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Exploring Visual-Based Approaches in Early Literacy and Numeracy Learning: Insights from Kindergarten Classroom Practices

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ABSTRACT
Background: Early literacy and numeracy are key foundations for children's readiness for primary education. Visual supports can help young learners connect symbols with meaning through concrete, engaging experiences.
Aims: This study examines how visual-based approaches are applied in teaching early literacy and numeracy and describes how children and teachers respond during classroom activities.
Methods: The study used a descriptive qualitative design. Data were gathered through participatory classroom observation during teaching practice, complemented by documentation and informal interviews with the class teacher. Analysis followed data reduction, data display, and conclusion drawing to identify recurring patterns in learning stages, responses, and implementation constraints.
Result: The use of flashcards and real objects fostered active participation and helped children recognize letters, syllables, and numbers more smoothly. Children appeared more attentive, willing to respond, and increasingly confident when learning tasks were linked to familiar images and objects. Teachers noted that visual cues supported classroom focus and clarified instruction, particularly for children who initially struggled with symbol recognition. The activities also provided opportunities for fine-motor practice and verbal interaction. Challenges included varied learning pace across children, limited time for repetition, and the need for stronger classroom management when adult assistance was insufficient.
Conclusion: Visual-based practices can enrich early literacy and numeracy learning by making core concepts easier to grasp and more motivating. Outcomes are likely to improve when teachers diversify media, use small-group routines, and extend practice through home support.

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Introduction

The urgency of examining visual-based instruction in early literacy and numeracy lies in how quickly early learning gaps can widen once children enter primary school (López-Íñiguez & Burnard, 2022; Suprihatiningrum et al., 2025). In the kindergarten years, children are still forming the basic habits of attending, noticing patterns, and attaching meaning to symbols. When early experiences with letters and numbers feel confusing or pressuring, children may disengage long before formal schooling begins (Campbell, 2021; Han, 2023). This is why early literacy and numeracy should be treated as a developmental pathway rather than a narrow academic target. Yet, classroom practices often drift toward routines that resemble primary-school instruction, even though kindergarten learners typically need concrete cues and playful interaction. In such situations, the central question is not only whether children "can" read or count, but how they make sense of symbols in a way that feels manageable and enjoyable. Visual resources offer a plausible bridge between abstract symbols and children's everyday experiences. For that reason, investigating how visual-based learning unfolds in real classroom practice remains a timely concern.

Young children typically interpret the world through what they can see, manipulate, and relate to familiar objects (Harris, 2021; Novak & Schwan, 2021). They are still developing the capacity to sustain attention across tasks that are repetitive or text-heavy. If learning relies mainly on verbal explanation or written drills, many children will struggle to stay engaged, and the learning moment is lost before the

concept is understood (Jayanthi et al., 2021; Stylianou & Zembylas, 2021). The challenge is not simply about motivation, but about the fit between teaching design and developmental readiness. Children learn best when instruction is anchored in concrete representation and immediate feedback. In early literacy, this means linking letters and syllables to recognizable images and spoken sounds. In early numeracy, it means connecting numbers to quantities that can be counted and compared. A classroom that respects these learning conditions tends to produce a more supportive atmosphere for foundational skills.

Visual-based approaches, particularly the use of flashcards and real objects, are frequently chosen because they simplify symbol recognition and invite interaction. Pictures and colors can reduce the cognitive load of processing unfamiliar forms, allowing children to focus on meaning. Flashcards, when used thoughtfully, can turn recognition practice into a fast-paced, playful exchange rather than a silent worksheet routine. Concrete objects add another layer by letting children verify quantities through counting, grouping, and matching. In many early childhood contexts, these materials become the "language" that helps children talk about letters, sounds, and numbers (Alatalo & Westlund, 2021; DePascale et al., 2021). However, the benefits of visual aids are not automatic, because the same materials can function differently depending on how the teacher structures the activity. Some classrooms use visuals as a brief decoration, while others integrate them as a central learning scaffold. This difference makes implementation processes worth studying, not only the materials themselves.

Another reason this topic matters is that early literacy and numeracy learning is rarely confined to cognitive outcomes alone (Fyfe et al., 2023). Activities with cards, small objects, and guided pointing naturally involve hand control and coordination. When children name images, repeat sounds, or answer questions in front of peers, they are also practicing verbal expression and confidence. Group routines around counting or reading syllables can foster turn-taking and social interaction, which are core features of early childhood pedagogy. Visual-based learning, in this sense, can be viewed as a multi-domain experience rather than a single-skill intervention (Allouch et al., 2021; Condello et al., 2021). Yet, classroom accounts often report "improvement" without explaining what children actually do during the learning moment. A richer description of interaction, engagement, and response is needed to show why the approach works in practice. This is particularly relevant in settings where teachers must accommodate diverse readiness levels within the same group. Observing the learning process closely can clarify how children's attention, participation, and understanding are supported across activities.

