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PBL-RME Learning Model for Improving Numeracy Skills of Fifth-Grade Elementary School Students: A Literature Review

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Abstract

This study aims to synthesize the theoretical concepts of the PBL-RME Model in an effort to improve the numeracy skills of fifth-grade elementary school students. The method used in this study is a literature review. Data sources were obtained from ten scientific articles published in national and international journals, accessed through Google Scholar, ERIC, and ScienceDirect databases from 2019 to 2025. The data collection technique employed documentation, while data analysis utilized content analysis methods, including collection, reading, identification, grouping, synthesis, and conclusion drawing. The results indicate that the PBL-RME Model possesses strong theoretical synergy, as both approaches are oriented toward contextual problem-solving and active student engagement. Theoretically, their integration has been proven to enhance numeracy skills across three main dimensions: the use of symbols and numbers in contextual problem-solving (achievement percentage reaching 83.5%), the ability to analyze information presented in various forms, and the capacity to interpret analysis results and draw conclusions. Supporting factors for the successful implementation of the PBL-RME Model include students' curiosity, which contributes 54.4% to numeracy skills, and the use of learning media such as student worksheets, booklets, and videos, which have proven effective. Thus, the PBL-RME Model represents a conceptual framework with significant potential to improve the numeracy skills of fifth-grade elementary school students.

Keywords: PbL; RME; Numeracy

Abstrak

Penelitian ini bertujuan mensintesiskan konsep teoretis Model PbL-RME dalam upaya meningkatkan kemampuan numerasi siswa kelas V sekolah dasar. Metode yang digunakan dalam adalah studi literatur. Sumber data diperoleh dari sepuluh artikel ilmiah yang dipublikasikan dalam jurnal nasional maupun internasional, yang diakses melalui basis data Google Scholar, ERIC, dan ScienceDirect dalam kurun waktu 2019 hingga 2025. Teknik pengumpulan data menggunakan dokumentasi, sedangkan analisis data menggunakan metode analisis isi yang meliputi pengumpulan, pembacaan, pengidentifikasian, pengelompokan, sintesis, dan penarikan simpulan. Hasil penelitian menunjukkan Model PbL-RME memiliki sinergi teoretis yang kuat karena sama-sama berorientasi pada pemecahan masalah kontekstual dan keterlibatan aktif siswa. Integrasi keduanya terbukti secara teoretis mampu meningkatkan kemampuan numerasi pada tiga dimensi utama, yaitu penggunaan simbol dan angka dalam pemecahan masalah kontekstual (persentase capaian mencapai 83,5%), kemampuan menganalisis informasi dalam berbagai bentuk sajian, serta kemampuan menafsirkan hasil analisis dan menarik kesimpulan. Faktor pendukung keberhasilan implementasi Model PbL-RME meliputi karakter rasa ingin tahu siswa yang memberikan kontribusi sebesar 54,4% terhadap kemampuan numerasi, serta penggunaan media pembelajaran seperti LKS, *booklet*, dan video yang terbukti efektif. Dengan demikian, Model PBL-RME merupakan kerangka konseptual yang berpotensi besar untuk meningkatkan kemampuan numerasi siswa kelas V sekolah dasar.

Kata Kunci: PbL; RME; Numerasi

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INTRODUCTION

Numeracy skills represent one of the fundamental competencies essential for every individual to master in the 21st century. Numeracy cannot be reduced merely to arithmetic skills; rather, it encompasses the capacity to reason using mathematical concepts, procedures, facts, and tools to solve contextual problems in daily life (Ramadhani et al., 2025). Through the Merdeka Belajar (Freedom to Learn) policy and the National Assessment (Asesmen Nasional), the Indonesian government has established numeracy as one of the foundational literacies measured alongside reading literacy and character development (Teresia, 2021). Low numeracy skills significantly impact students' readiness to face global challenges, given that many real-life decisions—such as data interpretation, risk analysis, and quantitative decision-making—require robust numerical reasoning. Research demonstrates that weak foundational numeracy skills at the elementary school level correlate with lower mathematics achievement in subsequent educational levels (Lamb et al., 2024; Whitehead & Hawes, 2023).

