

The Effects of Numeracy Literacy, Learning Motivation, the Use of Instructional Media, and Learning Models on Elementary School Students' Mathematics Learning Outcomes

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ABSTRACT

Elementary mathematics learning outcomes are shaped by cognitive, affective, and instructional conditions, yet previous studies have often examined numeracy literacy, learning motivation, instructional media, and learning models separately. This literature review aimed to synthesize evidence on the contributions of these four dimensions and develop an integrated understanding of their relationships with elementary students' mathematics learning outcomes. A qualitative integrative literature review was conducted using 32 journal studies published between 2021 and 2025, covering international, national, and local Indonesian contexts. Studies were selected based on their relevance to at least one of the four dimensions and elementary mathematics learning outcomes. Data were organized in a literature matrix and analyzed through thematic content analysis and comparative synthesis. The findings indicate that numeracy literacy functions as a cognitive foundation for mathematical interpretation, reasoning, contextual application, and problem-solving. Learning motivation supports engagement, persistence, and active participation, while instructional media facilitate representation, exploration, and access to abstract mathematical concepts. Learning models organize opportunities for interaction, reasoning, application, and problem-solving. The critical synthesis shows that these factors are complementary rather than isolated predictors, with active mathematical engagement emerging as a central mechanism connecting learner capacities and instructional conditions to learning outcomes. The review concludes that elementary mathematics achievement is better understood through an integrated framework that aligns cognitive competence, motivation, instructional representations, and pedagogical organization. Future research should empirically test these interactions across diverse elementary contexts.

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INTRODUCTION

Mathematics learning in elementary education is increasingly viewed as a multidimensional process in which students' achievement is shaped not only by their mathematical knowledge but also by literacy, motivation, instructional resources, and learning approaches. At the international level, mathematics achievement remains closely associated with students' motivational and engagement characteristics. Xia et al. (2022), for example, demonstrated among 1,538 Chinese

primary students that motivation and engagement were associated with mathematics achievement. Similarly, Reinhold et al. (2021) found that motivational and emotional orientations were related to students' engagement and achievement when learning mathematics through an electronic textbook, while Pollack et al. (2021) showed that anxiety, motivation, and mathematical competence were interconnected among children with and without learning difficulties. More recent evidence further indicates that students experience different emotional profiles in mathematics, including fear, boredom, and enjoyment, with these experiences being relevant to motivation and achievement (Radišić et al., 2024). These findings suggest that mathematics learning outcomes cannot be understood solely from cognitive performance but should also be considered in relation to students' motivational and affective conditions.

The learning environment and instructional design also play an important role in shaping mathematics learning. Bednorz and Bruhn (2023) found that primary students' self-regulated learning profiles influenced their perceptions of technology-enhanced mathematics learning environments. In addition, İlhan (2021) demonstrated that game-based, modeling, and collaborative learning methods influenced mathematics achievement, motivation, and perceptions of visual mathematical literacy. Siller and Ahmad (2024) similarly showed that combining concrete and virtual manipulatives could support elementary students' mathematical achievement. These findings are consistent with evidence that multimedia can positively influence mathematics learning outcomes at the elementary level (Pasambo & Radia, 2022). Interactive digital applications have also been shown to improve students' mathematical understanding (Firdaus et al., 2022), while thematic instructional materials that incorporate higher-order thinking can support the development of numeracy literacy (Ritonga et al., 2024). More recently, gamification has been associated with increased mathematics learning motivation and learning outcomes (Ansori et al., 2025), and mathematics e-modules have been reported to support both learning outcomes and student motivation (Hidayah et al., 2025). Collectively, these studies indicate that the quality, format, and pedagogical use of instructional resources are important considerations in improving mathematics learning.

Within the Indonesian context, similar concerns have emerged regarding students' numeracy literacy, motivation, instructional media, and learning models. Numeracy literacy is particularly important because students are expected not merely to perform calculations but also to interpret information, apply mathematical concepts, reason, and solve contextual problems. Putri et al. (2024) found that elementary students encountered challenges when solving Minimum Competency Assessment (AKM) numeracy questions, indicating that numeracy literacy involves more than basic computational competence. Maysarah et al. (2024) likewise identified differences in numeracy literacy abilities among elementary students with different levels of mathematical performance. At the local level, Haryadi and Masjudin (2025) identified variations in the cognitive and technical readiness of elementary students in Lombok Barat in relation to numeracy literacy and ANBK. The importance of the numeracy dimension is also supported by Ningsih et al. (2022), who directly examined numeracy literacy and mathematics learning outcomes among third-grade students, and by Nursyifa and Masyithoh (2023), who reported a relationship between students' numeracy literacy and learning outcomes. Thus, numeracy literacy represents an important foundation for understanding elementary students' mathematics learning outcomes.

Students' motivational conditions constitute another important dimension. Nurawaliah et al. (2023) reported that learning style, attitudes toward mathematics, anxiety, and learning motivation were associated with mathematics learning outcomes. In a more specific elementary school context, Vidiанти et al. (2022) found a significant effect of learning motivation on mathematics

learning outcomes among fourth-grade students. Sholeha et al. (2023) further demonstrated the relevance of students' perceptions and learning interest to mathematics learning outcomes. These findings are supported by Anggraini et al. (2023), who found that Project-Based Learning influenced both students' motivation and mathematics learning outcomes. Suyasmini (2022) likewise reported that a scientific approach combined with the Jigsaw cooperative learning method could improve students' motivation and mathematics achievement. Beyond the school environment, Salminen et al. (2021) demonstrated that the home numeracy environment and familial factors also contribute to children's early numeracy and literacy development. Consequently, motivation and numeracy should be understood as interconnected dimensions within a broader learning environment rather than as isolated student characteristics.

Instructional media and learning models provide another important pathway for improving mathematics outcomes. Dewi and Agustika (2022) developed mathematics learning video media for sixth-grade students and demonstrated the relevance of contextual video-based resources in mathematics learning. Puspita et al. (2024) found that interactive Powtoon media had a significant effect on elementary students' mathematics learning outcomes. In the local context, Rahmawati et al. (2023) found that PONTIKA, or a mathematics number-tree learning medium, influenced the counting abilities of third-grade students in Lombok Tengah, while Saputra et al. (2025) showed that STAD assisted by Tangram Puzzle media influenced mathematics learning outcomes among third-grade students in Mataram. Evidence concerning learning models is similarly diverse. Wahyuni et al. (2024) reported improvements in mathematics outcomes through the Numbered Heads Together model; Nofita (2024), through meta-analysis, identified a substantial effect of Problem-Based Learning on mathematics outcomes; and Lestari and Manurung (2024) found positive contributions of Realistic Mathematics Education. Simamora et al. (2024) also reported significant improvement following the implementation of RME, while Rahmah and Lubis (2024) found that the Problem Posing model improved mathematics learning outcomes across successive classroom-action-research cycles. These findings demonstrate that different models and media can produce meaningful learning improvements, although their effects are frequently examined separately.

Despite this growing body of evidence, the existing literature remains fragmented. Previous studies have established relationships between numeracy literacy and mathematics outcomes (Ningsih et al., 2022; Nursyifa & Masyithoh, 2023), examined motivation and affective factors (Nurawaliah et al., 2023; Vidianti et al., 2022; Xia et al., 2022), evaluated instructional media (Dewi & Agustika, 2022; Puspita et al., 2024; Pasambo & Radia, 2022), and investigated particular learning models such as RME, PBL, Project-Based Learning, STAD, Jigsaw, NHT, and Problem Posing (Anggraini et al., 2023; Lestari & Manurung, 2024; Nofita, 2024; Rahmah & Lubis, 2024; Saputra et al., 2025; Simamora et al., 2024; Suyasmini, 2022; Wahyuni et al., 2024). Although these studies provide substantial evidence, they largely treat the four explanatory dimensions—numeracy literacy, learning motivation, instructional media, and learning models—as separate research objects. International studies have also tended to emphasize individual motivational, emotional, technological, or instructional factors (Bednorz & Bruhn, 2023; İlhan, 2021; Reinhold et al., 2021; Siller & Ahmad, 2024). Consequently, what remains insufficiently understood is how the evidence concerning these four dimensions can be synthesized within one analytical framework to explain elementary students' mathematics learning outcomes.

This limitation matters because mathematics achievement is produced through interactions between what students can do with mathematical information, how motivated they are to learn, what resources mediate their learning, and how learning activities are organized. Treating these

factors independently may obscure their complementary roles and make it difficult to identify the broader pattern emerging across the literature. The problem is therefore not simply the limited number of studies, but the fragmentation of evidence across conceptual, instructional, and learner-related dimensions. A literature review that integrates these dimensions is needed to clarify the consistency of findings, identify dominant patterns, recognize contextual differences, and determine how the four factors collectively relate to mathematics learning outcomes.

Accordingly, the novelty of the present study lies primarily in its integrative synthesis of four influential dimensions—numeracy literacy, learning motivation, instructional media, and learning models—within a single framework of elementary school mathematics learning outcomes. Rather than evaluating one intervention or one student characteristic, this study brings together findings from international, national, and local Indonesian research to construct a more comprehensive understanding of the factors associated with mathematics achievement. The study therefore offers conceptual and practical contributions by connecting learner-related factors, particularly numeracy literacy and motivation, with instructional factors, particularly media and learning models. It focuses specifically on how these dimensions individually and collectively contribute to mathematics learning outcomes in elementary education. Based on this focus, the present literature review aims to synthesize existing evidence on the effects of numeracy literacy, learning motivation, instructional media, and learning models on elementary school students' mathematics learning outcomes, while identifying patterns, limitations, and directions for future research.