In everyday classrooms, teachers routinely face constraints that shape what can be achieved with any method, including visual-based instruction (Mpolomoka, 2025). Limited lesson time makes repetition difficult, even though repetition is often necessary for symbol recognition. Large class sizes reduce opportunities for individual guidance, which matters when children confuse similar shapes such as b and d or 6 and 9. Differences in learning pace can create a classroom dynamic where some children advance quickly while others need more scaffolding. Under these conditions, a method may look effective overall while still leaving certain children behind (Heleta & Bagus, 2021; Spinelli et al., 2021). This suggests that the question should shift from "Is the method effective?" to "Under what classroom conditions does it work best, and for whom?" Visual aids may support learning, but they also demand careful classroom management and structured routines to remain meaningful. Therefore, documenting challenges and practical solutions is part of the research value, not an afterthought.

The existing literature generally supports the use of visual media for early learning, yet many studies emphasize outcomes more than classroom processes (Leavy et al., 2023; Schraw & Richmond, 2022). Quantitative designs can show differences between pre and post conditions, but they often do not capture how children respond moment by moment or how teachers adapt instruction in real time. For early childhood education, these process details are not minor, because the quality of interaction often determines whether children stay engaged. Moreover, literacy and numeracy are frequently examined separately, even though in practice teachers integrate them within a single lesson sequence (Cai & Hwang, 2021). In classroom routines, children may shift from recognizing letters to reading syllables and then to counting objects within the same session. Visual-based learning is therefore better understood as an

integrated pedagogy than as a single technique. A qualitative description can highlight the sequence of teaching stages, the interaction patterns, and the points where difficulties arise. Such evidence can complement outcome-focused research and offer a more usable picture for practitioners.

For these reasons, investigating visual-based early literacy and numeracy learning through classroom observation provides a meaningful contribution (Levin & Flavian, 2022). It helps clarify how flashcards and concrete objects function as scaffolds rather than as standalone tools. It also captures children's engagement and confidence, as well as teachers' strategies for keeping learning activities manageable and enjoyable. By focusing on implementation stages and classroom responses, the study addresses a practical gap between theory and what teachers actually do. The study also acknowledges that effectiveness is shaped by context, including time availability, class size, and variation in children's readiness (Finders et al., 2021; Vaisarova & Reynolds, 2022). In doing so, it supports a view of early learning that is developmentally appropriate and sensitive to real teaching constraints. Ultimately, the background for this research is rooted in the need to strengthen foundational learning without compromising children's wellbeing and curiosity. This focus makes the study relevant for early childhood educators seeking methods that are both effective and humane.

Building on the earlier discussion that visual resources can bridge abstract symbols and children's concrete classroom experiences, recent literature further reinforces this perspective from multiple angles. Purba, Wondal, Yuliantina, Susanti, and Herman (2026) illustrate how visually mediated learning materials can bring numeracy concepts closer to children's everyday understanding, enabling numbers to be perceived not merely as symbols but as meaningful representations. In a similar vein, Laksana, Qondias, Lawe, and Wahyu (2026) argue that instructional models grounded in rich visual and cultural representations strengthen early literacy and numeracy by making symbols contextually familiar rather than cognitively distant. These findings align with the view that the effectiveness of visual-based learning does not reside solely in the media itself, but in how learning activities are intentionally designed and sequenced.

Evidence from broader developmental studies also supports this process-oriented perspective. Yang et al. (2026) demonstrate that interactive and activity-based curricula are associated not only with mathematical learning but also with language development and social-emotional growth in preschool children. Complementing this, Geng et al. (2026) emphasize that children's academic readiness in kindergarten is closely linked to their social-emotional adjustment, highlighting the importance of classroom engagement and interaction during learning activities. From a wider educational context, Salmon-Letelier et al. (2026) show that literacy and numeracy development is most sustainable when learning opportunities are embedded within supportive and integrated instructional environments, rather than delivered as isolated skill drills. Pedagogical strategies that emphasize participation further illuminate the value of visual-based classroom practices. Bonite et al. (2026) reveal that simulation-based and participatory learning activities can enhance mathematical understanding by encouraging active involvement rather than passive reception. At the same time, Raave et al. (2026) underscore how interactive learning designs contribute to children's social-emotional engagement, reinforcing the idea that learning effectiveness is shaped by classroom responsiveness and relational dynamics. Although situated in different disciplinary contexts, Baxter (2026) provides insight into how literacy-related constructs are commonly conceptualized and measured, while Ferri et al. (2026) highlight the importance of practitioner perspectives in understanding how educational practices function in real-world settings. Taken together, these studies support the framing of visual-based approaches not as isolated instructional tools, but as pedagogical practices that shape how children engage with, interpret, and internalize early literacy and numeracy learning within authentic kindergarten classroom practice.