Fifth-grade elementary school students, typically aged 10–11 years, are in a transitional phase from concrete to abstract thinking according to Piaget's theory of cognitive development (1952). At this stage, they greatly benefit from meaningful and contextual learning experiences to build a solid mathematical understanding. However, various studies and field reports indicate that fifth-grade students' numeracy skills remain relatively low. Research conducted by Bau (2023) revealed that students experience difficulties in interpreting word problems, using mathematical symbols appropriately, and applying numerical concepts in everyday life situations. Similarly, Paramitha (2024) demonstrated that students' numeracy literacy achievement on spatial geometry topics remained in the unsatisfactory category prior to instructional intervention. This low proficiency is also reflected in Indonesia's Programme for International Student Assessment (PISA) scores, which have remained below the Organisation for Economic Co-operation and Development (OECD) average in recent years, particularly in the mathematics domain measuring reasoning and contextual problem-solving (Haryanti & Yasin, 2024).

The primary cause of students' low numeracy skills is the predominance of mechanistic, teacher-centered instructional models saturated with procedural drills devoid of real-world context. In a systematic literature review, Dasan (2025) identified that teachers still tend to employ lecture methods and routine assignments that fail to provide space for critical exploration and reasoning. Such instructional approaches do not accommodate the cognitive needs of fifth-grade students, who still require concrete objects and meaningful situations as bridges to abstract understanding. Consequently, students become passive, easily bored, lack motivation, and are unaccustomed to critical thinking in solving non-routine problems (Ritonga, 2025). In contrast, ideal mathematics instruction should train students to discover concepts independently through authentic experiences, rather than passively receiving information from the teacher.

Two concepts that hold theoretical promise for addressing low numeracy skills are the Problem-Based Learning (PBL) Model and the Realistic Mathematics Education (RME) approach. The PBL Model trains students to solve authentic problems collaboratively in small groups, fostering critical and systematic thinking. Research by Pudjastuti et al. (2024) demonstrated that PBL implementation significantly improves numeracy skills among fifth-grade elementary school students, with the experimental group's posttest scores reaching the high category compared to the control group. Meanwhile, RME, developed by Freudenthal in the Netherlands, emphasizes the use of real-world contexts as the starting point for mathematics learning, enabling students to reinvent mathematical concepts through concrete experiences relevant to their lives (Van den Heuvel-Panhuizen & Drijvers, 2020). These two concepts possess strong synergy: PBL

provides a systematic thinking framework, while RME ensures contextual meaningfulness. Listyaningrum et al. (2025), in their systematic literature review, affirmed that RME integrated with technology and innovative learning models can enhance elementary school students' problem-solving skills and numeracy literacy.

Although studies on PBL and RME in isolation are numerous, research integrating both concepts specifically to improve fifth-grade elementary school students' numeracy skills remains limited. Most studies have focused on general mathematics learning outcomes or conceptual understanding, rather than on numeracy dimensions encompassing analysis, interpretation, and quantitative communication (Pangestika et al., 2025). Research on PBL has largely been directed toward improving general problem-solving skills, while studies on RME have predominantly highlighted learning design development and learning trajectories without specifically targeting numeracy as a measurable competency. Yet fifth-grade students study topics such as fractions, ratios, basic statistics, and geometry, all of which require robust numerical reasoning. This gap underscores the necessity of a literature study that synthesizes both learning concepts into an integrated framework for enhancing numeracy skills.

Based on the foregoing background, this study aims to synthesize the theoretical concepts of the PBL-RME Model in improving the numeracy skills of fifth-grade elementary school students through a review of relevant scientific articles. The findings of this study are expected to contribute to the development of elementary mathematics education, particularly in designing meaningful, contextual, and student-centered numeracy instruction, and to serve as a reference for subsequent researchers conducting empirical investigations into the effectiveness of the PBL-RME Model in the field.

RESEARCH METHOD

This study employed a qualitative approach with a literature review design. A literature review is a type of research conducted through in-depth examination of various bibliographic sources, such as scientific journal articles, textbooks, and relevant research reports related to the problem under investigation, in order to build a systematic theoretical foundation and conceptual framework (Powell & Connaway, 2004). In the context of this study, the literature review was utilized to explore the integration of the PBL Model and RME in improving the numeracy skills of fifth-grade elementary school students, drawing upon findings from previously published studies.

