment and parental involvement (Filtri, 2023), early childhood classrooms present unique pedagogical demands that necessitate specialized teacher-led instructional practices. Effective ECE instructional management involves translating curricular objectives into interactive, play-based learning experiences (meaningful play) and providing scaffolding through manipulative media (Filtri, 2023; Rahayu, 2025). Thus, instructional management functions as a vital mechanism through which pedagogical intentions are operationalized into impactful classroom practices.

Despite growing recognition of early math education, existing empirical literature reveals notable conceptual and methodological gaps regarding the direct contribution of holistic teacher instructional management to early numeracy attainment. Prior studies have predominantly evaluated isolated learning media (Fidesrinur et al., 2025; Rahayu, 2025) or relied on qualitative descriptive accounts of teacher roles (Filtri, 2023), without quantifying how instructional management across its planning, implementation, and evaluation phases collectively influences multi-dimensional numeracy outcomes. This study addresses these empirical gaps by moving beyond geographical considerations to evaluate teacher instructional management as a comprehensive construct and measuring its quantitative contribution to five core early numeracy indicators in an ex post facto framework.

To address these empirical gaps, this study investigates the contribution of teacher instructional management to early numeracy skills among children aged 5–6 years in West Bandung Regency. Specifically, this research aims to answer the following objectives: (1) to evaluate the profile of teacher instructional management across planning, implementation, and evaluation dimensions; (2) to describe children's achievement across five early numeracy indicators (number recognition, classification, seriation, quantity comparison, and patterning); and (3) to measure the magnitude of contribution of teacher instructional management to children's early numeracy skills. The findings of this study are expected to provide empirical evidence supporting the enhancement of ECE teachers' managerial and pedagogical competencies.

© 2026 Kurniansyah et al · CC BY-SA 4.0

METHOD

Research Design and Setting

This study adopted a quantitative ex post facto correlational design to examine the non-causal association and empirical contribution of teacher instructional management to early numeracy skills without direct experimental manipulation (Privitera, 2022). The ex post facto design was selected because instructional management practices occur naturally within authentic ECE classroom settings and cannot be ethically or practically manipulated. The study was conducted across 5 Early Childhood Education (ECE) centers in West Bandung Regency, West Java, Indonesia, during the Even Semester of the 2025/2026 Academic Year.

Participants, Instruments, and Procedures

Participants were selected using a purposive sampling technique based on explicit inclusion criteria: (1) ECE centers implementing structured early math stimulation activities, (2) teachers holding a Bachelor's degree in ECE or Education with a minimum of two years of teaching experience in Group B, and (3) children aged 5–6 years (Group B) regularly attending ECE programs. The final sample comprised 25 ECE teachers and 60 Group B children distributed across 25 classrooms in 5 ECE centers. Selecting 5-6-year-old children is theoretically justified as this developmental stage represents a critical trajectory window for building early mathematical foundations prior to primary school transition (Rittle-Johnson et al., 2019; Wijns et al., 2019).

To address the non-independence of observations resulting from 60 children being nested within 25 teacher classrooms, children's numeracy performance scores were aggregated at the classroom level by calculating the mean score per teacher/class. Consequently, N = 25 class-level units were utilized in the regression model to ensure statistical independence of observations and prevent Type I error inflation.

Two primary instruments were deployed:

1. Teacher Instructional Management Questionnaire (Variable X): A 20-item self-report questionnaire measuring Planning (6 items), Implementation (8 items), and Evaluation (6 items), grounded in the instructional frameworks of Ratnawati (2021) and Safitri et al., (2020). Items were scored on a 5-point Likert scale ranging from 1 (Strongly Disagree) to 5 (Strongly Agree). Potential social desirability bias inherent to self-report instruments was acknowledged and mitigated by guaranteeing complete anonymity and cross-verifying self-reports with classroom observations.

Table 1. Blueprint and Questionnaire Items of Teacher Instructional Management

Variable	Indicator	Sub-Indicator	Item No.	Questionnaire Statement
Teacher Instructional Management	Instructional Planning	Formulating learning objectives	1	I formulate numeracy learning objectives before the activity begins.
			2	I set learning objectives that align with children's developmental stages.
		Preparing learning media	3	I prepare numeracy learning media prior to the activity.
			4	I select learning media that are relevant and safe for children.
			5	I structure the sequence of learning activities systematically.