METHODS

1. Research Approach and Design

This study employed a qualitative integrative literature review to synthesize previous research concerning the effects of numeracy literacy, learning motivation, instructional media, and learning models on elementary school students' mathematics learning outcomes. An integrative review was considered appropriate because the reviewed studies addressed the research problem from different perspectives, contexts, and methodological approaches. Rather than examining a single intervention, the review integrated findings across several related dimensions to develop a broader understanding of mathematics learning outcomes. Hart (2018) explained that a rigorous literature review required systematic identification, critical reading, evaluation, and synthesis of relevant evidence. Similarly, Sugiyono (2019) emphasized that research methodology should be selected according to the characteristics of the research problem and the type of evidence required. Accordingly, this study used an integrative rather than a narrowly intervention-focused review design.

2. Sources and Study Selection

The data sources consisted of 32 relevant journal studies published between 2021 and 2025. The studies were selected because they directly addressed at least one of the four main factors investigated in this review—numeracy literacy, learning motivation, instructional media, or learning models—and examined their relationship with mathematics learning outcomes among elementary school students. The selected literature included international studies as well as studies conducted in Indonesia, particularly research from national and local contexts such as Lombok, Mataram, and West Nusa Tenggara. Kumar (2019) noted that a research sample should be selected according to clearly defined characteristics that correspond to the research objectives. In educational research, Sukardi (2021) similarly explained that the selection of research sources should be aligned with the focus, population, and purpose of the study. Therefore, studies that did not concern elementary education, mathematics learning, or the variables examined in this review were excluded.

3. Search Strategy and Data Collection

The literature was collected through searches of scholarly journal sources using combinations of keywords related to the four principal factors and the outcome variable. The search terms included “numeracy literacy,” “learning motivation,” “instructional media,” “learning models,” “mathematics learning outcomes,” “elementary school students,” and their Indonesian equivalents. Searches were combined using relevant keyword variations to identify studies addressing either individual factors or their relationships with mathematics achievement. Hart (2018) emphasized that literature searching should be purposeful and sufficiently broad to identify relevant evidence while remaining consistent with the research focus. In addition, Setiawan et al. (2021) described literature-based research as requiring a planned process of identifying and organizing relevant sources according to the objectives of the study. In this study, the search and selection process resulted in 32 studies that met the predetermined relevance criteria and were subsequently included in the synthesis.

4. Data Extraction and Organization

Data were extracted from each selected study using a structured literature-review matrix. The extracted information included the authors and publication year, research context, participants or educational level, principal variables, instructional intervention or learning factor, research approach, and major findings related to mathematics learning outcomes. The information was subsequently organized into four analytical categories: (1) numeracy literacy, (2) learning motivation, (3) instructional media, and (4) learning models. The studies were also grouped according to international, national, and local contexts to facilitate comparison of findings. Creswell and Creswell (2018) explained that systematic organization of research information was important for establishing connections between research questions, evidence, and interpretation. Likewise, Sugiyono (2019) emphasized the importance of organizing research data systematically so that patterns and relationships could be identified accurately.

5. Data Analysis and Synthesis

The collected data were analyzed through thematic content analysis and comparative synthesis. First, findings from each study were identified and summarized according to the four analytical categories. Second, similar findings were grouped to identify recurring patterns concerning the relationship between each factor and mathematics learning outcomes. Third, differences in research context, instructional approach, and reported outcomes were compared. Finally, the findings were synthesized to explain how numeracy literacy, motivation, instructional media, and learning models individually and collectively contributed to elementary students’ mathematics learning outcomes. Sarosa (2021) explained that qualitative analysis involved organizing information, coding meaningful data, identifying categories, and developing interpretations from recurring patterns. Similarly, Booth et al. (2021) emphasized that literature reviews required systematic organization and synthesis of evidence to produce meaningful conclusions rather than merely listing previous studies. The final synthesis was therefore used to identify consistent findings, areas of limited evidence, and the research gap concerning the integrated relationship among the four factors and mathematics learning outcomes.

RESULTS

1. The Effect of Numeracy Literacy on Mathematics Learning Outcomes

The synthesis of the reviewed literature indicates that numeracy literacy is closely associated with elementary school students’ mathematics learning outcomes. Across the 32 studies examined in this literature review, the evidence concerning numeracy literacy suggests that mathematics achievement is not determined only by students’ ability to perform numerical operations. Rather,

learning outcomes are related to students' capacity to understand mathematical information, interpret quantities and representations, apply mathematical concepts in contextual situations, reason about relationships, and use mathematical procedures to solve problems. This interpretation is consistent with recent discussions of numeracy as a broader capability involving the use of mathematics for interpretation, evaluation, and decision-making in real-life contexts (Geiger & Schmid, 2024). The reviewed evidence therefore positions numeracy literacy as an important cognitive foundation through which students transform mathematical knowledge into meaningful and applicable mathematical performance.

a. Numeracy Literacy and Mathematical Understanding

The literature demonstrates a close relationship between numeracy literacy and students' mathematical understanding. Numeracy literacy requires students to move beyond recognizing numbers or carrying out routine calculations toward understanding what numerical and mathematical information represents. In elementary mathematics, this includes recognizing relationships among quantities, interpreting mathematical representations, connecting concepts, and applying mathematical ideas to situations presented through words, tables, symbols, diagrams, or everyday contexts. Consequently, students with stronger numeracy literacy are more likely to demonstrate mathematical understanding because they can interpret the meaning of mathematical information before selecting an appropriate procedure.

This relationship is also reflected in international research on early mathematical development. Salminen et al. (2021), for example, showed that the development of numeracy skills is associated with children's broader learning environment and familial conditions, indicating that mathematical development begins through repeated experiences with numbers and quantities before and during formal schooling. Similarly, longitudinal evidence from early childhood research has shown that early numeracy skills can provide an important foundation for subsequent mathematics achievement. These findings are important for elementary education because they suggest that mathematical learning outcomes are partly built on previously developed numerical understanding rather than being produced exclusively through classroom instruction.

The reviewed Indonesian studies provide more direct evidence. Ningsih et al. (2022) reported a significant relationship between numeracy literacy and mathematics learning outcomes among third-grade elementary students. Nursyifa and Masyithoh (2023) likewise identified a relationship between students' numeracy literacy and learning outcomes, reinforcing the argument that students' ability to interpret and use numerical information is connected with their academic performance in mathematics. Putri et al. (2024) further demonstrated that elementary students encountered difficulties when solving Minimum Competency Assessment (AKM) numeracy questions, particularly when tasks required interpretation, reasoning, and contextual application rather than direct computation. These findings indicate that mathematics learning outcomes are affected not simply by whether students know mathematical procedures, but by whether they can understand when and how those procedures should be used.

The distinction between procedural performance and conceptual understanding is particularly relevant. A student may correctly perform addition, subtraction, multiplication, or division in a routine exercise but experience difficulty when the same mathematical relationship is presented in a contextual problem. Numeracy literacy bridges this gap by requiring students to identify relevant information, establish mathematical relationships, interpret representations, and determine the meaning of the obtained answer. Thus, the literature suggests that stronger numeracy literacy can contribute to more meaningful mathematical understanding and, consequently, to stronger learning outcomes.

The findings of Maysarah et al. (2024) also support this interpretation by showing variation in numeracy literacy abilities among elementary students. Differences between higher- and lower-performing students indicate that numeracy competence is not homogeneous and that students' mathematical performance can vary according to their ability to interpret and use mathematical information. Ritonga et al. (2024) similarly emphasized the role of learning materials that promote higher-order thinking and numeracy literacy, suggesting that the development of numeracy requires opportunities for students to reason with mathematical information rather than merely memorize mathematical procedures.

The relationship is therefore best understood as a process: numeracy literacy enables students to interpret mathematical information, interpretation supports conceptual understanding, and conceptual understanding facilitates successful mathematical performance. The reviewed literature does not imply that numeracy literacy is the sole determinant of mathematics achievement; rather, it functions as one important cognitive component within a broader learning system that also includes motivation, instructional media, teaching models, prior knowledge, and learning environments.

b. Numeracy Literacy and Mathematical Problem-Solving

A second pattern emerging from the literature is the strong connection between numeracy literacy and mathematical problem-solving. Numeracy literacy becomes particularly visible when students encounter non-routine or contextual mathematical tasks in which the required operation is not explicitly stated. In such situations, students must first understand the problem, identify relevant information, represent the situation mathematically, select an appropriate strategy, perform the necessary calculation, and interpret the result. These processes are closely connected with the core characteristics of numeracy literacy.

Putri et al. (2024) provide particularly relevant evidence in this regard. Their analysis of elementary students' performance on AKM questions indicated that numeracy literacy problems involve challenges in interpretation, reasoning, and contextual application. This suggests that students may possess basic computational knowledge while still experiencing difficulties in using mathematics to address unfamiliar situations. Numeracy literacy therefore represents a higher-level use of mathematical knowledge in which students must determine the relationship between mathematical concepts and the context in which those concepts are embedded.

The reviewed literature also indicates that mathematical problem-solving is influenced by students' ability to connect different forms of mathematical representation. Numeracy tasks frequently require students to move between verbal descriptions, numerical information, symbols, tables, diagrams, and real-life situations. Such transitions require comprehension and reasoning rather than mechanical calculation. Accordingly, students with stronger numeracy literacy are better positioned to recognize mathematical structures within contextual problems and to select procedures that correspond to those structures.

International evidence reinforces the importance of this broader understanding of mathematics. Research on mathematical learning has emphasized that students' prior mathematical knowledge and early numeracy competencies influence later mathematics achievement, while systematic evidence from mathematics interventions demonstrates that successful mathematics interventions frequently target number sense, arithmetic, mathematical concepts, and related forms of mathematical reasoning. Thus, numeracy literacy can be understood not as an isolated school skill but as part of a developmental continuum extending from early numerical knowledge to more complex mathematical reasoning and problem-solving.

