

Strategies for Enhancing Students' Numeracy Literacy in Primary Education

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Abstract. The persistently low performance of Indonesian students in numeracy, as consistently reflected in national and international assessments, indicates that numeracy instruction in primary schools still confronts substantial challenges. This study aims to identify and analyze various strategies that have been implemented to enhance numeracy literacy among primary school students in Indonesia. Employing a Systematic Literature Review (SLR) approach, 31 peer-reviewed articles published between 2018 and 2024 were systematically reviewed. The procedure involved selection based on inclusion criteria, content coding structured around strategic components, and thematic analysis of the instructional approaches utilized. The findings reveal five dominant strategies: the use of interactive media, contextual-thematic learning, collaborative-community-based approaches, differentiated instruction, and the integration of digital technology. The results further indicate that the efficacy of numeracy literacy enhancement is largely dependent on the alignment of the chosen strategies with the specific student context, the proactive role of the teacher, and the comprehensive support provided by the school and family environments. This study concludes that effective numeracy strategies must be integrative, adaptive, and contextually grounded to adequately meet the demands of 21st-century mathematics education. These findings are expected to serve as a practical and conceptual reference for teachers, curriculum developers, and educational researchers in designing effective and sustainable numeracy interventions at the primary education level.

Keywords: numeracy literacy, primary education, learning strategies, systematic literature review, mathematics instruction, educational innovation.

INTRODUCTION

Numerical literacy is recognized as one of the critical indicators for measuring 21st-century life skills, preparing students to navigate global challenges that rely on data interpretation, numerical reasoning, and problem-solving. However, various national and international assessments consistently indicate that these skills remain relatively low among Indonesian students. The results of the 2022 Program for International Student Assessment (PISA) placed Indonesia 73rd out of 79 countries in mathematical literacy, with the majority of students scoring below the minimum competency level (OECD, 2023). Similarly, the 2022 Computer-Based National Assessment (Asesmen Nasional Berbasis Komputer, ANBK) by the Ministry of Education, Culture, Research, and Technology showed that most primary school students are not yet proficient in effectively understanding and interpreting quantitative information within the context of daily life (Kemdikbudristek, 2022).

The low level of numeracy achievement suggests that mathematics instruction in primary schools is still not adequately focused on developing contextual numerical reasoning skills. Within the framework of the Merdeka Curriculum, numeracy is not confined solely to

mathematics lessons but must be integrated across various subjects and the student's overall learning experiences (Sundari1 et al., 2023). The low level of numeracy achievement suggests that mathematics instruction in primary schools is still not adequately focused on developing contextual numerical reasoning skills. Within the framework of the Merdeka Curriculum, numeracy is not confined solely to mathematics lessons but must be integrated across various subjects and the student's overall learning experiences (Badawi, 2023).

However, empirical conditions reveal that many teachers continue to face difficulties in constructing numeracy problems based on personal, social, and scientific contexts. The instructional process remains dominated by routine problems and procedural exercises that lack relevance to students' daily lives (Ismafitri et al., 2024; Susetyawati, 2023). Teachers' limited understanding of numerical literacy, a lack of training, and the unavailability of appropriate teaching materials constitute the primary barriers to optimizing numeracy instruction (Jayanti & Cesaria, 2024; Sulisti & Janah, 2023). Furthermore, support from the home environment and the surrounding community regarding numeracy culture remains limited (Supriatin & Syahbirin, 2022), leading to unsystematic efforts in literacy improvement.

Various alternative approaches have been developed by researchers and practitioners to address these challenges. Identified strategies include: project-based and local context-based approaches (Nazillah & Fajar, 2023), differentiated learning (Nissa & Darmawan, 2024), the utilization of interactive media such as numerical boards and educational games (Cahyani et al., 2024), the use of flipped classroom models (Salsabilla et al., 2024), and the integration of ethnomathematics in learning (Setiyadi & Muttaqin, 2024). Initiatives such as *Kampus Mengajar* have also proven to contribute positively to the enhancement of numerical literacy through collaborative approaches based on schools and communities (Salsabilla et al., 2024).