© 2026 Kurniansyah et al · CC BY-SA 4.0

Variable	Indicator	Sub-Indicator	Item No.	Questionnaire Statement
		Designing learning activities	6	I design learning activities according to early childhood characteristics.
	Instructional Implementation	Opening the lesson	7	I open the lesson with engaging warm-up activities to spark children's interest.
			8	I convey an overview of learning activities using language that is easily understood by children.
		Managing core activities	9	I carry out core numeracy learning activities according to the planned design.
			10	I manage learning time allocation proportionally and efficiently.
		Utilizing media	11	I optimize the use of learning media throughout the teaching and learning process.
			12	I utilize concrete/interactive media to help children comprehend numeracy concepts.
		Interacting with children	13	I build positive communication and interaction with children during learning activities.
			14	I provide opportunities for children to explore and ask questions.
	Instructional Evaluation	Conducting assessment	15	I conduct formative assessment while learning activities are in progress.
			16	I measure children's achievement based on established numeracy developmental indicators.
		Recording child development	17	I regularly record children's numeracy development on assessment sheets.
			18	I utilize developmental records as a basis for evaluating instruction.
		Follow-up on learning results	19	I provide feedback and scaffolding according to children's needs.
			20	I use evaluation results to plan subsequent instructional improvements.

2. Child Early Numeracy Performance Observation Sheet (Variable Y): An observational rubric assessing five core indicators number recognition, grouping, ordering, comparing, and pattern recognition grounded in early math learning trajectories (Clements & Sarama, 2020; Misrawati & Suryana, 2021). Children's performance was evaluated on a 4-point scale: 1 = Not Yet Developed (BB), 2 = Starting to Develop (MB), 3 = Developing as Expected (BSH), and 4 = Very Well Developed (BSB). Mean scores were categorized using interval criteria: 1.00–1.74 (BB), 1.75–2.49 (MB), 2.50–3.24 (BSH), and 3.25–4.00 (BSB).

© 2026 Kurniansyah et al · CC BY-SA 4.0

Table 2. Blueprint and Observation Descriptors of Children's Early Numeracy Skills

No.	Numeracy Indicator	Sub-Indicator	Observable Behavioral Descriptors
1	Number Recognition	Symbol & Quantity Recognition	Children are able to identify and match number symbols 1–10 with the corresponding quantity of objects.
2	Grouping	Object Classification	Children are able to accurately group manipulative objects based on similarities in type, color, or shape.
3	Ordering	Seriation	Children are able to logically arrange/order objects based on size progression (smallest–largest) or quantity.
4	Comparing	Quantity Comparison	Children are able to compare and state sets of objects that are "more", "fewer", or "equal to".
5	Pattern Recognition	Pattern Reasoning	Children are able to recognize, copy, and extend simple repeating pattern sequences (e.g., AB-AB or ABC-ABC color patterns).

Rationale for Instrument Appropriateness: The selection of a structured observation sheet over formal written tests is grounded in Developmentally Appropriate Practice (DAP) for early childhood education (Koenarso, 2023; Levy & Wasmuth, 2025). Children aged 5–6 years have emerging literacy and fine-motor writing capabilities; hence, standardized paper-and-pencil assessments are developmentally inappropriate, induce testing anxiety, and fail to capture authentic cognitive capabilities. Structured observation of performance tasks (unjuk kerja) using concrete mathematical manipulators represents the gold standard for assessing early numeracy skills (Clements & Sarama, 2020; Suryana, 2021). This technique allows observers to evaluate children's live mathematical reasoning and object manipulation in naturalistic play contexts. Standardized behavioral descriptors (Table 2) scored on a 4-point rubric by two independent trained observers guaranteed measurement objectivity and high inter-rater agreement.

Data Analysis

Data were analyzed using SPSS software. Descriptive statistics (means, standard deviations, percentage intervals) were computed to describe variable profiles. Prior to hypothesis testing, parametric assumptions were examined: normality was evaluated via the Kolmogorov-Smirnov test ($p > .05$), and homogeneity of variance was tested using Levene's test ($p > .05$). Simple linear regression analysis ($Y = a + bX$) was performed on the aggregated classroom units ($N = 25$) to test the empirical contribution of teacher instructional management to children's early numeracy achievement ($R2$ and F-test, $p < .001$). Missing or incomplete data were managed through listwise deletion prior to analysis.