Visual-based learning has become a familiar feature in many kindergarten classrooms, particularly in early literacy and numeracy instruction. Flashcards, pictures, and concrete objects are frequently introduced as practical tools to support symbol recognition and basic counting. However, the widespread presence of these materials does not automatically indicate thoughtful pedagogical use. In

many cases, visual media are treated as supplementary aids rather than as integral components of the learning process that shape children's engagement, interaction, and understanding. Early childhood learning is highly sensitive to how instruction is experienced rather than merely what content is delivered. Children's attention, willingness to respond, and confidence in interacting with letters and numbers provide valuable cues about the suitability of instructional approaches. At the same time, teachers continuously negotiate instructional decisions in response to classroom realities, including limited time, diverse learning readiness, and group management demands. These everyday decisions influence how visual-based learning actually unfolds in practice. The rationale of this study therefore lies in the need to examine visual-based approaches not as abstract strategies, but as lived classroom practices that emerge through interaction between teachers, children, and learning materials.

Although existing studies broadly support the contribution of visual media to early literacy and numeracy development, important gaps remain in how this contribution is understood. Much of the literature prioritizes outcome-based evidence, focusing on skill improvement or intervention effectiveness, while offering limited insight into the instructional processes that mediate these outcomes. As a result, the ways in which children engage with visual materials, interpret symbols, and respond during learning activities are often insufficiently documented. In addition, literacy and numeracy are frequently examined as distinct learning domains, even though kindergarten instruction commonly integrates both within a single learning sequence. This separation limits understanding of how visual-based approaches simultaneously support multiple foundational skills. Furthermore, relatively few studies adopt a qualitative, classroom-centered perspective that foregrounds teacher experience, child response, and instructional constraints. This study addresses these gaps by examining visual-based early literacy and numeracy learning as an integrated classroom practice, with attention to process, interaction, and contextual challenges rather than isolated outcomes.

The purpose of this study is to explore how visual-based approaches are implemented in early literacy and numeracy learning within a kindergarten classroom. Specifically, the study aims to describe instructional stages, children's engagement and responses, teachers' perspectives, and challenges encountered during classroom practice. By focusing on how learning activities are organized and experienced, the study seeks to provide a detailed account of visual-based instruction as it occurs in everyday teaching. This study does not seek to test causal hypotheses or measure effectiveness through quantitative indicators. Instead, it is guided by the assumption that visual-based learning supports early literacy and numeracy by making abstract symbols more accessible and by encouraging active participation. Through descriptive qualitative inquiry, the study aims to generate contextual insights that can inform more reflective, developmentally appropriate instructional practices in early childhood education.

Method

Research Design

This study adopted a descriptive qualitative design to generate a close, classroom-based account of how visual-based approaches were enacted in early literacy and numeracy learning. The design was selected because it allows the researcher to capture instructional sequences, interaction patterns, and children's responses as they emerge in natural classroom routines, rather than reducing learning to test scores alone. The research procedure followed a clear progression from identifying the instructional context through interpreting classroom evidence, which is summarized in Figure 1.

Participants

Participants consisted of kindergarten children involved in early literacy and numeracy activities and the classroom teacher who facilitated the learning sessions. The children represented varied levels of readiness in recognizing letters, syllables, and numbers, which enabled observation of diverse engagement patterns during the use of flashcards and concrete objects. The classroom teacher

contributed contextual information about instructional planning, classroom management, and constraints encountered during implementation. Participants were included purposively because they were directly involved in the learning practices under investigation.

Instrument

Data were gathered using classroom-based qualitative instruments suitable for documenting learning processes. Participatory observation served as the primary instrument, enabling the researcher to record the stages of instruction, children's participation, and the ways visual media were used during activities. Field notes were developed throughout the teaching sessions to document interactional detail and classroom atmosphere, while documentation of learning materials and classroom records supported the observation data. Informal interviews with the classroom teacher were conducted to clarify observed events and to obtain the teacher's reflections on children's responses and implementation challenges.

Data Analysis

Analysis was conducted descriptively and iteratively. All observation notes, interview insights, and documentation were first compiled to form a coherent dataset. The data were then reduced by selecting segments most relevant to instructional stages, engagement patterns, children's responses, and classroom constraints. Next, the data were organized into an interpretive narrative that made visible how visual-based learning unfolded across activities and how the teacher adjusted instruction in response to classroom realities. Conclusions were drawn by linking recurring patterns in the data to the study focus, ensuring that interpretations remained grounded in classroom evidence. Figure 1 provides an overview of the research flow from data collection to conclusion drawing.