The reviewed studies further suggest that problem-solving ability is strengthened when students are given learning experiences that require them to use mathematics in meaningful contexts. Ritonga et al. (2024), for example, linked thematic learning materials with higher-order thinking and numeracy literacy. This is significant because contextual and higher-order tasks require students to analyze information, establish relationships, and justify solutions. Similarly, Ningsih et al. (2022) and Nursyifa and Masyithoh (2023) provide evidence from Indonesian elementary education that numeracy literacy is associated with mathematics learning outcomes.

The relationship can therefore be synthesized as follows: numeracy literacy supports the identification and interpretation of mathematical information; these abilities facilitate strategy selection and mathematical reasoning; and successful reasoning contributes to improved problem-solving performance and mathematics learning outcomes. This pattern also explains why students may obtain different results when completing routine exercises compared with contextual problems. The latter require a more integrated use of numerical knowledge, comprehension, reasoning, and mathematical communication.

c. Evidence from Previous Studies

1) International Studies

International studies provide a conceptual and empirical foundation for understanding numeracy as a multidimensional competence rather than a narrow computational ability. Salminen et al. (2021) demonstrated the importance of early developmental and environmental factors in the development of numeracy and literacy skills. Their longitudinal perspective is particularly relevant because it indicates that numeracy development is cumulative and can be shaped by learning experiences in both home and educational environments.

International literature also emphasizes that mathematical competence is closely connected with prior knowledge and the ability to use mathematical knowledge meaningfully. Research on mathematics learning has reported that prior knowledge influences students' subsequent learning outcomes and that early numeracy competencies can predict later mathematics achievement. In addition, research examining early mathematical development shows that mathematical skills encompass number recognition, counting, quantity comparison, calculation, mathematical concepts, and representation, illustrating that numeracy develops through interconnected competencies rather than through isolated numerical operations.

The international evidence therefore supports three main observations. First, numeracy develops progressively from early mathematical experiences. Second, numeracy involves both procedural and conceptual components. Third, numeracy becomes academically meaningful when students can use mathematical knowledge to understand and solve problems. These findings provide a broader theoretical basis for interpreting the Indonesian studies reviewed in this article.

2) National Studies

At the national level, the evidence more directly demonstrates the relationship between numeracy literacy and mathematics learning outcomes among Indonesian elementary school students. Ningsih et al. (2022) found that numeracy literacy was associated with mathematics learning outcomes among third-grade students. Nursyifa and Masyithoh (2023) similarly identified a relationship between numeracy literacy and student learning outcomes. Together, these studies provide direct support for the first research question of the present literature review.

Putri et al. (2024) add an important dimension by showing that students experience difficulties in solving numeracy-oriented AKM questions, particularly when tasks demand interpretation, reasoning, and contextual application. Maysarah et al. (2024) likewise identified differences in numeracy literacy performance among elementary students, indicating variation in

students' ability to use mathematical information effectively. These findings suggest that low mathematics achievement cannot always be interpreted as a lack of computational knowledge; in some cases, it may reflect difficulties in interpreting mathematical situations and transferring learned concepts into unfamiliar contexts.

Haryadi and Masjudin (2025), through their analysis of cognitive and technical readiness for numeracy literacy based on ANBK data in Lombok Barat, further indicate that numeracy performance is influenced by students' readiness to engage with numeracy tasks. This finding is particularly relevant to the present synthesis because it shows that numeracy literacy encompasses both cognitive capabilities and the practical ability to engage with assessment and learning demands.

Other studies among the 32 reviewed references provide complementary evidence about conditions that can support the development and application of numeracy. For example, Ritonga et al. (2024) demonstrated the relevance of thematic learning materials oriented toward higher-order thinking and numeracy literacy. Although such studies do not always measure numeracy literacy as the sole independent variable, they reinforce the finding that students need learning experiences that require interpretation, reasoning, application, and higher-order thinking if numeracy is to contribute meaningfully to mathematics learning.

3) Local Studies

Local studies from West Nusa Tenggara provide contextual evidence that strengthens the national findings. Ningsih et al. (2022) examined the relationship between numeracy literacy and mathematics learning outcomes among elementary students, while Rahmawati et al. (2023) investigated the use of PONTIKA, a mathematical number-tree learning medium, in relation to students' counting ability in SDN Karang Jangkong, Pringgarata, Central Lombok. Although the latter study focuses on instructional media rather than numeracy literacy as an independent variable, its findings are relevant because counting competence represents an important component of elementary numeracy development.

Haryadi and Masjudin (2025) provide particularly important local evidence through their examination of numeracy readiness among elementary students in Lombok Barat using ANBK-related data. Their findings indicate variation in students' cognitive and technical readiness, demonstrating that numeracy achievement in the local context cannot be separated from students' preparedness to engage with numeracy-oriented tasks.

Other local studies included in the broader 32-study corpus also demonstrate that mathematical outcomes are shaped by factors that interact with numeracy development. Sholeha et al. (2023), for example, examined perceptions and learning interest in relation to mathematics outcomes among fifth-grade students in Lombok Barat, while Saputra et al. (2025) investigated the effect of STAD combined with Tangram Puzzle media on mathematics outcomes among third-grade students in Mataram. These studies do not directly establish that numeracy literacy causes higher mathematics achievement; instead, they demonstrate that the relationship between numeracy and mathematics outcomes operates within a wider instructional and learner context.

The local evidence is therefore consistent with the national pattern but also highlights contextual variation. Students may possess different levels of numerical readiness, mathematical understanding, learning interest, and exposure to instructional resources. Consequently, numeracy literacy should be developed through learning environments that provide repeated opportunities to interpret, reason, communicate, and apply mathematics to meaningful situations.

d. Synthesis of the Relationship Between Numeracy Literacy and Mathematics Learning Outcomes

The overall synthesis indicates a positive and theoretically coherent relationship between numeracy literacy and mathematics learning outcomes at the elementary school level. Across the reviewed literature, numeracy literacy appears to function as a bridge between mathematical knowledge and mathematical application. Students are required not only to know mathematical procedures but also to understand numerical information, identify relationships, interpret representations, select appropriate strategies, solve contextual problems, and evaluate the meaning of their solutions. These capabilities are directly relevant to the forms of performance represented in mathematics learning outcomes.

The evidence can be summarized through four interconnected mechanisms. First, numeracy literacy strengthens mathematical understanding by requiring students to interpret quantities, relationships, symbols, and representations. Second, it supports mathematical problem-solving because students must identify relevant information, formulate mathematical strategies, and apply concepts to contextual situations. Third, it facilitates transfer, allowing students to apply classroom mathematics beyond routine exercises to unfamiliar and real-world problems. Fourth, its contribution to learning outcomes is conditioned by the learning environment, including prior knowledge, instructional materials, motivation, and opportunities for meaningful mathematical practice.

Importantly, the literature does not support an interpretation in which numeracy literacy operates independently from all other educational factors. Rather, the 32 reviewed studies suggest a multidimensional structure in which learner characteristics and instructional conditions interact. Evidence on motivation, instructional media, and learning models in the broader corpus indicates that these factors can create learning conditions in which numeracy skills are more effectively developed and applied. For example, studies of instructional materials, technology, concrete and virtual manipulatives, and mathematics learning models demonstrate that students' mathematical performance can respond to the ways in which mathematical concepts are represented and practiced. This broader pattern is consistent with systematic evidence showing that mathematics interventions frequently produce effects on mathematical achievement and related skills, although the magnitude and type of effects vary across educational settings and intervention designs.

Accordingly, the principal finding for the first research question is that numeracy literacy is an important contributor to elementary students' mathematics learning outcomes because it enables students to transform mathematical knowledge into understanding, reasoning, problem-solving, and contextual application. The strongest pattern across the literature is not simply that students who are "good at numeracy" obtain higher mathematics scores, but that the competencies embedded in numeracy literacy—interpretation, reasoning, representation, application, and problem-solving—correspond closely with the cognitive processes required for successful mathematics learning. The evidence from international, national, and local studies converges on this relationship, while also indicating that the development of numeracy literacy is embedded within broader motivational, instructional, and environmental conditions.

2. The Contribution of Learning Motivation, Instructional Media, and Learning Models

The synthesis of the reviewed literature indicates that mathematics learning outcomes among elementary school students are influenced not only by cognitive competencies such as numeracy literacy but also by motivational, instructional, and pedagogical factors. Across the reviewed studies, learning motivation, instructional media, and learning models emerged as interconnected components of the mathematics learning process. Learning motivation determines students'

willingness to participate and persist in mathematical activities, instructional media influence how mathematical concepts are represented and experienced, while learning models structure the ways in which students interact with mathematical problems, teachers, peers, and learning resources. The evidence therefore suggests that improvements in mathematics learning outcomes are more appropriately understood as the result of interactions between learner-related and instructional factors rather than as the consequence of a single educational intervention.

a. Learning Motivation and Mathematics Learning Outcomes

Learning motivation emerged as an important learner-related factor associated with mathematics learning outcomes. The reviewed literature indicates that students' motivation affects their willingness to engage in mathematical tasks, maintain attention, persist when encountering difficulties, and participate actively in classroom activities. Mathematics often requires sustained cognitive effort, particularly when students encounter abstract concepts or unfamiliar problems. Consequently, students who are motivated to learn are more likely to devote effort to mathematical activities and continue working when an initial strategy does not produce the expected solution.

Xia et al. (2022), in a study involving Chinese primary students, examined the relationship among motivation, engagement, and mathematics achievement and demonstrated the relevance of motivational processes to mathematics performance. Reinhold et al. (2021) similarly showed that motivational and emotional orientations were connected with engagement and achievement in mathematics learning. These findings indicate that motivation should not be regarded merely as an affective characteristic that exists separately from academic achievement. Rather, motivation operates through students' engagement with learning activities and their willingness to invest effort in mathematical learning.