RESULTS

Based on data collection conducted across several Early Childhood Education (ECE) institutions in West Bandung Regency, an empirical overview of teacher instructional management and children's early numeracy skills was obtained. The collected data were analyzed sequentially using descriptive and inferential statistical techniques.

© 2026 Kurniansyah et al · CC BY-SA 4.0

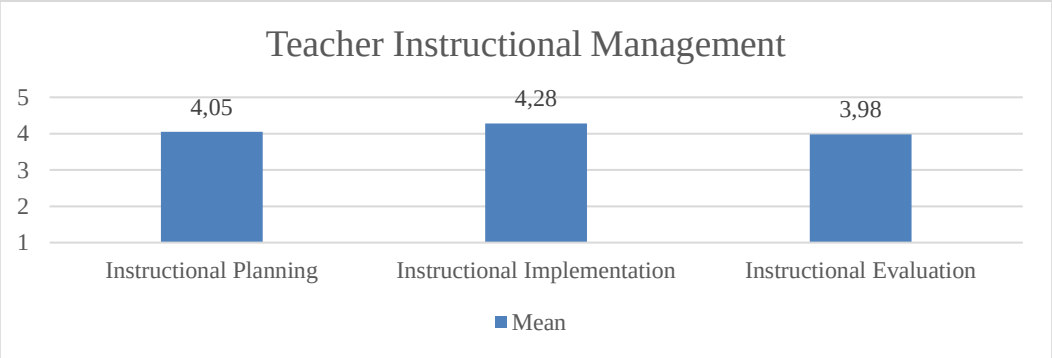

Figure 1. Average Scores of Teachers Instructional Management

Figure 1 illustrates the distribution of average scores across the three dimensions of teacher instructional management using the full-scale range (1.00–5.00). The bar chart visually highlights that instructional implementation achieved the highest mean score, whereas instructional evaluation recorded the lowest relative average among the three dimensions.

Table 3. Descriptive Analysis Results of Teacher Instructional Management

No	Indicator	Mean	Standard Deviation	Category
1	Instructional Planning	4.05	0.35	Good
2	Instructional Implementation	4.28	0.30	Very Good
3	Instructional Evaluation	3.98	0.40	Good
Overall	**Teacher Instructional Management**	**4.12**	**0.32**	**Good**

As presented in **Table 3**, overall teacher instructional management fell within the "Good" category, with an aggregate mean score of 4.12. Instructional implementation obtained the highest rating (M = 4.28, SD = 0.30), reflecting teachers' strong execution in conducting interactive core activities and using manipulative learning media. Instructional planning recorded a mean of 4.05 (SD = 0.35). Instructional evaluation yielded the lowest average (M = 3.98, SD = 0.40), indicating greater score variability and suggesting that systematic assessment logging and reflective follow-up remain areas for improvement.

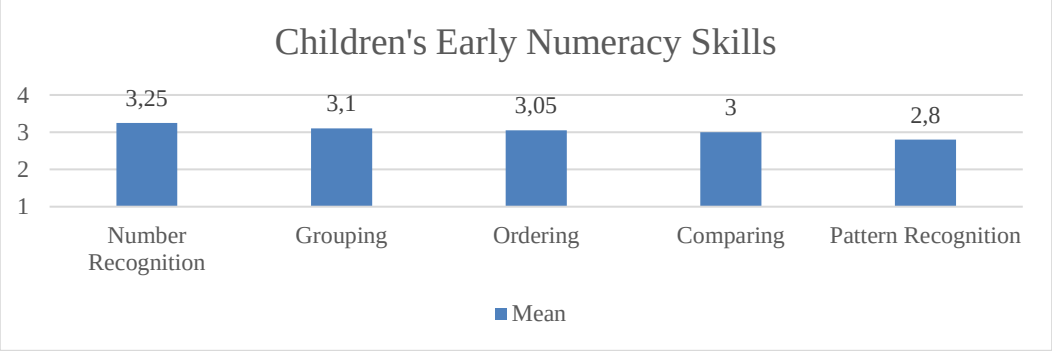

Figure 2. Average Scores of Children's Early Numeracy Skills

Figure 2 depicts the profile of early numeracy performance across the five evaluated indicators on a 1.00–4.00 observation scale. The chart shows a progressive gradient where basic numerical identification scores are highest, whereas abstract pattern reasoning scores are noticeably lower.