The data sources for this study were obtained from scientific articles published in national and international journals, using keywords such as: PBL Model, RME approach, numeracy skills, and elementary school mathematics learning. A total of ten scientific articles used in this study were accessed through journal databases including Google Scholar, ERIC, and ScienceDirect. The article selection process employed terms substantively related to the topic, including PBL Model, PBL syntax, RME, realistic mathematics approach, numeracy, numeracy indicators, numeracy literacy, and fifth-grade elementary school mathematics learning. Selected articles were analyzed to identify main ideas, strategic approaches, and various findings relevant to the research topic (Gale et al., 2013).

Data collection in this study employed documentation techniques. Documentation was conducted by collecting relevant scientific articles, thoroughly examining their content, and recording important information related to the research problem (Sugiyono, 2013). The instrument used in this study was an article analysis sheet encompassing several components, including researcher name and year of publication, research title, research objectives, research methods, and findings related to the PBL Model, PBL syntax, RME approach, RME principles, numeracy skills, numeracy indicators, and fifth-grade elementary school mathematics learning. This instrument enabled systematic data organization to facilitate the analysis process.

Data analysis in this study employed content analysis methods. Content analysis was conducted by thoroughly examining the content of the collected scientific articles, then identifying ideas, findings, and information relevant to the research problem (Drisko & Maschi, 2016). The data analysis procedure in this study encompassed the following steps: (1) collecting scientific articles relevant to the keywords PBL Model, RME approach, numeracy skills, and elementary school mathematics learning; (2) reading and comprehensively interpreting the article content; (3) identifying relevant research findings, such as PBL syntax, RME principles, numeracy skill indicators, and the results of implementing both concepts in mathematics learning; (4) grouping data based on themes or research variables, such as PBL, RME, PBL-RME integration, and numeracy skills; (5) synthesizing research findings to construct a comprehensive conceptual framework for the application of the PBL-RME Model in improving numeracy; and (6) drawing conclusions based on the literature analysis findings (Braun & Clarke, 2006). Through this analytical technique, it was expected to obtain a comprehensive and holistic overview of the theoretical concepts between the PBL-RME Model in an effort to improve the numeracy skills of fifth-grade elementary school students.

RESULTS AND DISCUSSION

Results

Below, the researcher presents the results of the analysis of 10 relevant articles, from both national and international journals, collected from various database sources. The presentation is organized in tabular format, containing the following components: researcher name and year, research title, research objectives, research method, and research findings.

Table 1. Article Analysis

No	Researcher(s) & Year	Title	Objectives	Method	Findings
1	Siregar, Firmansyah, Purwati, & Haryanto (2025)	The Effectiveness of a Problem-Based Learning Model Supplemented by Student Worksheets in Improving Numeracy Skills as Measured by Elementary School Students' Curiosity	To test the effectiveness of PBL Model assisted by student worksheets in improving numeracy literacy based on students' curiosity	Quantitative quasi-experimental (Nonequivalent Control Group Design)	Learning tools and instruments valid (very good). Classical mastery >75%. Numeracy skills in experimental class better than control. Significant influence of curiosity on numeracy (54.4%).
2	Silvia & Asdarina (2024)	Analysis of Students' Numeracy Skills in Fractions Operations Using the Problem-Based Learning (PBL) Model	To analyze numeracy skills of seventh-grade students on fraction operations through PBL implementation	Qualitative descriptive	High-category numeracy skills (average 72.6%). Symbol use indicator 83.5% (very high), information analysis 59.8% (moderate), interpretation 74.7% (high).
3	Hasanah & Rondli (2024)	The Application of the Realistic Mathematics Approach to Improve Numeracy Skills in the Merdeka Curriculum	To improve numeracy skills of fourth-grade students on fractions through RME approach	Classroom Action Research (qualitative & quantitative)	Numeracy skills improved from pre-cycle 38.09% to Cycle I 66.67% to Cycle II 85.71%. RME approach effective in improving numeracy.
4	Pudjastuti, Agustika, & Wiyasa (2024)	*Improving the Numeracy Skills Elementary School Students by Problem Based Learning Model*	To analyze the significant effect of PBL Model on numeracy skills of fifth-grade students	Quantitative quasi-experimental (Nonequivalent Control Group Design)	Average posttest experimental 82.31 (high), control 63.68 (low). t-test showed t-count (10.038) > t-table (2.016), indicating PBL significantly affects numeracy.
5	Nugroho, Wijaya, & Suminar (2023)	*Numeric Literacy in Mathematics Learning Assisted of*	To test the design, feasibility, and effectiveness of RME-	Research & Development (4-D model)	RME booklet declared feasible (82.6% by media experts, 79.4% by material experts). N-gain 0.45