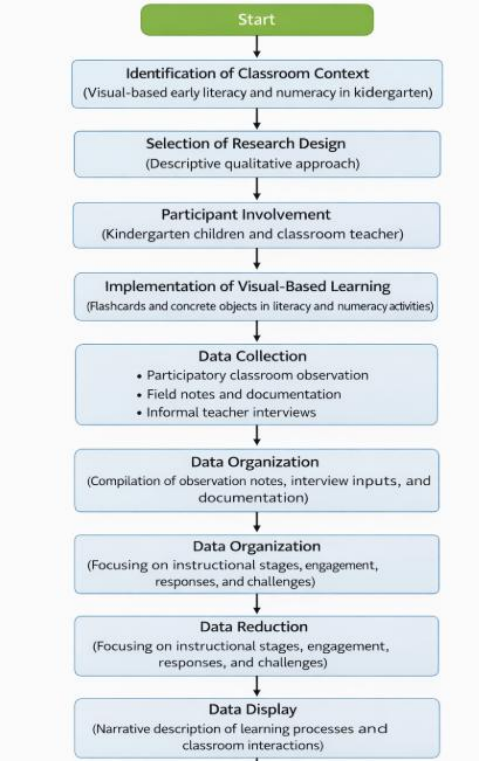

Figure 1. Flowchart of the Research Procedure.

This figure presents the sequential stages of the study, including identification of the classroom context, selection of the descriptive qualitative design, participant involvement, implementation of visual-based learning with flashcards and concrete objects, data collection through observation, documentation, and informal interviews, followed by data organization, reduction, narrative display, and conclusion drawing.

Results and Discussion

Results

The results of this study are derived from classroom observations conducted during the implementation of visual-based early literacy and numeracy learning. Rather than presenting numerical scores, the findings focus on instructional stages, the types of visual media employed, children's observable responses, and challenges encountered during classroom practice. A summary of the main observational findings is presented in Table 1 to provide a clear overview of how visual-based learning unfolded across different activities.

Table 1. Observational Summary of Visual-Based Early Literacy and Numeracy Learning

Instructional Focus	Visual Media Employed	Children's Observed Responses	Classroom Challenges
Recognition of letters and numbers	Flashcards with images and numerical symbols	Children showed interest and actively named letters and numbers while responding to visual prompts	Some children experienced difficulty distinguishing similar symbols (e.g., b–d, 6–9)
Practice of syllable reading	Color-coded syllable flashcards	Children followed reading patterns more confidently and participated in guided repetition	Variation in learning pace required repeated explanation and support
Introduction to basic numeracy	Concrete objects combined with number cards	Children counted objects independently and maintained attention during activities	Limited instructional time constrained repetition opportunities
Integrated literacy and numeracy activities	Combination of flashcards and real objects	Children remained engaged across activities and displayed increased confidence	Large group size limited individualized assistance

As illustrated in Table 1, the use of visual-based learning materials supported children's engagement throughout early literacy and numeracy activities. Flashcards helped children associate abstract symbols with familiar objects, making letter and number recognition more accessible. During syllable reading practice, visual consistency and color differentiation appeared to assist children in following reading patterns with greater confidence. In numeracy activities, the presence of concrete objects allowed children to verify quantities directly, encouraging active participation and self-correction. Observations also revealed that children were more responsive when visual cues were maintained consistently across learning stages. Many children demonstrated willingness to speak, count aloud, and interact with learning materials. Nevertheless, differences in learning readiness were evident, with some children requiring additional guidance and repetition. Classroom constraints, including limited instructional time and the number of children involved, influenced the extent to which individualized support could be provided. Overall, the results indicate that visual-based approaches contributed positively to classroom engagement while simultaneously highlighting practical challenges that shaped instructional implementation.

Discussion

The classroom evidence from this study suggests that visual-based learning plays an essential role in how young children approach early literacy and numeracy tasks. Through repeated exposure to flashcards and concrete objects, children were able to associate abstract symbols with everyday references more naturally. This pattern is consistent with the observations of Purba et al. (2026), who argue that visual mediation helps children construct meaning rather than memorize symbols mechanically. Visual materials in this study functioned as anchors that guided attention and encouraged interaction. Children were more willing to speak, point, and count when visual cues were present. These

behaviors indicate reduced cognitive strain during learning activities. Engagement emerged progressively, not instantly, reflecting developmental readiness. Therefore, visual-based learning should be viewed as a gradual meaning-building process rather than a shortcut to rapid skill acquisition.