© 2026 Kurniansyah et al · CC BY-SA 4.0

Table 4. Descriptive Analysis Results of Children's Early Numeracy Skills

No	Indicator	Mean	Standard Deviation	Category
1	Number Recognition	3.25	0.45	Developing as Expected (BSH)
2	Grouping	3.10	0.42	Developing as Expected (BSH)
3	Ordering	3.05	0.40	Developing as Expected (BSH)
4	Comparing	3.00	0.38	Developing as Expected (BSH)
5	Pattern Recognition	2.80	0.47	Developing as Expected (BSH)
Overall	**Early Numeracy Skills**	**3.08**	**0.39**	**Developing as Expected (BSH)**

Table 4 details the performance across all five early numeracy indicators. Overall early numeracy achievement reached a mean score of 3.08 (SD = 0.39), placing children in the "Developing as Expected" (BSH) category. The highest achievement was observed in number recognition (M = 3.25, SD = 0.45), confirming that most children reliably matched number symbols with object quantities. Object grouping (M = 3.10, SD = 0.42), ordering (M = 3.05, SD = 0.40), and quantity comparison (M = 3.00, SD = 0.38) all maintained steady " Developing as Expected " performance. In contrast, pattern recognition recorded the lowest mean score (M = 2.80, SD = 0.47), highlighting that abstract sequence continuation represents the most challenging task for children at this age.

Table 5. Normality Test Results

	Kolmogorov-Smirnov[a]		
	Statistic	**df**	**Sig.**
Teacher Instructional Management	.155	25	.200
Early Numeracy Skills	.186	60	.200

Prior to hypothesis testing, prerequisite analysis tests were conducted to ensure data suitability specifically, a normality test, as shown in **Table 5**. The normality test, performed using the Kolmogorov-Smirnov technique, yielded a significance value of p = 0.200 for both the teacher instructional management variable (N = 25) and the early numeracy skills variable (N = 60). Since the p-value is greater than 0.05, both variables are considered to be normally distributed.

Table 6. Linearity Test Results

			Sum of Squares	**df**	**Mean Square**	**F**	**Sig.**
Teacher Instructional Management * Early Numeracy Skills	Between Groups	(Combined)	72.400	8	9.050	3.620	.014
		Linearity	52.800	1	52.800	21.120	< .001
		Deviation from Linearity	19.600	7	2.000	1.120	.398
	Within Groups		40.000	16	1.120		
	Total		112.400	24			

Based on **Table 6**, A linearity prerequisite test was performed to verify that the relationship between teacher instructional management (X) and children's early numeracy achievement (Y) is linear, thereby satisfying the primary assumption for simple linear regression analysis. The ANOVA Test for Linearity evaluated at the classroom unit of analysis (N = 25) yielded an F-statistic for the linearity component of F(1, 16) = 21.120 with a significance value of p < .001, confirming a statistically significant linear trend between the quality of teacher instructional management and children's early numeracy outcomes. Crucially, the test for deviation from linearity yielded F(7, 16) = 1.120 with a significance value of p = .398 (p > .05). Because the p-value for deviation from linearity exceeds the standard .05 alpha threshold, it confirms that there is no significant departure from a straight-line relationship.

© 2026 Kurniansyah et al · CC BY-SA 4.0

To quantify the empirical contribution of teacher instructional management (X) to children's early numeracy achievement (Y), a simple linear regression analysis was conducted on the aggregated classroom dataset (N = 25). Both variables were analyzed using mean scores matching their respective instrument scales (1.00–5.00 for teacher instructional management and 1.00–4.00 for children's early numeracy achievement).

Table 7. Simple Linear Regression Test Results

Variable	Unstandardized Coefficient (B)	Standard Error (E)	Standardized Coefficient (β)	t-statistic	p-value (Sig.)
(Constant)	.28	.63	-	.44	0,002
Teacher Instructional Management (X)	.68	.15	.678	4.43	0,000

As presented in **Table 7**, teacher instructional management significantly predicts children's early numeracy achievement (β = .678, t = 4.43, p < .001). The ANOVA model test confirms overall regression significance, F (1, 23) = 19.59, p < .001. The unstandardized regression equation based on mean scores is formulated as follows:

$$Y = 0.28 + 0.68X$$

The positive slope coefficient (B = 0.68) indicates that for every 1.00-unit increase in the mean score of teacher instructional management, children's early numeracy achievement increases by 0.68 units on the 4-point observation scale. Substituting the overall teacher management sample mean (X = 4.12) into the model yields an estimated early numeracy mean score of Y = 3.08, which perfectly aligns with the empirically observed child achievement baseline reported in **Table 4**.