No	Researcher(s) & Year	Title	Objectives	Method	Findings
		RME-Based Booklet Teaching Materials in Class V Elementary School Students	based booklet teaching materials for improving numeracy literacy		(moderate). Significant difference between pretest and posttest.
6	Qadri, Krismanto, & Zainal (2023)	*The Science, Technology, Engineering, Mathematics (STEM)-based Problem-based Learning (PbL) Learning Model on the Numeracy Skills*	To identify significant impact of STEM-based PBL on numeracy skills of fifth-grade students	Quantitative quasi-experimental (Nonequivalent Control Group Design)	Average experimental 78.24, control 64.52. t-count (8.73) > t-table (2.010). Effect size high (2.188). STEM in PBL significantly affects numeracy.
7	Qadri, Krismanto, & Zainal (2023)	*Video Support in Problem-based Learning to Facilitate of Elementary Students' Numeracy Abilities Improvement*	To examine the implementation of video-assisted PBL in improving numeracy skills on word problems	Classroom Action Research (2 cycles)	Numeracy skills improved from Cycle I (61% high-moderate category) to Cycle II (89% high-moderate category). Video-based PBL enhances focus, activity, and collaboration.
8	Purwati, Lukman, & Imswatama (2021)	Development of PBL-Based Instructional Materials Using the RME Approach to Improve Students' Mathematical Literacy Skills	To develop PBL-based learning tools with RME approach on linear equations to improve mathematical literacy	R&D (5 stages)	Learning tools (lesson plans, worksheets, media) declared very valid (85.1%). Alignment between PBL syntax, RME characteristics, and mathematical literacy indicators.
9	Ndiung, Dantes, Ardana, & Marhaeni (2019)	*Treffinger Creative Learning Model with RME Principles on Creative Thinking Skill by Considering Numerical Ability*	To test the effect of Treffinger Creative Learning Model with RME principles on creative thinking, controlling for numerical ability	Quantitative experimental (post-test only control group design) with ANCOVA	Creative thinking in experimental group higher than control. After controlling for numerical ability, remained higher. Numerical ability contributed 33.2% to creative thinking.
10	Purwati et al. (2021)	The Implementation of the PBL Model Using the RME Approach on Students' Mathematical Literacy Skills	To improve mathematical literacy through PBL Model with RME approach	Literature study & tool development	PBL Model with RME approach has strong theoretical synergy for improving mathematical literacy. Students receiving PBL-RME treatment had better mathematical literacy than conventional instruction.

Discussion

Theoretical Synergy between the PBL Model and the RME Approach

Theoretically, PBL and RME possess complementary epistemological foundations. PBL emphasizes the presentation of authentic problems as triggers for critical and collaborative thinking processes, while RME departs from the principle that mathematics is a human activity that must be connected to meaningful real-world contexts for students. Purwati et al. (2021), in their development research, affirmed that learning tools integrating PBL syntax with RME characteristics demonstrated very high validity (85.1%) because both concepts are oriented toward contextual problem-solving and active student engagement. This synergy is further reinforced by Ndiung et al.'s (2019) finding that combining the Treffinger Creative Learning Model with RME principles significantly improved students' creative thinking skills after controlling for numerical ability. Thus, the integration of PBL and RME is not merely additive but multiplicative in creating a learning environment rich in cognitive challenges while remaining relevant to students' real-world experiences.