Although diverse strategies have been implemented across various regions and levels, a systematic review that compiles, compares, and evaluates the effectiveness of these strategies comprehensively is not yet available. This gap hinders teachers, policymakers, and educational institutions from designing evidence-based approaches that are truly aligned with the conditions and characteristics of primary education in Indonesia.

This study employs a *Systematic Literature Review* (SLR), reviewing scientific literature conducted systematically, explicitly, and replicably to identify, select, and synthesize research findings related to strategies for improving primary school students' numerical literacy. By analyzing 60 scientific articles published within the last five years, this study aims to present a map of utilized strategies, assess the success of their implementation, and provide

recommendations for best practices relevant and applicable to primary education units. These findings are expected to enrich scientific references and serve as a guideline for policy-making and the development of more effective and contextual numeracy learning practices in Indonesia.

METHODOLOGY

This research utilizes a *Systematic Literature Review* (SLR) approach to identify, analyze, and synthesize strategies for enhancing numerical literacy at the primary school level. SLR was selected for its ability to provide a comprehensive and evidence-based overview of trends, approaches, and the effectiveness of strategies implemented across various educational contexts. The entire process was conducted in a systematic, transparent, and structured manner to ensure traceability and replicability.

Implementation Procedures

The implementation procedure began with the determination of focus and inclusion criteria. Selected articles were required to feature numerical literacy in primary school students as the main topic, contain instructional strategies or numerical interventions, and be published between 2018 and 2024. Only articles originating from accredited national journals, proceedings, and research reports based on official institutions were considered. All documents were collected through manual uploading based on independent screening by the researchers. From an initial total of 60 collected articles, 31 articles meeting all criteria were selected as the primary data for analysis. (Figure 1)