Table 8. Model Summary and Coefficient of Determination (R^2)

Model	Correlation (R)	R Square (R^2)	Adjusted R^2	Std. Error of the Estimate	Effect Size Category (Cohen, 1988)
X → Y	.678	0,460	.437	.15	Substantial/Moderate-to-Large

As detailed in **Table 8**, the correlation coefficient between variables was R = .678, reflecting a strong positive relationship. The coefficient of determination was R2 = .460 (Adjusted R2 = .437), demonstrating that teacher instructional management contributes 46.0% to the variance in early childhood numeracy achievement. According to established statistical criteria by (Poth, 2023) and (Hair et al., 2021), an R2 value of .460 represents a substantial contribution (large effect size, f2 = 0.852) in behavioral and educational research. The remaining 54.0% of the variance is influenced by unmeasured external factors outside the scope of this study, such as parental involvement and the home learning environment.

DISCUSSION

The empirical findings of this study demonstrate that teacher instructional management in West Bandung Regency falls into the good category (M = 4.12) and contributes significantly to early childhood numeracy achievement (R2 = .460, p < .001). These results corroborate the theoretical framework that structured, high-quality instructional governance in early childhood education (ECE) serves as a critical driver of cognitive and foundational mathematical development (Clements & Sarama, 2020; Sarama & Clements, 2019). Rather than implying direct causality, the findings suggest that well-organized classroom management characterized by systematic planning, play-based execution, and

 © 2026 Kurniansyah et al · CC BY-SA 4.0

reflective evaluation creates a supportive learning environment that optimizes children's early mathematical capabilities (Fidesrinur et al., 2025; Kurniansyah et al., 2026; Safitri et al., 2020).

In deeper detail, the instructional implementation dimension achieved the highest rating (M = 4.28, SD = 0.30), whereas instructional evaluation recorded the lowest relative mean (M = 3.98, SD = 0.40). This disparity indicates that while ECE teachers exhibit proficient pedagogical skills in facilitating interactive core activities and integrating concrete learning media(Rahayu, 2025; Ratnawati, 2021; Safitri et al., 2020), systematic logging of assessment data and reflective follow-up remain less consistently executed due to lingering gaps in teacher managerial competency (Hakim & Rostini, 2026; Kurniansyah et al., 2026). Correspondingly, children's early numeracy performance reached the "Developing as Expected" (BSH) stage (M = 3.08). Number recognition emerged as the highest-performing indicator (M = 3.25), whereas pattern recognition recorded the lowest achievement (M = 2.80). Patterning requires higher-order cognitive abstraction, spatial reasoning, and working memory beyond basic numerical symbol identification (Lüken & Sauzet, 2021; Rittle-Johnson et al., 2019; Suryana, 2021). This finding reinforces the perspective of Nugraha & Muntazhimah (2024) and Fidesrinur et al. (2025), emphasizing that abstract concepts such as pattern reasoning necessitate continuous hands-on exploration through contextual concrete manipulators, rather than passive worksheet-based instruction.

The linear regression model revealed that teacher instructional management accounts for 46.0% of the variance in children's early numeracy achievement (R2 = .460). An explained variance of 46% represents a substantial effect size (f2 = 0.852) in educational and behavioral research (Hair et al., 2021; Privitera, 2022). While this proportion is notably high for a model linking teacher self-reports to student observational outcomes, several methodological and context-specific factors account for this magnitude. First, aggregating individual child scores to the classroom level (N = 25) effectively minimized child-level measurement noise, thereby accentuating classroom-level instructional effects (Koo et al., 2021). Second, in early childhood settings, children's exposure to structured mathematical stimulation is almost exclusively mediated through classroom teacher interactions, making instructional quality a particularly potent contributor compared to later educational stages (Clements & Sarama, 2020; Schwartz et al., 2021). Comparative ECE literature similarly reports medium-to-large effect sizes (R2 ranging from .35 to .48) when evaluating comprehensive teacher pedagogical management against observational developmental rubrics. The remaining 54.0% of the variance reflects unmeasured external factors outside the scope of this study, including the home learning environment and parental involvement (Filtri, 2023), ECE institutional administrative support (Sagita et al., 2026), and readiness requirements for transitioning to primary education (Dasan, 2025).