The organization of instructional stages appeared to influence how effectively visual-based learning supported children's participation. Visual cues that were consistently carried across activities helped children anticipate what was expected in each stage. This finding aligns with Laksana et al. (2026), who emphasize the importance of coherent instructional design grounded in meaningful representation. When visual elements were used continuously from letter recognition to syllable reading, children transitioned between tasks with less hesitation. In contrast, abrupt shifts without visual continuity disrupted attention for some learners. This suggests that visual media are most effective when embedded within a clear instructional sequence. Teachers' planning decisions shaped how visual materials were perceived by children. Pedagogical coherence, rather than the media alone, determined learning flow. As a result, visual-based approaches demand intentional structuring rather than incidental use.

Beyond academic engagement, visual-based learning in this study supported broader aspects of child development. Manipulating cards and objects required fine motor coordination, which developed alongside literacy and numeracy activities. Verbal exchanges during visual tasks also strengthened expressive language and confidence. These outcomes resonate with Yang et al. (2026), who report that interactive learning environments contribute to language and social-emotional growth in early childhood. Visual tasks created shared attention spaces where children learned through observation and imitation. Peer responses often encouraged hesitant children to participate. This social dimension highlights that learning in kindergarten is inherently interactive. Visual-based instruction thus extends beyond symbol recognition. It contributes to holistic development when designed to encourage interaction and movement.

Children's engagement emerged as a central factor mediating the effectiveness of visual-based learning. Sustained attention was more evident when learning activities provided predictable visual references. This observation supports Geng et al. (2026), who identify engagement and emotional adjustment as key contributors to academic readiness. Visual cues helped children feel oriented within learning tasks, reducing uncertainty. Familiar images and objects appeared to create a sense of comfort during instruction. As a result, children were more willing to respond publicly and attempt tasks. Engagement, therefore, functioned as a prerequisite rather than a by-product of learning. Visual-based approaches supported this engagement structurally. This challenges instructional models that prioritize content coverage over learner experience.

The classroom context strongly shaped how visual-based learning unfolded in practice. While visual materials supported attention and participation, their impact was constrained by time availability and class size. Teachers had limited opportunities to provide individualized support, especially for children who required repeated explanation. This contextual influence echoes the findings of Salmon-Letelier et al. (2026), who stress that literacy and numeracy development depends on supportive learning environments. Even well-designed activities were less effective when instructional time was insufficient. Classroom realities influenced the depth of engagement possible in each session. These findings caution against interpreting effectiveness without considering context. Pedagogical strategies must be evaluated within actual teaching conditions. Qualitative classroom-based evidence is therefore crucial.

Differences in children's learning pace became particularly visible during visual-based activities. Some children responded quickly to visual prompts, while others required extended repetition and guidance. Such variation reflects normal developmental diversity rather than instructional weakness. Bonite et al. (2026) similarly observe that participatory learning environments reveal uneven response patterns among learners. Visual tools made these differences easier to identify, offering opportunities for targeted support. However, limited adult assistance restricted the extent of differentiation possible. This created tension between inclusive instruction and practical constraints. Visual-based learning alone

cannot resolve this tension. Flexible grouping and adaptive pacing are needed to address diverse readiness levels.

The findings also invite reflection on how literacy and numeracy are framed in early childhood education. Classroom observations showed that children often engaged with reading and counting within the same activity. This integrated engagement corresponds with Baxter (2026), who conceptualizes literacy as a contextual and multifaceted construct. Visual-based tasks naturally bridged different skill domains through shared representations. Children did not experience learning as segmented into discrete subjects. Instead, literacy and numeracy emerged together through interaction with materials. Instruction that mirrors this integrated experience may feel more intuitive to young learners. Rigid separation of domains risks overlooking these natural connections. Visual-based learning offers a practical means of supporting integrated instruction.

Teacher agency played a decisive role in shaping how visual-based learning was enacted. Teachers continuously adjusted pacing, repetition, and interaction based on children's responses. This finding reflects Ferri et al. (2026), who emphasize practitioner perspectives in understanding how practices function in real settings. Teachers' interpretive decisions determined whether visual materials facilitated or hindered engagement. Instruction was not static but responsive to classroom dynamics. Such responsiveness required professional judgment rather than scripted procedures. Visual-based learning cannot be standardized without losing effectiveness. Understanding teacher agency is therefore central to pedagogical improvement. Research that foregrounds teacher decision-making offers valuable insights.

This study also challenges narrow definitions of effectiveness in early childhood education. Instead of focusing solely on immediate mastery, the findings highlight engagement, confidence, and participation as meaningful indicators. These dimensions shape children's long-term relationship with learning. Visual-based approaches appeared to support these affective outcomes alongside cognitive engagement. This aligns with Raave et al. (2026), who argue that interactive learning environments foster foundational competencies beyond measurable gains. Emphasizing process over speed allows for more developmentally appropriate evaluation. Learning effectiveness should be interpreted broadly in early childhood contexts. Visual-based learning fits well within this expanded perspective. Such framing supports more humane and child-centered pedagogy.