The Indonesian evidence is consistent with this pattern. Nurawaliah et al. (2023) identified learning motivation as one of several learner-related factors associated with mathematics learning outcomes, together with learning style, attitudes toward mathematics, and mathematics anxiety. Vidiанти et al. (2022) likewise reported a relationship between learning motivation and mathematics learning outcomes among elementary students. Sholeha et al. (2023) further demonstrated the relevance of students' perceptions and learning interest to mathematics outcomes. Taken together, these studies suggest that positive motivational conditions can support students' involvement in mathematics learning, although motivation should be considered alongside other cognitive and contextual factors.

1) Motivational and Affective Factors

The literature reveals that motivation interacts with several affective dimensions, particularly interest, attitudes, anxiety, confidence, and emotional orientation toward mathematics. Students' perceptions of mathematics can influence whether they approach mathematical tasks as meaningful learning opportunities or as difficult activities to be avoided. Nurawaliah et al. (2023) demonstrated that attitudes toward mathematics, anxiety, and motivation were related to mathematics learning outcomes, indicating that affective experiences may either support or constrain students' engagement with mathematical tasks.

This pattern is also supported by international evidence. Pollack et al. (2021) examined anxiety, motivation, and mathematical competence among children with and without learning difficulties and emphasized the interconnectedness of these dimensions. Radišić et al. (2024), through an analysis of primary students' academic emotions toward mathematics, identified different emotional profiles associated with students' experiences of mathematics. Such findings indicate that mathematics learning is not exclusively a cognitive process; students' emotional responses to mathematical activities can shape their willingness to participate and persist.

Motivation can therefore be understood as a mechanism linking students' affective orientation to their academic behavior. When students perceive mathematics as meaningful and manageable, they may be more willing to participate, practice, ask questions, and attempt alternative strategies. Conversely, negative emotional experiences may reduce persistence and engagement. However, the literature does not support a simple causal interpretation in which motivation alone determines achievement. Instead, motivation interacts with instructional quality, prior knowledge, learning resources, and classroom experiences.

An important pattern also emerges from studies examining mathematics learning models. Anggraini et al. (2023), for example, found that Project-Based Learning was associated with both motivation and mathematics learning outcomes among elementary students. This suggests that motivation is not merely an individual characteristic that teachers must accept as given; it can also be influenced by the design of learning experiences. Learning environments that provide meaningful tasks, collaboration, autonomy, and opportunities to apply mathematics may contribute to students' motivation while simultaneously supporting mathematical achievement.

2) Evidence from Previous Studies

The evidence concerning motivation can be organized into three recurring patterns. First, motivation is associated with engagement. Xia et al. (2022) showed that motivation and engagement are relevant to mathematics achievement, indicating that motivated students are more likely to participate actively in learning. Second, motivation interacts with affective experiences. Reinhold et al. (2021), Pollack et al. (2021), and Radišić et al. (2024) demonstrate that motivation, emotions, and mathematics achievement should be considered as interconnected dimensions. Third, instructional design can contribute to motivational conditions. Anggraini et al. (2023) found that PjBL was related to students' motivation and mathematics achievement, while Ansori et al. (2025) reported positive effects associated with gamification on motivation and mathematics learning outcomes.

The evidence thus suggests that motivation contributes to mathematics learning outcomes through engagement, persistence, and active participation. It is also influenced by the characteristics of learning activities and instructional environments. Motivation should consequently be interpreted as both a learner-related factor and a dimension that can be supported through appropriate instructional design.

b. Instructional Media and Mathematics Learning Outcomes

The second major pattern concerns the contribution of instructional media to mathematics learning outcomes. The reviewed studies indicate that instructional media can make abstract mathematical concepts more accessible by providing visual, concrete, interactive, or digital representations. This function is particularly relevant at the elementary level, where students are still developing the capacity to move from concrete experiences toward abstract mathematical reasoning.

Instructional media can support learning through several mechanisms. First, media can provide representations of mathematical objects and relationships that are difficult to communicate through verbal explanation alone. Second, interactive media can provide opportunities for students to manipulate mathematical representations and receive immediate responses. Third, concrete materials can connect mathematical concepts with physical objects and observable relationships. Fourth, digital media can combine visual, auditory, textual, and interactive elements to support students with different learning needs.

Pasambo and Radia (2022), through a meta-analysis of multimedia in elementary mathematics learning, reported a positive effect of multimedia on mathematics learning outcomes.

Firdaus et al. (2022) similarly demonstrated the relevance of Macromedia Flash for improving elementary students' mathematical understanding. These findings support the interpretation that media can function not merely as supplementary classroom equipment but as a pedagogical resource that changes how mathematical concepts are presented and practiced.

1) Digital, Interactive, and Concrete Media

The reviewed literature reveals three broad categories of instructional media: digital media, interactive media, and concrete or manipulative media. Digital media include electronic modules, multimedia applications, gamification, and technology-supported learning environments. Interactive media allow students to respond to, manipulate, or explore mathematical representations. Concrete media provide physical representations through objects or manipulatives that help students connect mathematical concepts with observable experiences.

Hidayah et al. (2025) reported that mathematics e-modules were associated with mathematics learning outcomes and student motivation. Ansori et al. (2025) likewise found that gamification could support motivation and mathematics outcomes. These studies suggest that digital media may contribute not only through the presentation of content but also by increasing students' engagement with mathematical tasks.

Evidence concerning manipulatives further strengthens this interpretation. Siller and Ahmad (2024) examined blended instruction involving concrete and virtual manipulatives and found relevance to elementary students' mathematical achievement. The combination of concrete and virtual representations is particularly important because it provides students with opportunities to explore mathematical concepts through multiple forms of representation. Rather than replacing concrete experiences with technology, blended approaches can connect physical manipulation with digital visualization.

Indonesian studies provide complementary evidence. Dewi and Agustika (2022) examined mathematics learning videos for sixth-grade elementary students, while Puspita et al. (2024) investigated interactive Powtoon media and mathematics learning outcomes. Rahmawati et al. (2023) examined PONTIKA, a number-tree learning medium, in relation to elementary students' counting ability. Saputra et al. (2025) combined the STAD learning model with Tangram Puzzle media in mathematics learning. Together, these studies demonstrate that the contribution of media is not restricted to digital technologies. Concrete, visual, audiovisual, and interactive resources can all provide alternative ways of representing mathematical ideas.

The synthesis nevertheless indicates that media effectiveness depends on pedagogical integration. Technology or visual materials do not automatically improve mathematics learning simply because they are novel or attractive. Their contribution is more meaningful when the medium corresponds with the mathematical concept, supports students' cognitive activity, and is integrated into a coherent learning sequence. This interpretation is consistent with research on technology-enhanced mathematics learning environments, which emphasizes the interaction between students' self-regulation and the characteristics of technology-supported learning environments (Bednorz & Bruhn, 2023).

2) Evidence from Previous Studies

The evidence concerning instructional media indicates three principal patterns. First, multimedia and digital resources can support mathematical achievement and understanding. Pasambo and Radia (2022), Firdaus et al. (2022), and Hidayah et al. (2025) provide evidence in this direction. Second, interactive and concrete representations can facilitate students' engagement with mathematical concepts. Siller and Ahmad (2024) demonstrated the relevance of combining concrete and virtual manipulatives, while Rahmawati et al. (2023) and Saputra et al. (2025) illustrate

the contribution of concrete or puzzle-based media in Indonesian elementary mathematics settings. Third, media can interact with motivation. Gamification, interactive resources, and technology-supported learning can increase students' attention and engagement, which may subsequently support mathematics learning outcomes.

The evidence therefore indicates that instructional media contribute to mathematics learning not simply by delivering information but by changing the form in which students encounter mathematical concepts. Effective media can make mathematical relationships more visible, manipulable, contextual, and engaging. Nevertheless, the literature suggests that the quality of pedagogical implementation remains more important than the technological sophistication of the medium itself.

c. Learning Models and Mathematics Learning Outcomes

The third dimension concerns learning models. The reviewed studies consistently indicate that the structure of classroom interaction influences students' opportunities to understand, practice, communicate, and apply mathematical knowledge. Learning models determine whether students primarily receive explanations, work collaboratively, investigate problems, develop projects, connect mathematics with real-life situations, or construct solutions through guided inquiry.

The evidence from the 32 reviewed studies indicates that several learning models have been associated with improvements in mathematics learning outcomes, including cooperative learning, Project-Based Learning (PjBL), Problem-Based Learning (PBL), and Realistic Mathematics Education (RME). However, the mechanisms through which these models support achievement differ. Cooperative models emphasize peer interaction and shared responsibility; PjBL emphasizes sustained activities and meaningful products; PBL emphasizes problem analysis and solution development; and RME emphasizes connections between mathematical concepts and real-life contexts.

1) Cooperative and Project-Based Learning Models

Cooperative learning appears repeatedly in the reviewed literature as a model capable of supporting mathematics learning through interaction among students. Wahyuni et al. (2024), for example, reported improved mathematics learning outcomes following the application of the Numbered Heads Together (NHT) cooperative learning model. The model creates opportunities for students to discuss mathematical tasks, compare reasoning, and take collective responsibility for producing answers.

Suyasmini (2022) similarly reported that a scientific approach combined with the Jigsaw cooperative learning model supported students' motivation and mathematics learning outcomes. Although this study involves a particular instructional combination, its findings are relevant to the broader synthesis because they illustrate how collaborative structures can simultaneously influence motivational engagement and academic performance.

Project-Based Learning provides another form of active learning. Anggraini et al. (2023) found that PjBL was associated with improved mathematics outcomes and motivation among elementary students. Project-based activities can create opportunities for students to use mathematics in extended tasks, collaborate with peers, make decisions, and produce meaningful outcomes. In this sense, PjBL connects cognitive and motivational processes rather than treating them as separate dimensions.

The reviewed evidence suggests that cooperative and project-based approaches are particularly relevant when mathematics learning requires communication, application, and active participation. Their contribution is therefore not limited to the acquisition of mathematical

procedures but may extend to students' engagement with mathematical tasks and their ability to explain and negotiate mathematical ideas.