Several methodological limitations should be considered when interpreting the findings of this study. First, the study relied on a relatively small sample of 25 ECE teachers and 60 Group B children restricted to a single geographical area (West Bandung Regency), which limits the direct generalization of the findings to broader educational contexts. Second, the non-probability purposive sampling approach may introduce potential selection bias. Third, teacher instructional management was evaluated via a self-report questionnaire, which carries inherent social desirability bias despite assurances of complete anonymity. Fourth, while aggregating data to N = 25 classroom units resolved observation non-independence, it precluded multi-level modeling of individual child-level variance. Finally, the cross-sectional ex post facto design prevents establishing direct cause-and-effect relationships; future research should incorporate longitudinal or randomized experimental designs to track children's numeracy development over extended periods.

© 2026 Kurniansyah et al · CC BY-SA 4.0

CONCLUSION

Based on the results of the data analysis and discussion, it can be concluded that teacher instructional management in West Bandung Regency is in the good category, with the instructional implementation aspect serving as the primary strength, while the evaluation aspect still requires reinforcement. Correspondingly, children's early numeracy skills fall into the Developing as Expected (BSH) category, where the number recognition indicator achieved the highest score, whereas the pattern recognition indicator recorded the lowest achievement. Inferential testing proves that teacher instructional management exerts a positive and significant effect on early childhood numeracy skills ($p = 0.000 < 0.05$), contributing 46% ($R2 = 0.460$), while the remaining 54% is influenced by other variables outside the scope of this study.

These findings confirm that more optimal learning governance implemented by teachers ranging from structured planning and interactive play-based execution to continuous evaluation results in more optimal development of children's early numeracy skills. Therefore, the continuous enhancement of early childhood teachers' pedagogical competencies, particularly in designing reflective assessments and pattern recognition stimulation activities, represents a strategic imperative that should be pursued by ECE institution administrators and relevant educational authorities. Furthermore, future researchers are encouraged to investigate the remaining 54% of external factors not examined in this study, such as the home learning environment, children's school readiness, and the availability of concrete learning media in schools.

DECLARATIONS

Author Contributions: Conceptualization: Kurniansyah; Methodology: Kurniansyah; Data collection and formal analysis: Rafaeni & Kartika; Writing-original draft preparation: Kurniansyah; Writing-review and editing: Kurniansyah, Rafaeni & Kartika. All authors have read and approved the final manuscript.

Funding: This research received no external funding.

Ethics Approval and Consent: Ethical approval was granted by the research committee of Institut Darul Falah Bandung Barat. Informed consent was obtained from all participating ECE teachers, and written consent was obtained from parents/legal guardians of all participating children prior to data collection.

Data Availability: The authors declare no potential or actual conflicts of interest with respect to the research, authorship, and/or publication of this article.

Conflict of Interest: the authors declare that there is no conflict of interest regarding the publication of this paper.

Use of Generative AI: Generative AI assistance was utilized solely for manuscript formatting, language editing, and grammar refinement. The authors have reviewed, verified, and edited all content, and take full responsibility for the integrity and accuracy of the final published work.

 © 2026 Kurniansyah et al · CC BY-SA 4.0

REFERENCES

Clements, D. H., & Sarama, J. (2020). *Learning and teaching early math: The learning trajectories approach*. Routledge.

Dasan, S. (2025). Peran guru sekolah dasar dalam meningkatkan literasi dan numerasi dasar. *Jurnal Ilmu Pendidikan Guru Sekolah Dasar Dan Usia Dini*, *2*(1), 19–24.

Fidesrinur, F., Fitria, N., Lestari, A., & Riza, E. (2025). Upaya Meningkatkan Kemampuan Numerasi Awal Anak Usia 5–6 Tahun melalui Media Zoo Math Pack. *Jurnal Obsesi: Jurnal Pendidikan Anak Usia Dini*, *9*(3), 809–821.