Overall, the discussion situates visual-based learning as a pedagogical practice shaped by interaction, context, and teacher judgment. Visual materials functioned not as neutral tools but as resources whose impact depended on how they were used. Examining classroom processes provided insight into why certain strategies supported engagement while others faced limitations. By emphasizing lived classroom experience, the study complements outcome-focused research with contextual depth. These findings encourage educators to reflect on instructional design rather than rely on materials alone. Visual-based approaches hold promise when integrated thoughtfully and responsively. The discussion reinforces the value of classroom-based qualitative inquiry. Ultimately, understanding how learning unfolds in practice is essential for strengthening early literacy and numeracy education.

Implications

The findings of this study indicate that visual-based learning holds meaningful pedagogical value for early literacy and numeracy instruction when it is treated as an integral part of classroom practice. The consistent use of flashcards and concrete objects helped children navigate learning activities with greater confidence and engagement, suggesting that visual continuity across instructional stages is crucial. Rather than functioning as occasional aids, visual materials supported children's meaning-making processes by linking abstract symbols to familiar experiences. This implies that teachers need to design learning sequences that intentionally embed visual cues throughout the lesson, not merely at the introduction stage. In addition, the study highlights the central role of teacher responsiveness in maximizing the benefits of visual-based learning. Teachers' decisions to adjust pacing, repetition, and interaction in response to children's reactions shaped how learning unfolded in practice. This suggests

that professional development for early childhood educators should emphasize reflective teaching skills and sensitivity to classroom dynamics. At the institutional level, the findings imply that supportive conditions, such as reasonable class sizes and sufficient instructional time, are necessary to allow visual-based approaches to function effectively. Together, these implications reinforce the idea that successful early literacy and numeracy instruction depends on the interaction between materials, pedagogy, and context.

Limitations

While the implications highlight the potential of visual-based learning, several limitations frame how the findings should be interpreted. The study was conducted in a single kindergarten classroom, which means that the instructional context, teacher practices, and learner characteristics may not represent other early childhood settings. Differences in curriculum structure, institutional support, and classroom composition could lead to different outcomes when similar approaches are applied elsewhere. As a result, the findings should be understood as context-specific rather than universally generalizable. Another limitation relates to the qualitative and time-bound nature of the study. The focus on classroom processes and observable responses provided rich descriptive insight but did not capture measurable changes in children's literacy or numeracy achievement. In addition, the observation period did not allow examination of longer-term learning development or retention. Children's engagement and responses may also have been influenced by situational factors such as mood, classroom atmosphere, or daily routines. These constraints suggest that the findings offer an in-depth snapshot of practice rather than a comprehensive evaluation of effectiveness over time.

Suggestions

Building on both the implications and limitations, several directions for future research and practice can be proposed. Further studies could involve multiple kindergarten classrooms to explore how visual-based learning operates across varied contexts and teaching styles. Comparative or multi-site qualitative research would help clarify how factors such as class size, teacher experience, and resource availability shape implementation. Longitudinal studies are also recommended to examine how sustained visual-based instruction influences the development of literacy and numeracy skills over a longer period. For classroom practice, teachers are encouraged to diversify visual media and to combine whole-class instruction with small-group activities to better accommodate differences in learning pace. Repeated exposure to visual materials, paired with interactive dialogue, may help strengthen children's confidence and understanding. Collaboration with parents could further support learning continuity by extending visual-based activities beyond the classroom. At the curriculum and policy level, early childhood programs may consider explicitly incorporating visual-based strategies into learning guidelines. Such alignment between research, practice, and policy could contribute to more engaging and developmentally appropriate early literacy and numeracy education.

Conclusion

This study affirms that visual-based learning contributes substantially to early literacy and numeracy experiences in kindergarten classrooms by helping children interpret letters and numbers through concrete and familiar references. The consistent use of flashcards and real objects encouraged children's involvement, supported confidence in responding, and created learning situations in which abstract symbols felt more approachable. Rather than serving only as supplementary teaching tools, visual materials shaped how children focused attention, interacted with tasks, and constructed understanding during classroom activities. The findings also reveal that the effectiveness of visual-based learning depends strongly on how instruction is organized, including the continuity of visual cues, the teacher's adaptive responses to differing learning pace, and opportunities for meaningful interaction. Classroom realities, such as limited time and group size, influenced the extent to which individual

guidance could be provided, particularly for children who required repeated support. Viewed through a descriptive qualitative perspective, this study highlights the importance of examining instructional processes as they occur in everyday practice. Overall, the findings underscore the value of integrating visual-based approaches thoughtfully and responsively to support developmentally appropriate, child-centered early literacy and numeracy learning.