2) Problem-Based and Realistic Mathematics Learning Models

Problem-Based Learning represents another important instructional approach identified in the reviewed literature. Nofita (2024), through a meta-analysis of 15 studies, found a positive effect of PBL on mathematics learning outcomes among elementary students. The reported average effect size was 1.302231, indicating a substantial effect across the analyzed studies.

More recent meta-analytic evidence also supports the relationship between PBL and mathematical problem-solving. Salsabila and Asih (2024), in a meta-analysis of ten studies, reported a positive effect of PBL on students' mathematical problem-solving ability, with an effect size of $r = .642$. These findings are relevant to the present review because problem-solving represents an important component of mathematics learning outcomes and is closely related to numeracy literacy discussed in the previous subsection.

PBL may contribute to mathematics achievement because it changes the role of students from recipients of mathematical procedures to active problem solvers. Students are required to examine a problem, identify relevant information, formulate strategies, test possible solutions, and communicate their reasoning. Such processes correspond with higher-order mathematical activity and provide opportunities for students to integrate conceptual understanding with procedural knowledge.

Realistic Mathematics Education provides a related but distinct approach. RME emphasizes meaningful contexts and connects mathematical concepts with situations that students can recognize from everyday life. Lestari and Manurung (2024) reported a positive contribution of RME to elementary students' mathematics learning outcomes. Simamora et al. (2024) likewise found a significant positive influence of RME on mathematics learning outcomes among second-grade elementary students.

The contribution of RME is particularly relevant to numeracy because contextualization requires students to interpret mathematical information within meaningful situations. Rather than introducing mathematical procedures as isolated rules, RME provides opportunities for students to understand why mathematical procedures are relevant and how they can be applied. Recent evidence likewise indicates that RME can support both mathematics learning outcomes and motivation among elementary students, reinforcing the connection between instructional context and affective engagement.

Thus, PBL and RME share an emphasis on meaningful mathematical activity but operate through somewhat different mechanisms. PBL places greater emphasis on the investigation and solution of problems, whereas RME emphasizes the mathematization of meaningful real-world situations. Both approaches, however, reduce the separation between mathematical knowledge and its application.

3) Evidence from Previous Studies

The evidence across learning models demonstrates that no single model operates through exactly the same mechanism. Cooperative learning primarily provides social interaction and shared cognitive activity; PjBL provides extended, meaningful tasks; PBL develops problem analysis and solution strategies; and RME connects mathematical concepts with realistic contexts. Nevertheless, the models share a common characteristic: they increase opportunities for students to become actively involved in mathematical learning.

The reviewed evidence can therefore be synthesized into four patterns. First, cooperative learning supports mathematics outcomes through interaction and shared participation, as

demonstrated by studies of NHT and Jigsaw (Suyasmini, 2022; Wahyuni et al., 2024). Second, PjBL links motivation and mathematics achievement through meaningful project activities (Anggraini et al., 2023). Third, PBL supports mathematical learning through contextual problem-solving and active inquiry, with meta-analytic evidence indicating positive effects on mathematics outcomes and problem-solving (Nofita, 2024; Salsabila & Asih, 2024). Fourth, RME supports achievement by connecting mathematical concepts with meaningful real-world contexts (Lestari & Manurung, 2024; Simamora et al., 2024).

Overall, the synthesis demonstrates that learning models contribute to mathematics learning outcomes by shaping the quality of students' mathematical experiences. Models that provide opportunities for interaction, contextualization, problem-solving, investigation, and application tend to create conditions in which students can engage more deeply with mathematics. However, the reviewed evidence also indicates that the effectiveness of a learning model depends on implementation, student characteristics, instructional objectives, and the learning environment. A model should therefore not be interpreted as universally effective independent of context.

Taken together, the findings for the second research question indicate that learning motivation, instructional media, and learning models contribute to mathematics learning outcomes through complementary mechanisms. Motivation provides the willingness and persistence to engage; instructional media provide representations and learning resources through which mathematical ideas can be explored; and learning models organize the interaction and activities through which students construct and apply mathematical knowledge. Their contribution is therefore interconnected rather than additive in a simple mechanical sense.

The literature suggests a conceptual chain in which motivation encourages engagement, instructional media facilitate access to and representation of mathematical concepts, and appropriate learning models organize meaningful mathematical activity; these processes together create conditions that can support stronger mathematics learning outcomes. This interpretation is consistent with the broader evidence that technology-enhanced environments, interactive resources, and student-centered instructional models can influence engagement, understanding, and achievement, while their effects remain dependent on pedagogical design and implementation.

Accordingly, the findings do not indicate that motivation, media, or learning models should be treated as isolated predictors of mathematics achievement. Rather, they should be understood as mutually supportive dimensions of the learning process. Students are more likely to benefit from instructional media when they are motivated to engage with them, while learning models determine how those media are used and what kinds of mathematical thinking students are expected to perform. This interconnectedness provides the basis for the next section, which synthesizes how numeracy literacy, learning motivation, instructional media, and learning models collectively influence elementary school students' mathematics learning outcomes.

3. Integrated Influence of Numeracy Literacy, Learning Motivation, Instructional Media, and Learning Models

The synthesis of the 32 reviewed studies indicates that elementary school students' mathematics learning outcomes are shaped by the interaction of cognitive, affective, and instructional factors. Numeracy literacy represents an important cognitive foundation because students need to interpret numerical information, reason mathematically, and apply mathematical concepts to solve problems. Learning motivation provides the willingness and persistence required to engage with mathematical tasks. Instructional media provide concrete, visual, digital, or interactive representations that facilitate access to mathematical concepts, while learning models organize the activities through which students discuss, investigate, practice, and apply mathematics.

The reviewed literature therefore suggests that these four factors should not be viewed as independent educational components but as interconnected dimensions of mathematics learning.

a. Interrelationships among the Four Factors

The first pattern identified in the literature is the interrelationship between numeracy literacy and the instructional and affective conditions in which it develops. Numeracy literacy requires students to actively interpret, reason, and apply mathematical information. Such processes are unlikely to develop fully when students merely memorize procedures or passively receive explanations. They require sustained engagement with mathematical tasks, meaningful representations, and instructional activities that encourage reasoning and application.

The relationship between motivation and numeracy is particularly important. Students who are motivated to learn mathematics are more likely to participate actively, persist when solving challenging problems, and practice mathematical reasoning. Xia et al. (2022) identified relationships among motivation, engagement, and mathematics achievement, while Reinhold et al. (2021) demonstrated the relevance of motivational and emotional orientations to engagement and achievement in mathematics. Indonesian evidence similarly connects motivation with mathematics learning outcomes (Nurawaliah et al., 2023; Vidiанти et al., 2022). These findings suggest that the development and application of numeracy literacy occur within an affective environment that can either support or constrain students' mathematical engagement.

Instructional media provide another important connection. Numeracy tasks frequently require students to interpret numbers, diagrams, tables, symbols, quantities, and contextual information. Appropriate media can make these representations more accessible and enable students to explore relationships that may otherwise remain abstract. Pasambo and Radia (2022) found a positive effect of multimedia on elementary mathematics learning outcomes, while Siller and Ahmad (2024) demonstrated the relevance of combining concrete and virtual manipulatives for mathematical achievement. Digital and interactive resources may therefore provide opportunities through which numeracy knowledge can be represented and practiced.

Learning models determine how these resources and mathematical competencies are brought together. Cooperative learning creates opportunities for students to discuss mathematical reasoning, PjBL provides extended opportunities for application, PBL emphasizes problem analysis and solution development, and RME connects mathematical concepts with realistic situations. The evidence from Wahyuni et al. (2024), Anggraini et al. (2023), Nofita (2024), and Lestari and Manurung (2024) illustrates that different instructional models can support mathematics outcomes through different pedagogical mechanisms.

The four factors can therefore be understood as a connected process:

Numeracy Literacy → Mathematical Understanding and Reasoning → Engagement and Application → Mathematics Learning Outcomes

This process is strengthened when learning motivation sustains student engagement, instructional media facilitate mathematical representation and exploration, and learning models provide structured opportunities for students to apply and communicate mathematical knowledge. The relationship is consequently better represented as an interacting system than as a linear model in which each factor independently produces an outcome.

b. Complementary Roles of Learner and Instructional Factors

The reviewed literature reveals a distinction between learner-related factors and instructional factors while simultaneously demonstrating their complementarity. Numeracy literacy and learning motivation primarily represent characteristics or capacities that students bring to the learning

process, whereas instructional media and learning models are largely determined by pedagogical design. However, the two categories continuously interact during mathematics learning.

Numeracy literacy provides students with the cognitive resources needed to interpret and solve mathematical problems. Motivation influences whether students are willing to mobilize those resources. A student may possess adequate mathematical knowledge but fail to demonstrate it consistently when motivation, interest, or persistence is low. Conversely, motivation alone cannot compensate fully for limited mathematical understanding or numeracy competence. The literature on motivation, anxiety, and competence supports this interaction, showing that affective and cognitive dimensions of mathematics learning are closely connected (Pollack et al., 2021; Radišić et al., 2024).

Instructional media and learning models provide the external conditions through which these learner capacities can be activated. For example, visual and interactive media can provide representations that help students understand mathematical relationships, while cooperative or problem-based models can encourage students to explain and negotiate their mathematical reasoning. Bednorz and Bruhn (2023) demonstrated the relevance of students' self-regulated learning profiles to their perceptions of technology-enhanced mathematics learning environments, illustrating that the same instructional environment may be experienced differently according to learner characteristics.

The reviewed studies therefore indicate that effective mathematics learning involves a fit between learner capacity and instructional conditions. Numeracy literacy becomes more useful when students encounter tasks that require its application; motivation is strengthened when learning activities are meaningful and appropriately challenging; media become more effective when they correspond with the mathematical concepts being taught; and learning models become more productive when they provide activities appropriate to students' developmental and cognitive needs.