Filtri, H. (2023). Peran Orangtua Dalam Pengembangan Literasi Numerasi Pada Anak Usia Dini. *Edusiana: Jurnal Ilmu Pendidikan*, *1*(2).

Hair, J. F., Black, W. C., Babin, B. J., & Anderson, R. E. (2021). *Multivariate data analysis*.

Hakim, A. R., & Rostini, D. (2026). Professional Competency Management of Teachers in Improving the Quality of Meaningful Learning in Elementary Schools. *Journal of Innovation and Research in Primary Education*, *5*(1), 621–633.

Koenarso, D. A. P. (2023). Assessment and evaluation of early childhood education institutions. *ThufuLA: Jurnal Inovasi Pendidikan Guru Raudhatul Athfal*, *11*(1), 165–180.

Koo, B., Lee, K.-S., & Khojasteh, J. (2021). *Review of an introduction to multilevel modeling techniques*. Taylor & Francis.

Kurniansyah, M. Y., Meilani, R., & Aryanti, L. N. (2026). From play to numeracy: exploring cognitive and pedagogical processes in early childhood learning. *Journal on Mathematics Education Research (J-MER)*, *7*(1), 135–147.

Levy, R. V., & Wasmuth, H. (2025). Developmentally appropriate practice and its impact on the field of early child education and care in the United States1. *International Perspectives on the History of Early Childhood Education: Institution–Family–Profession*, *109*.

Lüken, M. M., & Sauzet, O. (2021). Patterning strategies in early childhood: A mixed methods study examining 3-to 5-year-old children's patterning competencies. *Mathematical Thinking and Learning*, *23*(1), 28–48.

Misrawati, M., & Suryana, D. (2021). Bahan Ajar Matematika Berbasis Model Pembelajaran Tematik terhadap Kemampuan Berhitung Anak Usia Dini. *Jurnal Obsesi : Jurnal Pendidikan Anak Usia Dini*, *6*(1), 298–306. https://doi.org/10.31004/obsesi.v6i1.1249

Nugraha, A. C., & Muntazhimah, M. (2024). Analisis konten penelitian kemampuan numerasi awal pada anak usia dini: Tinjauan metodologi penelitian. *JURNAL OBSESI Учредители: Universitas Pahlawan Tuanku Tambusai*, *8*(5), 1174–1184.

Poth, C. N. (2023). *The Sage handbook of mixed methods research design*.

Privitera, G. J. (2022). *Research methods for the behavioral sciences (3rd updated ed.)*. Sage Publications.

Rahayu, S. (2025). Exploring the influence of interactive learning media on the numerical ability of early childhood learners at PAUD Gemilang Tangerang Selatan. *Jurnal ASIK: Jurnal Administrasi, Bisnis, Ilmu Manajemen & Kependidikan*, *3*(3), 56–66.

Ratnawati, S. (2021). Pengembangan potensi anak usia dini. *La-Tahzan: Jurnal Pendidikan Islam*, *13*(1), 97–115.

 © 2026 Kurniansyah et al · CC BY-SA 4.0

Rittle-Johnson, B., Zippert, E. L., & Boice, K. L. (2019). The roles of patterning and spatial skills in early mathematics development. *Early Childhood Research Quarterly*, *46*, 166–178.

Safitri, A., Kabiba, K., Nasir, N., & Nurlina, N. (2020). Manajemen pembelajaran bagi anak usia dini dalam meningkatkan kualitas pembelajaran. *Jurnal Obsesi: Jurnal Pendidikan Anak Usia Dini*, *5*(2), 1209–1220.

Sarama, J., & Clements, D. H. (2019). Learning trajectories in early mathematics education. *Researching and Using Progressions (Trajectories) in Mathematics Education*, *3*, 32–55.

Schwartz, M., Hijazy, S., & Deeb, I. (2021). The role of play in creating a language-conducive context in a bilingual preschool. *European Early Childhood Education Research Journal*, *29*(3), 381–396.

Suryana, D. (2021). *Pendidikan anak usia dini teori dan praktik pembelajaran*. Prenada media.

Wijns, N., Torbeyns, J., Bakker, M., De Smedt, B., & Verschaffel, L. (2019). Four-year olds' understanding of repeating and growing patterns and its association with early numerical ability. *Early Childhood Research Quarterly*, *49*, 152–163.

 © 2026 Kurniansyah et al · CC BY-SA 4.0