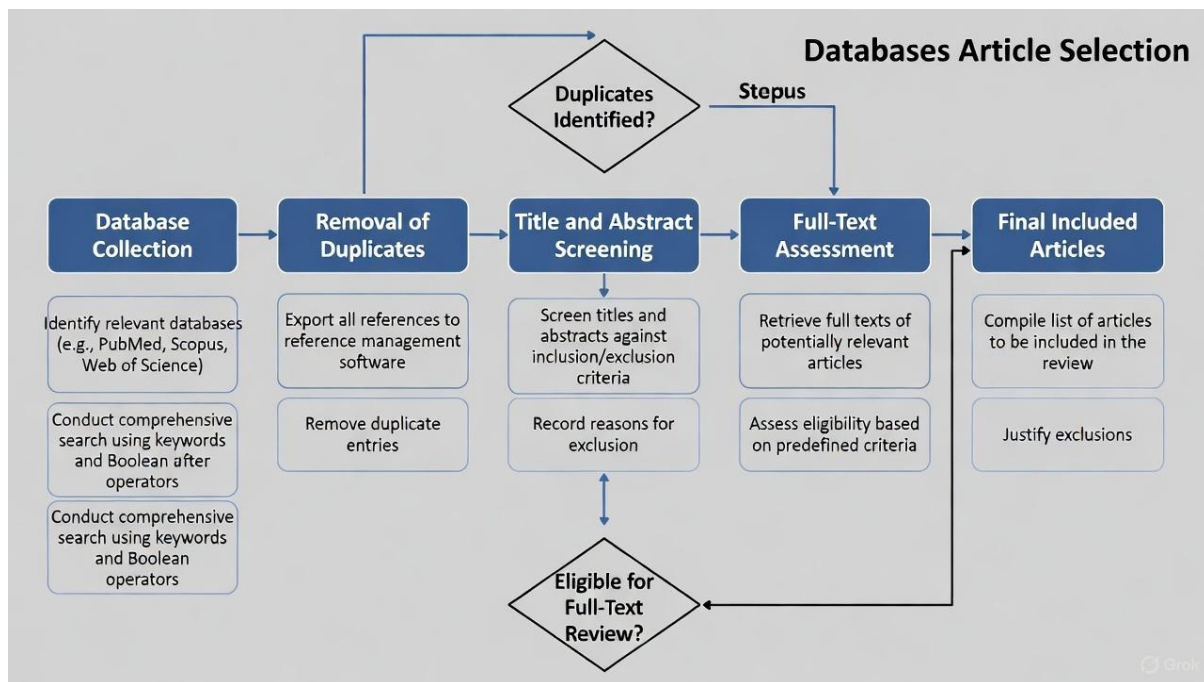


Figure 1. Flowchart of Database Collection and Article Selection Process

Data Collection and Instruments

Data collection was performed through a thematic document search using an analysis matrix based on instructional strategy components. Each article was analyzed using a literature review sheet containing information regarding: (1) article identity, (2) strategy or approach used, (3) school level and context, (4) main findings, (5) effectiveness or results, and (6) relevance to numerical literacy.

Data Analysis Technique

The analysis was conducted using a descriptive thematic approach, grouping identified strategies based on recurring patterns, such as media-based, contextual, collaborative, technological, or curricular. The findings were then mapped into a synthesis table and analyzed narratively to examine the strengths, weaknesses, and applicability of these strategies. The researchers also observed success indicators reported in the articles, including quantitative data (e.g., increased numerical literacy scores or t-tests) and qualitative data (e.g., teacher and student responses, as well as implementation constraints).

Data Validation

To ensure data accuracy and consistency, two independent readings were conducted for each article. Additionally, triangulation among researchers was performed in categorizing strategies and establishing thematic findings. The coding and classification process adhered to SLR accountability guidelines, specifically process clarity, source traceability, and analytical coherence.

RESULTS AND DISCUSSION

This study identified and analyzed 31 scientific articles discussing strategies for improving numerical literacy among primary school students in Indonesia. The results are presented in the form of a synthesis table and thematic descriptions, focusing on strategy patterns, instructional approaches, implementation contexts, and reported effectiveness.

Results

From the synthesis results, five dominant strategy categories used to improve numerical literacy in primary schools were identified:

1. Media-based and educational game strategies. Visual media such as rotary wheels (Cahyani et al., 2024), numeracy snakes and ladders (Salsabilla et al., 2024), and numerical boards were proven to increase student appeal and engagement. These media transform learning from passive to active and interactive.
2. Contextual and thematic strategies: Learning that links mathematical concepts to real life, local culture, and religious contexts encourages students to grasp numerical concepts in a more meaningful way (Setiyadi & Muttaqin, 2024).
3. Collaborative and community strategies. The involvement of Kampus Mengajar and school forums (FKKS) has yielded positive results, particularly in areas experiencing a shortage of numeracy teachers (Salsabilla et al., 2024).
4. Adaptive and differentiated strategies. This model attends to student readiness, learning styles, and interests. Differentiated instruction significantly increased engagement and numeracy results (Nissa & Darmawan, 2024).
5. Integration of technology in numeracy learning. The flipped classroom approach, supported by digital applications (GeoGebra, YouTube, Wordwall), facilitates more flexible and contextual learning (Salsabilla et al., 2024).

Based on these five categories, the frequency distribution of the retrieved articles was analyzed to identify trends in strategy implementation. The results of the numeracy strategy distribution are detailed in the following table

Table 1. Frequency Distribution of Numerical Literacy Strategies by Main Category

Strategy Category	Number of Articles (Frequency)
Interactive Media & Games	11
Contextual & Thematic	9
Collaborative & Community	6
Adaptive & Differentiated	3
Technology & Digital	2

Table 2. Overview of Strategies, Authors, and Key Findings from Literature on Numerical Literacy in Primary Education