This complementarity can be summarized as follows:

- 1) Numeracy literacy provides cognitive capacity for interpreting and applying mathematics.
- 2) Learning motivation provides engagement, persistence, and willingness to participate.
- 3) Instructional media provide representations and resources for mathematical exploration.
- 4) Learning models provide structures for interaction, reasoning, practice, and application.

The four roles are complementary rather than interchangeable. Consequently, strengthening one dimension does not necessarily eliminate the need for the others.

c. Patterns and Differences across Previous Studies

Although the reviewed studies generally indicate positive relationships between the four factors and mathematics learning outcomes, important differences appear in research focus, educational context, intervention type, and measured outcomes. These differences are important because they prevent the findings from being interpreted as evidence that every instructional approach produces the same effect under all conditions.

First, studies focusing on numeracy literacy tend to emphasize students' cognitive abilities to interpret, reason, and apply mathematical information. Ningsih et al. (2022) and Nursyifa and Masyithoh (2023) provide evidence of the relationship between numeracy literacy and mathematics learning outcomes, while Putri et al. (2024) and Maysarah et al. (2024) highlight differences and challenges in elementary students' numeracy performance. Haryadi and Masjudin (2025) add evidence concerning cognitive and technical readiness for numeracy literacy in Lombok Barat. These studies tend to conceptualize the problem from the perspective of students' mathematical competence.

Second, studies of learning motivation place greater emphasis on affective engagement. Xia et al. (2022), Reinhold et al. (2021), Pollack et al. (2021), and Radišić et al. (2024) demonstrate that motivation, emotions, engagement, anxiety, and competence are interconnected. Indonesian studies similarly identify motivation, interest, and attitudes as relevant factors in mathematics learning (Nurawaliah et al., 2023; Vidiанти et al., 2022; Sholeha et al., 2023). The central difference is therefore that these studies explain mathematics outcomes partly through students' willingness and emotional orientation toward learning.

Third, studies concerning instructional media emphasize the role of representation and learning resources. Pasambo and Radia (2022) reported positive effects of multimedia, while Firdaus et al. (2022), Dewi and Agustika (2022), Puspita et al. (2024), Hidayah et al. (2025), and Rahmawati et al. (2023) examined different forms of digital, audiovisual, interactive, electronic, and concrete media. Siller and Ahmad (2024) further demonstrate that concrete and virtual manipulatives can be combined in mathematics instruction. The differences among these studies indicate that "instructional media" is not a homogeneous category; the pedagogical function of a concrete manipulative is different from that of an e-module, video, multimedia application, or gamified platform.

Fourth, studies of learning models demonstrate variation in how mathematics learning is organized. Cooperative models such as NHT and Jigsaw emphasize peer interaction (Wahyuni et al., 2024; Suyasmini, 2022). PjBL emphasizes extended and meaningful project activities (Anggraini et al., 2023). PBL emphasizes mathematical problem-solving and inquiry, with meta-analytic evidence supporting its positive contribution to mathematics outcomes (Nofita, 2024). RME emphasizes contextualization and the connection between mathematical concepts and realistic situations (Lestari & Manurung, 2024; Simamora et al., 2024).

Despite these differences, a common pattern emerges: the studies generally report more favorable mathematics learning outcomes when students are given opportunities to engage actively with mathematical content, use appropriate representations, interact with others, apply concepts, and solve meaningful problems. The differences therefore concern the mechanisms and contexts through which these opportunities are provided rather than a fundamental contradiction among the studies.

The international studies tend to provide broader evidence concerning motivation, emotions, technology-enhanced learning, early numeracy development, and mathematical competence (Salminen et al., 2021; Xia et al., 2022; Bednorz & Bruhn, 2023; Siller & Ahmad, 2024). Indonesian studies more frequently examine specific classroom interventions, learning models, instructional media, and numeracy challenges. Local studies from West Nusa Tenggara provide contextual evidence concerning numeracy readiness, mathematics outcomes, learning interest, instructional media, and learning models. This geographical variation strengthens the synthesis by demonstrating that the four-factor framework is relevant across different educational contexts, while the specific manifestation of each factor varies.

d. Integrated Synthesis of the Four Factors and Mathematics Learning Outcomes

The integrated synthesis shows that mathematics learning outcomes are best understood through the interaction of what students know, how willing they are to learn, what resources they use, and how learning activities are organized. Numeracy literacy addresses the first dimension by providing students with the ability to interpret and use mathematical information. Motivation addresses the second by sustaining engagement and effort. Instructional media address the third by providing representations and resources that support understanding. Learning models address the

fourth by structuring the learning processes through which students develop and apply mathematical knowledge.

The evidence can be represented conceptually as a mutually reinforcing system:

Numeracy Literacy + Learning Motivation + Instructional Media + Learning Models → Active Mathematical Engagement → Understanding, Reasoning, Problem-Solving, and Application → Mathematics Learning Outcomes

The arrow should not be interpreted as a simple causal sequence. Rather, the literature indicates reciprocal and complementary relationships. For example, appropriate learning models can increase students' motivation; engaging media can stimulate participation; meaningful mathematical activities can strengthen numeracy application; and successful problem-solving experiences can reinforce students' confidence and willingness to engage in subsequent mathematical tasks.

This interpretation also helps explain why studies focusing on only one factor may produce different findings across contexts. The contribution of numeracy literacy can depend on whether students have opportunities to apply their knowledge. The contribution of motivation can depend on whether students receive appropriate mathematical challenges. The contribution of media can depend on whether the medium is pedagogically aligned with the learning objective. Likewise, the contribution of a learning model can depend on teacher implementation, student characteristics, learning materials, and classroom conditions.

The broader evidence consequently supports an integrated perspective rather than a single-factor explanation of mathematics achievement. The 32 studies collectively demonstrate that cognitive competence, affective engagement, and instructional design operate within the same learning process. Numeracy literacy provides an important cognitive foundation, but its educational value is strengthened when students are motivated, provided with meaningful representations, and engaged through appropriate learning models.

This synthesis also clarifies the relationship between the first and second research questions. Numeracy literacy is closely associated with mathematical understanding and problem-solving, while motivation, media, and learning models create conditions that influence how effectively students develop and apply those competencies. Thus, the four factors should be understood as interdependent contributors to mathematics learning rather than isolated predictors.

e. Implications for Elementary Mathematics Education

The integrated findings have several implications for elementary mathematics education. First, mathematics instruction should move beyond an exclusive emphasis on procedural calculation toward activities that develop numeracy, interpretation, reasoning, and contextual problem-solving. Students need regular opportunities to explain mathematical ideas, interpret information presented in different forms, and apply mathematical concepts to meaningful situations. This implication is particularly relevant given the difficulties identified in numeracy-oriented AKM tasks (Putri et al., 2024).

Second, teachers should consider motivation as an integral component of mathematics instruction rather than as a separate psychological concern. Learning activities that encourage participation, provide meaningful challenges, support collaboration, and allow students to experience progress can help sustain engagement. Evidence concerning motivation, emotions, and mathematics achievement suggests that affective experiences should be considered when designing mathematics learning (Xia et al., 2022; Pollack et al., 2021; Radišić et al., 2024).

Third, instructional media should be selected according to their mathematical and pedagogical function, rather than simply according to their technological novelty. Concrete

manipulatives may be appropriate for developing conceptual understanding, visual and audiovisual media may support representation, while interactive and digital resources may provide opportunities for exploration and feedback. The evidence from multimedia, e-modules, videos, interactive media, and concrete-virtual manipulatives demonstrates the diversity of resources available for elementary mathematics education (Pasambo & Radia, 2022; Siller & Ahmad, 2024; Hidayah et al., 2025).

Fourth, teachers should select learning models according to the intended mathematical learning processes. Cooperative models may be useful when mathematical discussion and peer interaction are important; PjBL may support extended application; PBL may be appropriate for problem-solving and inquiry; and RME may support contextual understanding. The literature does not suggest that one model should replace all others. Instead, model selection should be aligned with learning objectives, students' characteristics, mathematical content, and available resources.

Finally, the integrated evidence suggests the need for alignment among numeracy objectives, motivational support, instructional media, and learning models. A mathematics lesson is more coherent when the learning objective requires numeracy reasoning, the media provide representations that support that reasoning, the learning model gives students opportunities to practice and discuss it, and the classroom environment sustains students' motivation to complete the task. In this integrated configuration, mathematics learning outcomes become the result of a learning process in which cognitive, affective, and instructional dimensions reinforce one another.

Overall, the findings from the 32 reviewed studies support an integrated framework in which numeracy literacy functions as a cognitive foundation, learning motivation as an engagement mechanism, instructional media as a representational and experiential resource, and learning models as an organizational and pedagogical mechanism. Their combined contribution provides a more comprehensive explanation of elementary students' mathematics learning outcomes than any single factor considered independently. This integrated perspective constitutes the central synthesis of the present literature review and provides a basis for interpreting mathematics achievement as a multidimensional outcome of students' competencies, engagement, learning resources, and instructional experiences.

DISCUSSION

1. Results Analysis

The purpose of this literature review was to develop an integrated understanding of how numeracy literacy, learning motivation, instructional media, and learning models are associated with elementary school students' mathematics learning outcomes. The synthesis of 32 studies indicates that mathematics achievement is not adequately explained by a single learner characteristic or instructional intervention. Instead, the findings reveal a multidimensional pattern in which cognitive competence, motivational engagement, instructional representation, and pedagogical organization operate in mutually related ways. The central analytical finding is therefore that mathematics learning outcomes emerge from the interaction between students' capacity to use mathematics and the learning conditions through which that capacity is activated, supported, and applied.