Author Contributions Statement

Ertati contributed to the conceptualization of the study, research design, and coordination of classroom observation and teaching practice. Ayu Mayang Sari was responsible for data collection through participatory observation, documentation, and informal interviews, as well as initial data organization. Eka Selpi Oktariani contributed to data analysis, interpretation of findings, and drafting of the manuscript. All authors collaboratively reviewed, revised, and approved the final version of the manuscript and agreed to be accountable for all aspects of the work.

References

Alatalo, T., & Westlund, B. (2021). Preschool teachers' perceptions about read-alouds as a means to support children's early literacy and language development. *Journal of Early Childhood Literacy*, *21*(3), 413–435. https://doi.org/10.1177/1468798419852136

Allouch, M., Azaria, A., & Azoulay, R. (2021). Conversational Agents: Goals, Technologies, Vision and Challenges. *Sensors*, *21*(24), 8448. https://doi.org/10.3390/s21248448

Baxter, M. L. (2026). Systematic Review and Analysis of Measures of Oral Health Literacy. *Journal of Dental Education*, *90*(1), 51–64. https://doi.org/10.1002/jdd.13895

Bonite, I. A., Calo, J. P. B., Cuevas, V. B., & Cultura, J. F. (2026). Classroom Store Simulation Challenge: An Innovative Pedagogical Strategy to Enhance Primary Learners' Math Problem-Solving Skills in the Philippines. In *Lecture Notes in Educational Technology: Part F1214* (pp. 129–138). Springer Science and Business Media Deutschland GmbH. https://doi.org/10.1007/978-981-95-0872-3_11

Cai, J., & Hwang, S. (2021). Teachers as redesigners of curriculum to teach mathematics through problem posing: Conceptualization and initial findings of a problem-posing project. *ZDM – Mathematics Education*, *53*(6), 1403–1416. https://doi.org/10.1007/s11858-021-01252-3

Campbell, S. (2021). Phonics and play-literacy: Parental expectations of an early childhood literacy program. *The Australian Journal of Language and Literacy*, *44*(3), 60–73. https://doi.org/10.1007/BF03652081

Condello, G., Mazzoli, E., Masci, I., De Fano, A., Ben-Soussan, T. D., Marchetti, R., & Pesce, C. (2021). Fostering Holistic Development with a Designed Multisport Intervention in Physical Education: A Class-Randomized Cross-Over Trial. *International Journal of Environmental Research and Public Health*, *18*(18), 9871. https://doi.org/10.3390/ijerph18189871

DePascale, M., Prather, R., & Ramani, G. B. (2021). Parent and child spontaneous focus on number, mathematical abilities, and mathematical talk during play activities. *Cognitive Development*, *59*, 101076. https://doi.org/10.1016/j.cogdev.2021.101076

Ferri, G. M., Frank, A., Li, D., Anand, P., Abdallah, M., Avalone, V., Mark Sloan, J., Sanchorawala, V., Lerner, A., Szalat, R. E., Petrocca, F., Edwards, C. V., & Bell, B. N. (2026). When ICAN(S) Becomes ICAN'T: Clinician and Staff Perspectives on In-Hospital Neurotoxicity Grading. *Clinical Lymphoma, Myeloma and Leukemia*, *26*(1), e77–e82. https://doi.org/10.1016/j.clml.2025.08.021

Finders, J. K., Budrevich, A., Duncan, R. J., Purpura, D. J., Elicker, J., & Schmitt, S. A. (2021). Variability in Preschool CLASS Scores and Children's School Readiness. *AERA Open*, *7*, 23328584211038938. https://doi.org/10.1177/23328584211038938

Fyfe, E. R., Borriello, G. A., & Merrick, M. (2023). A developmental perspective on feedback: How corrective feedback influences children's literacy, mathematics, and problem solving. *Educational Psychologist*, *58*(3), 130–145. https://doi.org/10.1080/00461520.2022.2108426

Geng, Z., Huang, R., Zeng, B., & Huang, J. (2026). Exploring the associations among Chinese kindergartners between social-emotional development and behavioral and academic adjustment. *European Journal of Psychology of Education*, *41*(1). https://doi.org/10.1007/s10212-025-01062-1

Han, F. (2023). Level of consistency between students' self-reported and observed study approaches in flipped classroom courses: How does it influence students' academic learning outcomes? *PLOS ONE*, *18*(6), e0286549. https://doi.org/10.1371/journal.pone.0286549

Harris, P. L. (2021). Early Constraints on the Imagination: The Realism of Young Children. *Child Development*, *92*(2), 466–483. https://doi.org/10.1111/cdev.13487

Heleta, S., & Bagus, T. (2021). Sustainable development goals and higher education: Leaving many behind. *Higher Education*, *81*(1), 163–177. https://doi.org/10.1007/s10734-020-00573-8