No	Author(s) & Year	Main Strategy Category	Key Findings
1	Anne Gracia & Watini (2023)	Interactive Media & Games	The ATIK method, utilizing water painting, was found to significantly improve early numeracy skills in kindergarten students
2	Arie Wahyuni et al. (2023)	Interactive Media & Games	Implementation of play-based science-numeracy activities increased engagement and fostered a joyful learning environment in Early Childhood Education (PAUD).
3	Cahyani et al. (2024)	Interactive Media & Games	The use of spinning wheel media resulted in a significant enhancement of numeracy skills regarding plane figures ($t = 7.862, p < 0.05$)
4	Windari et al. (2024)	Interactive Media & Games	Traditional games were demonstrated to boost student motivation, self-confidence, and numerical proficiency
5	Nazillah & Fajar (2023)	Interactive Media & Games	The "Literacy-Numeracy Tree" project raised student interest in reading and numeracy from 10% to 50% over a four-week period.
6	Sidiq et al. (2023)	Interactive Media & Games	An interactive numeracy classroom design was shown to improve teacher creativity and enhance student motivation.
7	Sundari et al. (2023)	Interactive Media & Games	PjBL integrated with educational games was identified as highly effective within the Merdeka Curriculum framework.
8	Salsabilla et al. (2024)	Interactive Media & Games	The <i>Kampus Mengajar</i> program utilized numeracy games to successfully increase student learning motivation. mpus Mengajar: numeracy games increased motivation
9	Larasati & Yasin (2024)	Interactive Media & Games	(PjBL and digital simulations improved students' 21st-century numeracy skills
10	Ismafitri et al. (2024)	Interactive Media & Games	The study identified a lack of engaging media among teachers and recommended the development of interactive tools based on local contexts.
11	Setyansah & Lusiana (2020)	Interactive Media & Games	Web-based tutorials using MATLAB were found to strengthen numeracy literacy through digital methods.

No	Author(s) & Year	Main Category	Strategy	Key Findings
12	Parulian Siregar (2022)	Contextual Thematic	&	Contextual tasks based on daily life improved the application of numeracy skills in fifth-grade students.
13	Nurul Latifah et al. (2023)	Contextual Thematic	&	The study noted a deficiency in contextual numeracy problems within the current implementation of the Merdeka Curriculum.
14	Wahyudin Nur Nasution (2017)	Contextual Thematic	&	The literature highlights contextual strategies as essential for fostering meaningful mathematics learning.
15	Baiduri (2020)	Contextual Thematic	&	The study emphasized that numeracy in the Industry 4.0 era requires strong connections to real-world mathematical applications.
16	Kemdikbud (2017)	Contextual Thematic	&	Established official national support materials and guidelines for numeracy instruction
17	Setiyadi & Muttaqin (2024)	Contextual Thematic	&	The integration of ethnomathematics in <i>pesantren</i> (Islamic boarding schools) increased instructional relevance and numeracy performance
18	Susetyawati & Kintoko (2023)	Contextual Thematic	&	Junior high school students were observed to struggle significantly with lengthy contextual problems.
19	Sulisti & Janah (2023)	Contextual Thematic	&	The study reported a low average numeracy score of 55.1%, highlighting specific student deficiencies in data interpretation and contextual reasoning
20	Akhmad Air Puji et al. (2023)	Contextual Thematic	&	A flipped classroom model combined with a contextual approach resulted in a normalized gain score of 0.65, indicating medium instructional effectiveness.
21	Rosmita Sari Siregar (2022)	Collaborative Community	&	The implementation of the Group Investigation learning model was shown to improve numeracy outcomes among fifth-grade students
22	Supriatin & Syahbirin (2022)	Collaborative Community	&	The community-based "Rumah Literasi" program effectively engaged parents in supporting their children's numeracy development
23	Memolo (2018)	Collaborative Community	&	Collaborative activities involving peer data collection and group presentations were found to enhance statistical numeracy skills
24	Patriana et al. (2021)	Collaborative Community	&	Developing a school-wide numeracy culture through teacher collaboration proved effective in preparing students for AKM.
25	Husna et al. (2022)	Collaborative Community	&	A Systematic Literature Review (SLR) identified cooperative learning and PjBL as the most effective pedagogical strategies for numeracy.
26	Jayanti & Cesaria (2024)	Collaborative Community	&	Statistical analysis revealed that parental support and prior numeracy ability are significant predictors of story-problem performance ($R^2 = 0.624$)
27	Badawi (2023)	Adaptive Differentiated	&	The Developmentally Appropriate Practice (DAP) model was demonstrated to be an effective approach for accommodating diverse learners in primary education.
28	Septianthari et al. (2023)	Adaptive Differentiated	&	The study found that students' self-concept and motivation mediate the effectiveness of differentiated instruction strategies.
29	Nissa & Darmawan (2025)	Adaptive Differentiated	&	Differentiated instruction was observed to significantly improve individual student numeracy outcomes.