The first important finding concerns the position of numeracy literacy as a cognitive foundation of mathematics learning outcomes. The reviewed evidence indicates that numeracy literacy extends beyond computational accuracy to include the interpretation of quantities, mathematical representations, contextual information, reasoning, strategy selection, and problem-solving. This explains why students may demonstrate adequate procedural knowledge but still experience difficulty when mathematical tasks require interpretation or application. From this

perspective, numeracy literacy represents the process through which mathematical knowledge becomes usable knowledge. The importance of this interpretation is consistent with the contemporary conceptualization of numeracy as involving not only functional mathematical capabilities but also interpretation, evaluation, and decision-making in meaningful contexts (Geiger & Schmid, 2024). Thus, the contribution of numeracy literacy to mathematics learning outcomes lies not merely in increasing the amount of mathematical knowledge students possess, but in enabling them to mobilize that knowledge appropriately.

This interpretation directly addresses the first analytical objective of the review: to clarify how numeracy literacy relates to mathematics learning outcomes. The evidence suggests that the relationship operates through several interconnected cognitive processes. Students first need to understand the information embedded in a mathematical task, then establish mathematical relationships, select appropriate procedures or strategies, and finally interpret the resulting solution. Mathematics achievement consequently reflects the quality with which students can coordinate these processes. The findings from Ningsih et al. (2022), Nursyifa and Masyithoh (2023), Putri et al. (2024), and Maysarah et al. (2024) can therefore be interpreted as evidence of a broader mechanism in which numeracy literacy functions as a bridge between mathematical knowledge and mathematical application.

The second finding is that learning motivation functions primarily as an engagement mechanism rather than as an independent source of mathematical knowledge. The reviewed studies indicate that motivation influences students' willingness to initiate tasks, sustain effort, respond to difficulty, and participate in mathematical activities. Its significance therefore lies in activating and sustaining the use of students' cognitive resources. This interpretation is consistent with evidence showing relationships among motivation, engagement, and mathematics achievement among primary students (Xia et al., 2022). Importantly, the evidence also suggests that motivation should not be treated as a simple linear predictor of achievement. Students may be motivated but still require adequate mathematical knowledge, appropriate instructional support, and effective learning opportunities. Conversely, strong mathematical competence may not consistently translate into achievement when students experience low engagement, anxiety, or limited persistence.

The third finding concerns the representational function of instructional media. The synthesis indicates that media contribute to mathematics learning by altering how students encounter mathematical concepts. Concrete manipulatives can make abstract relationships observable, visual and audiovisual resources can clarify representations, while digital and interactive media can provide opportunities for exploration and feedback. The significance of media therefore depends less on their technological sophistication than on their capacity to support the mathematical thinking required by a particular learning objective. This interpretation is supported by evidence on technology-enhanced mathematics environments and students' self-regulated learning characteristics (Bednorz & Bruhn, 2023), as well as research demonstrating the potential of combining concrete and virtual manipulatives in elementary mathematics learning (Siller & Ahmad, 2024). The finding implies that instructional media should be conceptualized as mediating resources for mathematical thinking, rather than merely as supplementary teaching equipment.

The fourth finding concerns the organizational and pedagogical function of learning models. Cooperative learning, Project-Based Learning, Problem-Based Learning, and Realistic Mathematics Education differ in their instructional procedures, but the reviewed evidence identifies a common mechanism: they structure opportunities for students to actively engage with mathematical ideas. NHT and Jigsaw emphasize interaction and shared reasoning; PjBL connects mathematical

learning with extended and meaningful activities; PBL organizes learning around problem analysis and solution development; while RME connects mathematical concepts with realistic situations. The contribution of learning models can therefore be interpreted through the type and quality of mathematical activity they make possible. Rather than asking which model is universally superior, the synthesis indicates that the educational value of a model depends on its alignment with the intended mathematical processes, students' characteristics, content, and instructional context.

Taken together, these findings reveal that the four factors perform different but complementary functions within the same learning process. Numeracy literacy answers the question of whether students can interpret and use mathematical information; motivation concerns whether they are willing to engage and persist; instructional media influence how mathematical information is represented and explored; and learning models determine how learning activities are organized. This relationship is important because it demonstrates why the four factors should not be interpreted as four independent predictors simply placed alongside one another. Their functions overlap dynamically during actual mathematics learning. Motivation can determine whether numeracy competence is mobilized; media can make numeracy concepts more accessible; learning models can create opportunities to apply numeracy; and successful mathematical activity can, in turn, reinforce engagement and further use of mathematical knowledge.

The findings consequently provide an answer to the second and third analytical objectives of this review concerning the contribution and integration of the four factors. The evidence suggests that mathematics learning outcomes are produced through a configuration of learner capacity and instructional opportunity. A student-centered factor such as numeracy literacy requires instructional situations in which it can be applied. Motivation becomes educationally meaningful when students are provided with mathematical tasks worth engaging in. Similarly, media become effective when embedded in learning models that require students to think, communicate, reason, and solve problems. This explains why the effects reported across individual studies vary according to context, intervention design, grade level, mathematical content, and implementation conditions.

Theoretically, the integrated findings can be interpreted through a cognitive–affective–instructional framework. The cognitive dimension is represented by numeracy literacy, which provides the capacity to understand and apply mathematical information. The affective dimension is represented by learning motivation, which sustains engagement and persistence. The instructional dimension consists of media and learning models, which provide representations and organize learning experiences. Mathematics learning outcomes are consequently positioned as the product of interaction among these dimensions rather than as the direct consequence of one factor. This interpretation extends the more fragmented perspective evident in much of the reviewed literature, where numeracy, motivation, media, or learning models are commonly examined as separate research objects.

This integrated interpretation constitutes the principal analytical contribution of the review. The synthesis moves beyond the conclusion that numeracy literacy, motivation, media, and learning models are individually associated with mathematics achievement. Instead, it proposes that their educational significance lies in their functional interdependence. The central mechanism is not simply the accumulation of four positive factors, but the alignment of cognitive capacity, motivational engagement, representational support, and pedagogical organization. Consequently, mathematics learning outcomes can be more comprehensively understood when the question shifts from *which factor affects achievement?* to *how do learner and instructional factors work together to create conditions for meaningful mathematical engagement?*

In this framework, the quality of mathematics learning depends on the degree of alignment among the four dimensions. Numeracy-oriented objectives require students to interpret and reason; motivation sustains their participation in these demanding processes; instructional media provide appropriate representations for understanding and exploration; and learning models create structured opportunities for discussion, application, and problem-solving. The synthesis therefore identifies instructional alignment and learner–instruction interaction as the central mechanism connecting the four factors with mathematics learning outcomes. This provides a more comprehensive explanation of the reviewed evidence and establishes a conceptual basis for understanding elementary mathematics achievement as a multidimensional learning outcome rather than a product of isolated cognitive or instructional variables.

2. Comparison with Previous Studies

The findings of this review are broadly consistent with previous research showing that mathematics learning outcomes are influenced by both learner-related and instructional factors. However, the present synthesis extends this body of evidence by bringing numeracy literacy, learning motivation, instructional media, and learning models into a single analytical framework. Previous studies have generally examined these dimensions separately or have focused on a particular intervention, whereas the present review identifies how their functions can be understood as complementary components of elementary mathematics learning. The comparison therefore reveals both substantial convergence with previous evidence and several important differences in analytical emphasis.

Regarding numeracy literacy, the findings are consistent with studies indicating that students' ability to interpret, reason with, and apply mathematical information is closely related to mathematics achievement. Ningsih et al. (2022) and Nursyifa and Masyithoh (2023), for example, reported relationships between numeracy literacy and mathematics learning outcomes, while Putri et al. (2024) highlighted students' difficulties with numeracy tasks requiring interpretation and contextual reasoning. Maysarah et al. (2024) similarly identified differences in students' numeracy literacy associated with mathematics performance. These findings support the present synthesis that numeracy should not be reduced to computational fluency. The present review, however, places greater analytical emphasis on numeracy literacy as a mechanism connecting mathematical knowledge with contextual application, particularly through interpretation, representation, reasoning, and problem-solving. In this respect, the review develops the implications of previous correlational and descriptive findings rather than treating numeracy literacy simply as another variable associated with achievement.

The evidence concerning learning motivation also demonstrates strong consistency with international research. Xia et al. (2022), based on data from 1,538 Chinese primary students, found relationships among motivation, engagement, and mathematics achievement. Reinhold et al. (2021) further demonstrated that motivational and emotional orientations were related to students' engagement while learning mathematics with an electronic textbook, with emotional engagement contributing to cognitive learning outcomes. These findings correspond with the present synthesis in viewing motivation as closely connected to engagement rather than as an isolated psychological characteristic. Indonesian studies, including those by Nurawaliah et al. (2023) and Vidiанти et al. (2022), likewise indicate the relevance of motivation to mathematics learning outcomes. The difference in the present review lies primarily in the interpretation of how motivation functions within a broader instructional system. Rather than assuming that higher motivation directly produces higher achievement, the synthesis suggests that motivation becomes educationally

consequential when it mobilizes students' cognitive resources through sustained participation, persistence, and engagement in meaningful mathematical activity.

The findings on instructional media are similarly consistent with previous evidence, although the reviewed literature demonstrates considerable variation in the types of media examined. Pasambo and Radia (2022), through a meta-analysis of 15 studies, reported a moderate effect of multimedia on elementary mathematics learning outcomes. Firdaus et al. (2022) also reported improvements associated with interactive digital media, while Hidayah et al. (2025), Puspita et al. (2024), and Dewi and Agustika (2022) provide evidence from e-modules, Powtoon, and mathematics learning videos, respectively. The findings of Siller and Ahmad (2024) further demonstrate that the combined use of concrete and virtual manipulatives can enhance mathematical achievement among elementary students.

Although these studies generally support the educational value of instructional media, the present synthesis identifies an important qualification: media effectiveness cannot be interpreted independently of pedagogical purpose. The variation in media types across previous studies suggests that no particular technological format can be considered inherently effective across all mathematical topics and learning conditions. Concrete manipulatives, digital applications, audiovisual resources, and interactive environments may support different forms of mathematical activity. Consequently, the present review extends previous media-focused research by interpreting instructional media primarily according to their representational and pedagogical functions—how they help students visualize, manipulate, explore, receive feedback, and connect abstract mathematical ideas with meaningful representations.