Jayanthi, M., Gersten, R., Schumacher, R. F., Dimino, J., Smolkowski, K., & Spallone, S. (2021). Improving Struggling Fifth-Grade Students' Understanding of Fractions: A Randomized Controlled Trial of an Intervention That Stresses Both Concepts and Procedures. *Exceptional Children*, *88*(1), 81–100. https://doi.org/10.1177/00144029211008851

Laksana, D. N. L., Qondias, D., Lawe, Y. U., & Wahyu, Y. (2026). Designing an ethnolinguistic-based instructional model to improve early grade literacy and numeracy in indigenous ethnic learners. *Multidisciplinary Science Journal*, *8*(5). https://doi.org/10.31893/multiscience.2026299

Leavy, A., Dick, L., Meletiou-Mavrotheris, M., Paparistodemou, E., & Stylianou, E. (2023). The prevalence and use of emerging technologies in STEAM education: A systematic review of the literature. *Journal of Computer Assisted Learning*, *39*(4), 1061–1082. https://doi.org/10.1111/jcal.12806

Levin, O., & Flavian, H. (2022). Simulation-based learning in the context of peer learning from the perspective of preservice teachers: A case study. *European Journal of Teacher Education*, *45*(3), 373–394. https://doi.org/10.1080/02619768.2020.1827391

López-Íñiguez, G., & Burnard, P. (2022). Toward a nuanced understanding of musicians' professional learning pathways: What does critical reflection contribute? *Research Studies in Music Education*, *44*(1), 127–157. https://doi.org/10.1177/1321103X211025850

Mpolomoka, D. L. (2025). Classroom experiences of learners with visual impairments in selected schools in Zambia. *British Journal of Visual Impairment*, 02646196251352361. https://doi.org/10.1177/02646196251352361

Novak, M., & Schwan, S. (2021). Does Touching Real Objects Affect Learning? *Educational Psychology Review*, *33*(2), 637–665. https://doi.org/10.1007/s10648-020-09551-z

Purba, N., Wondal, R., Yuliantina, I., Sagala, A. C. D., Budiarti, E., Susanti, D., & Herman, H. (2026). Bringing Numbers to Life through Numeracy Literacy: Practical Use of E-Comic Media in Early Education. *Studies in Media and Communication*, *14*(1), 15–25. https://doi.org/10.11114/smc.v14i1.7933

Raave, D. K., Colasante, T., Roa, E. R., Martinez, J. C. R., Li, H., Mukherjee, S., & Malti, T. (2026). An experimental study exploring human–AI complementarity in early social-emotional learning. *Computers and Education Open*, *10*. https://doi.org/10.1016/j.caeo.2026.100331

Salmon-Letelier, M., Sarr, K. G., Trembley, A., Heaner, G., Mull, A. C., Di Filippantonio, G., Pearson, I., & Arp, J. (2026). Building integrated learning opportunities for marginalized adolescent girls in Sierra Leone: Impact of the EAGER project on literacy and numeracy learning and personal competencies. *International Journal of Educational Development*, *121*. https://doi.org/10.1016/j.ijedudev.2025.103484

Schraw, G., & Richmond, A. S. (2022). Using Visual Displays to Improve Classroom Thinking. *Educational Research: Theory and Practice*, *33*(2), 80–102.

Spinelli, M., Lionetti, F., Setti, A., & Fasolo, M. (2021). Parenting Stress During the COVID-19 Outbreak: Socioeconomic and Environmental Risk Factors and Implications for Children Emotion Regulation. *Family Process*, *60*(2), 639–653. https://doi.org/10.1111/famp.12601

Stylianou, P., & Zembylas, M. (2021). Engaging with issues of death, loss, and grief in elementary school: Teachers' perceptions and affective experiences of an in-service training program on death education in Cyprus. *Theory & Research in Social Education*, *49*(1), 54–77. https://doi.org/10.1080/00933104.2020.1841700

Suprihatiningrum, J., Ristiyanti, S., Maulidina, F., & Wulayalin, K. A. (2025). Science Teachers' Experiences to Ensure Science for All Movement: From Theory to Practice. *Science Education International*, *36*(3), 259–267.

Vaisarova, J., & Reynolds, A. J. (2022). Is more child-initiated always better? Exploring relations between child-initiated instruction and preschoolers' school readiness. *Educational Assessment, Evaluation and Accountability*, *34*(2), 195–226. https://doi.org/10.1007/s11092-021-09376-6

Yang, W., Lin, C., Wang, X. C., Bautista, A., Li, H., Datu, J. A. D., & Hu, B. Y. (2026). Beyond Coding: Effects of a Computing Curriculum on Preschoolers' Computational Thinking, Math, Language, and Social-Emotional Skills. *Journal of Educational Computing Research*, *64*(1), 126–154. https://doi.org/10.1177/07356331251384546