No	Author(s) & Year	Main Strategy Category	Key Findings
30	Yeni Listiana et al. (2023)	Technology Digital	& The utilization of numeric method materials assisted by GeoGebra software resulted in improved numerical literacy.
31	Muhtadi et al. (2023)	Technology Digital	& The integration of the "Math Master" application with digital tools increased numeracy achievement in upper primary and junior high school levels.

The data presented in Table 1 reveal variations in the strategies utilized for numeracy enhancement across primary education studies. The interpretation of these strategy categories is delineated below:

1. Interactive Media and Games represents the most frequently identified strategy, accounting for 11 studies. This category involves the widespread utilization of concrete and engaging tools, including spinning wheels, traditional games (e.g., *congklak*, snakes-and-ladders, *engklek*), numeracy trees, interactive classroom configurations, and web-based tutorials (Cahyani et al., 2024; Gracia & Watini, 2022; Ismafitri et al., 2024; Larasati & Mohamad Yasin, 2024; Nazillah & Fajar, 2023; Salsabilla et al., 2024; Sidiq et al., 2023; Wahyuni et al., 2022; Windari et al., 2024) .
2. Contextual & Thematic approaches rank second (9 studies) and emphasise connecting mathematics to students' daily lives, local culture, religious values (ethnomathematics in pesantren), and real-world problems (Baiduri, 2019; Latifah et al., 2023; Nasution, 2017; Puji et al., 2023; Setiyadi & Muttaqin, 2024; Siregar, 2022; Sulisti & Janah, 2023; Susetyawati, 2023).
3. Collaborative & Community strategies (6 studies) highlight the importance of involvement beyond the classroom, including parental engagement through Rumah Literasi, peer-group investigations, teacher collaboration forums, and the Kampus Mengajar program (Husna et al., 2022; Jayanti & Cesaria, 2024; Memolo, 2018; Patriana et al., 2021; Siregar, 2022; Supriatin & Syahbirin, 2022).
4. Adaptive & Differentiated instruction, although less common (3 studies), demonstrates high effectiveness when learning content, process, and products are adjusted according to students' readiness, interests, and learning profiles (Badawi, 2023; Nissa & Darmawan, 2024; Septianthari et al., 2023).

5. Technology & Digital strategies are still emerging (2 studies) but show promising results through the use of GeoGebra-assisted materials, digital modules (Math Master), and interactive simulations (Listiana et al., 2022; Muhtadi et al., 2025).

Discussion

The review of 31 articles indicates that while strategies for enhancing numerical literacy at the primary level are highly diverse, they can be thematically classified into five main approaches: interactive media, contextual-thematic approaches, collaborative-community approaches, differentiated instruction, and technology utilization. This variation demonstrates that there is no single most effective strategy; rather, success is determined by the alignment of the approach with the school context, student characteristics, and teacher readiness in designing meaningful numeracy instruction.

The most widely employed strategy is the use of interactive media and educational games, such as spinning wheels, numerical snakes and ladders, multiplication boards, and other concrete teaching aids. This strategy provides visual and kinesthetic stimulation that aids students in achieving a more concrete understanding of numeracy concepts (Cahyani et al., 2024; Salsabilla et al., 2024). This aligns with constructivist learning theory, which emphasizes the importance of direct experience in building conceptual understanding (Piaget, 2005 dalam Schunk, 2012b). Prior studies have also found that visual media and educational games can improve information retention and create a more enjoyable learning experience (Jayanti & Cesaria, 2024; Windari et al., 2024).