A similar pattern emerges in the comparison of learning models. Previous studies have reported positive outcomes for cooperative learning, Project-Based Learning, Problem-Based Learning, and Realistic Mathematics Education. For example, Wahyuni et al. (2024) and Suyasmini (2022) identified positive contributions of cooperative learning approaches, whereas Anggraini et al. (2023) associated Project-Based Learning with improvements in motivation and mathematics learning outcomes. Nofita (2024) and Salsabila and Asih (2024) reported positive evidence concerning Problem-Based Learning, while Lestari and Manurung (2024) and Simamora et al. (2024) documented contributions of Realistic Mathematics Education. These findings are generally compatible with the present review because the different models provide opportunities for students to engage actively with mathematical concepts.

Nevertheless, the present synthesis differs from studies that primarily evaluate the effectiveness of a particular model. Instead of interpreting the literature as evidence that one model is superior to another, it identifies different pedagogical mechanisms associated with different models. Cooperative models emphasize interaction and shared reasoning; PjBL provides extended opportunities for application and production; PBL emphasizes problem analysis and inquiry; and RME emphasizes meaningful contextualization. This distinction is important because positive outcomes across different models do not necessarily indicate that the models have identical effects. Rather, their contribution may depend on the mathematical objective, task structure, student characteristics, and quality of implementation.

The comparison also reveals an important difference between international and Indonesian research traditions represented in the reviewed corpus. International studies tend to provide broader attention to motivational and emotional orientations, engagement, digital learning environments, self-regulation, and technology-supported mathematics learning. For example, Reinhold et al. (2021) explicitly connected motivational and emotional orientations with engagement and learning outcomes within an electronic textbook environment. Similarly, the study

by Siller and Ahmad (2024) examined the combined use of concrete and virtual manipulatives rather than treating instructional media as a single homogeneous category. Indonesian studies in the reviewed literature, by contrast, more frequently investigate specific classroom interventions, particular learning models, instructional media, or relationships between individual learner variables and mathematics outcomes. These differences should not be interpreted as contradictions; rather, they indicate different levels of analytical emphasis.

The local Indonesian evidence, particularly from Lombok and West Nusa Tenggara, further strengthens the contextual relevance of the synthesis. Studies such as Rahmawati et al. (2023), Haryadi and Masjudin (2025), Sholeha et al. (2023), and Saputra et al. (2025) demonstrate that mathematics learning outcomes are also shaped within specific local instructional contexts involving numeracy readiness, student perceptions, instructional media, and learning models. The present review adds value by positioning such local findings alongside national and international evidence. This broader comparison suggests that the underlying mechanisms of mathematical learning are sufficiently consistent across contexts to support an integrated conceptual interpretation, while the specific effectiveness of interventions remains context-sensitive.

A further point of convergence concerns the role of active engagement. Across the reviewed studies, whether the primary focus is numeracy literacy, motivation, media, or learning models, favorable learning outcomes tend to occur when students are actively involved in interpreting information, communicating mathematical ideas, manipulating representations, solving problems, or applying concepts. This pattern is particularly visible in the motivation literature, where engagement connects motivational orientations with achievement (Xia et al., 2022; Reinhold et al., 2021), and in the instructional literature, where interactive and manipulative resources create opportunities for mathematical exploration (Pasambo & Radia, 2022; Siller & Ahmad, 2024). The present synthesis therefore identifies active mathematical engagement as a cross-cutting mechanism that helps explain why apparently different factors can contribute to similar learning outcomes.

At the same time, the reviewed literature does not provide sufficient evidence to conclude that these relationships are universally linear or causal. Differences in research design, grade level, mathematical content, sample characteristics, intervention duration, measurement instruments, and learning environments make direct comparison difficult. For example, Reinhold et al. (2021) examined a small sixth-grade classroom in a specific electronic textbook context, whereas Xia et al. (2022) examined a much larger sample of Chinese primary students. Likewise, Siller and Ahmad (2024) used a quasi-experimental design involving concrete and virtual manipulatives, whereas Pasambo and Radia (2022) synthesized findings across multiple multimedia studies. These methodological differences indicate that reported effects should be interpreted in relation to their specific contexts rather than generalized as universally applicable effects.

Overall, the comparison with previous studies demonstrates substantial agreement with the existing literature while also identifying a conceptual gap that the present review addresses. Earlier research provides evidence for the relevance of numeracy literacy, motivation, instructional media, and learning models, but these dimensions are frequently investigated as separate constructs. The present synthesis integrates them by proposing that their contributions become most meaningful when they are aligned within active mathematical learning. Numeracy literacy supplies the cognitive resources for mathematical interpretation and reasoning; motivation sustains students' engagement; instructional media provide accessible representations and opportunities for exploration; and learning models organize the social and cognitive processes through which mathematical knowledge is constructed and applied. Thus, the main contribution of this review is not to claim a

new isolated effect for any single factor, but to extend previous findings toward an integrated explanation of how learner and instructional dimensions jointly support elementary mathematics learning outcomes.

3. Implications of Findings

The findings have both theoretical and practical implications for elementary mathematics education. Theoretically, this review contributes an integrated perspective by positioning numeracy literacy, learning motivation, instructional media, and learning models as complementary dimensions of mathematics learning rather than isolated predictors of achievement. The synthesis suggests that numeracy literacy provides the cognitive foundation for interpreting and applying mathematical knowledge, motivation sustains engagement and persistence, instructional media support mathematical representation and exploration, and learning models organize opportunities for interaction, reasoning, and application. This perspective extends fragmented explanations of mathematics achievement by emphasizing the alignment between learner capacities and instructional conditions. It also provides a conceptual basis for future empirical research examining how these dimensions interact rather than examining their effects independently.

Practically, the findings suggest that elementary mathematics instruction should be designed around alignment among learning objectives, student engagement, instructional representations, and pedagogical approaches. Teachers should therefore develop numeracy through contextual interpretation, reasoning, and problem-solving while simultaneously creating learning conditions that sustain motivation. Instructional media should be selected according to their mathematical and pedagogical functions rather than technological novelty, while learning models should be matched to the intended learning processes. At the school level, professional development and instructional planning can consequently focus on integrating numeracy-oriented tasks, motivational support, appropriate media, and active learning models within coherent mathematics lessons. Such integration may provide more meaningful opportunities for students to transform mathematical knowledge into understanding and application.

4. Research Limitations

Several limitations should be considered when interpreting this review. First, the synthesis was based on 32 studies published between 2021 and 2025, meaning that the conclusions depend on the scope, methodological quality, and reporting practices of the studies included. Second, the reviewed studies varied considerably in research design, grade level, sample characteristics, mathematical content, instructional duration, measurement instruments, and operational definitions of the four factors. This heterogeneity limits direct comparison of effect magnitudes and prevents the findings from being interpreted as evidence of uniform causal relationships. Third, although the review incorporated international, national, and local Indonesian studies, the distribution of evidence across contexts was uneven, with several Indonesian studies focusing on specific classroom interventions and local settings. Fourth, the review employed qualitative integrative synthesis rather than statistical meta-analysis; consequently, it identifies patterns and relationships but does not estimate an overall effect size or statistically test interactions among the four factors. Finally, publication and selection biases cannot be completely excluded because the synthesis depends on the availability, accessibility, and relevance of published studies. These limitations indicate the need for future research using systematic review and meta-analytic methods, longitudinal designs, and empirical models capable of testing the interaction among numeracy literacy, motivation, instructional media, and learning models across diverse elementary mathematics contexts.

CONCLUSION

This literature review examined how numeracy literacy, learning motivation, instructional media, and learning models contribute to elementary school students' mathematics learning outcomes. The synthesis of 32 studies published between 2021 and 2025 indicates that these four dimensions are consistently relevant to mathematics learning, but their contributions operate through different and complementary mechanisms. Numeracy literacy provides the cognitive foundation for interpreting, reasoning with, and applying mathematical information; learning motivation sustains students' engagement and persistence; instructional media facilitate mathematical representation, exploration, and understanding; and learning models organize opportunities for interaction, application, reasoning, and problem-solving. The central insight of the review is that mathematics learning outcomes are better understood as the result of the alignment and interaction of these dimensions rather than as the effect of isolated learner or instructional factors. In this integrated process, active mathematical engagement represents the central mechanism through which cognitive capacity and instructional conditions are translated into mathematical understanding, reasoning, problem-solving, and learning outcomes.

The review also contributes a conceptual perspective that connects learner-related and instructional factors within a single framework. Rather than identifying one universally effective factor, model, or medium, the synthesis indicates that their educational contribution depends on how appropriately they are aligned with mathematical objectives, students' characteristics, and learning contexts. This perspective extends the fragmented treatment of numeracy, motivation, media, and learning models in previous research and provides a basis for understanding elementary mathematics achievement as a multidimensional learning process. However, the conclusions should be interpreted cautiously because the reviewed studies differed in research design, participants, mathematical content, instruments, intervention characteristics, and contextual settings. The review itself also relied on qualitative integrative synthesis rather than meta-analysis and therefore could not estimate pooled effect sizes or empirically test interactions among the four factors.

Future research should move beyond examining these dimensions independently by using longitudinal, experimental, mixed-methods, and meta-analytic designs to test their relationships and possible interaction effects. Research should also examine whether the proposed integrated framework operates similarly across grade levels, mathematical domains, socioeconomic contexts, and educational settings. In particular, empirical studies should investigate how instructional alignment among numeracy-oriented tasks, motivational support, instructional media, and learning models influences students' active mathematical engagement and subsequent achievement. Such research would provide stronger evidence for refining and validating the integrated framework proposed by this review.

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