The contextual and thematic approach has emerged as an effective strategy for bridging abstract mathematical concepts with students' real lives. Learning that connects numeracy with local culture, religious activities, or the surrounding environment helps students understand the practical functions of numbers (Nazillah & Fajar, 2023; Setiyadi & Muttaqin, 2024). This strategy supports the framework of meaningful learning, as developed by Ausubel, which emphasizes connection between new knowledge and a student's existing cognitive structure (Ausubel, 1968 dalam Schunk, 2012b). The application of ethnomathematics and community-based projects also strengthens students' cultural identity and encourages confidence in using mathematics in daily life (Ismafitri et al., 2024).

Collaborative and community-based strategies, including the Kampus Mengajar program and teacher coordination forums, have proven effective in extending the reach of numerical literacy

beyond the formal classroom. This approach creates synergy between university students, teachers, and parents in building a numerate learning environment (Salsabilla et al., 2024; Sidiq et al., 2023) Community support not only improves access to learning media but also reinforces numeracy habits both at home and at school (Jayanti & Cesaria, 2024; Supriatin & Syahbirin, 2022).

Although not as prevalent as other strategies, differentiated instruction appears as a potential approach in accommodating the diversity of student abilities. By adjusting the content, process, and product of learning based on student readiness and interest, this approach allows each student to achieve optimal numerical development (Nissa & Darmawan, 2024). This principle accords with Vygotsky's theory of development regarding the Zone of Proximal Development (ZPD), which suggests that learning should be situated within the student's potential zone with appropriate support (Schunk, 2012b).

The final strategy, which is becoming increasingly relevant, is the utilization of digital technology, whether in the form of flipped classroom learning, numeracy learning applications, or the use of online media such as instructional videos and interactive quizzes (Salsabilla et al., 2024). Digital learning enables students to learn independently while teachers act as facilitators. This flexibility enhances student participation, particularly in the post-pandemic context and amid rising digital literacy.

From the overall review results, it is evident that the success of numerical literacy strategies is determined not only by the approach used but also by consistency in implementation, systemic support, and teacher competence. Previous research asserts the importance of teacher training in compiling context-based numeracy problems and in adapting instruction to student needs (Ismafitri et al., 2024; Sulisti & Janah, 2023). Without such support, even the best strategies will not function optimally.

Therefore, this study illustrates that effective numerical literacy approaches in primary schools are comprehensive, contextual, and collaborative, combining concrete, adaptive, and meaningful learning experiences. This research contributes to compiling an evidence-based map of numerical literacy strategies that can serve as a reference for teachers, policymakers, and educational institutions in designing appropriate and sustainable numeracy interventions.

CONCLUSION

Based on the systematic review of 31 scientific articles, this study concludes that the enhancement of numerical literacy among primary school students in Indonesia has been conducted through various instructional strategies that are contextual, collaborative, adaptive, media-based, and technology-integrated. These strategies do not stand alone but complement one another in creating numeracy instruction that is meaningful, applicable, and relevant to students' real lives.

The five main approaches identified are: (1) the use of interactive media and educational games; (2) contextual and thematic learning connecting mathematics with students' culture and lives; (3) community involvement in supporting numeracy culture through school forums and service programs such as *Kampus Mengajar*; (4) the application of differentiated instruction to accommodate learner diversity, and (5) the utilization of digital technology as a means to support the flexibility and accessibility of numeracy learning.

These findings answer the research question by demonstrating that there is no single universal strategy; rather, the success of numerical literacy enhancement depends on the strategy's alignment with the classroom context, teacher readiness, and comprehensive systemic support. Thus, the primary contribution of this research lies in mapping categories of strategies proven to be effective, thereby serving as a reference in designing numeracy instruction integrated with the characteristics of primary school students.

Recommendations from this study include the necessity of strengthening teacher capacity through training in the preparation of contextual numeracy instruction, the integration of community-based strategies, and the provision of digital platforms that support numerical literacy. This study also implies that education policy must encourage numeracy approaches that are interdisciplinary, based on real experience, and sensitive to cultural diversity and student learning needs. For future researchers, further studies could be directed toward testing the effectiveness of combinative strategies through quasi-experimental methods or action research in primary schools with diverse social and geographical backgrounds.

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