Contribution of the PBL-RME Model to Improving Numeracy Skills

Numeracy skills are not merely arithmetic proficiency; they encompass the capacity to analyze, interpret, and communicate quantitative information across various contexts. Empirical research demonstrates that PBL significantly

contributes to improving numeracy skills among elementary school students. Pudjastuti et al. (2024) proved that the experimental class applying PBL achieved an average posttest score of 82.31 (high category), while the control class scored only 63.68, with the t-test indicating a significant effect. Firmansyah et al. (2023) also reported that PBL assisted by student worksheets not only improved numeracy literacy but also achieved classical mastery exceeding 75% and demonstrated that curiosity contributed 54.4% to numeracy skills. Meanwhile, research specifically integrating RME principles, such as that conducted by Hasanah & Rondli (2024), showed numeracy skill improvement from 38.09% in the pre-cycle to 85.71% in Cycle II following RME implementation. This indicates that the PBL-RME Model holds significant potential in bridging the gap between procedural mathematical knowledge and its application in students' daily lives.

The Role of Supporting Media and Teaching Materials in PBL-RME Model Implementation

The effectiveness of the PBL-RME Model is highly dependent on the quality of media and teaching materials used as vehicles for conveying contextual problems. Nugroho et al. (2023) developed RME-based booklet teaching materials for fifth-grade elementary school students, obtaining media expert validation of 82.6% and material expert validation of 79.4%, with effectiveness in the moderate category (N-gain 0.45). Research by Qadri et al. (2023) on video-assisted PBL demonstrated that video use within PBL syntax enhanced learning focus, activity, and student interaction and collaboration, increasing the percentage of students in the high and moderate numeracy categories from 61% in Cycle I to 89% in Cycle II. Additionally, Firmansyah et al. (2023) emphasized the importance of systematically designed student worksheets to guide students through the gradual discovery of mathematical concepts. Thus, learning media such as student worksheets, booklets, and videos are not merely supplementary but are integral components determining the success of PBL-RME Model implementation in improving numeracy.

Dimensions of Numeracy Skills Developed through the PBL-RME Model

Based on the review of various studies, the numeracy skills that can be developed through the PBL-RME Model encompass three main dimensions. First, the use of symbols and numbers in contextual problem-solving. Silvia & Asdarina (2024) reported that the indicator of using various forms of symbols and numbers achieved the highest percentage (83.5%) following PBL implementation. Second, the ability to analyze information presented in various forms (tables, graphs, diagrams). On this indicator, Silvia & Asdarina's (2024) research showed 59.8% achievement in the moderate category, indicating that the analysis dimension requires greater attention in learning design. Third, the ability to interpret analysis results and draw conclusions or predictions. The same study reported 74.7% achievement for this indicator, while Ndiung et al. (2019) found that numerical ability contributed 33.2% to students' creative thinking skills. Thus, the PBL-RME Model not only trains computational skills but also sharpens quantitative reasoning and data-based decision-making.

Supporting and Inhibiting Factors in PBL-RME Model Implementation

The successful implementation of the PBL-RME Model in improving numeracy skills is influenced by several factors. The primary supporting factor is students' curiosity, as revealed by Firmansyah et al. (2023), where this characteristic contributed 54.4% to numeracy skills. Additionally, support from video media (Qadri et al., 2023) and contextual teaching materials (Nugroho et al., 2023) also constitute significant supporting factors. On the other hand, inhibiting factors include the lack of student activity and engagement in conventional instruction, as identified by Hasanah & Rondli (2023) in the pre-cycle condition. Purwati et al.'s (2021) research also highlighted that teachers are often unfamiliar with designing instruction that simultaneously integrates PBL syntax with

RME. Therefore, training and mentoring for teachers are necessary to optimally manage PBL-RME Model instruction, including formulating authentic problems, facilitating group discussions, and conducting ongoing assessments of students' numeracy skills.

Theoretical and Practical Implications of the PBL-RME Model for Numeracy

Theoretically, the integration of PBL and RME enriches the repertoire of mathematics learning models oriented toward developing numeracy literacy. Research by Qadri et al. (2023) showed that STEM-based PBL is also closely related to strengthening numeracy, with the resulting effect size classified as high (2.188). This strengthens the argument that interdisciplinary approaches such as STEM can be integrated into the PBL-RME Model to expand the scope of numeracy skills. Practically, the findings from these ten studies offer concrete recommendations for teachers and curriculum developers: (1) numeracy instruction should begin with realistic problems close to students' daily experiences; (2) PBL syntax (problem orientation, organizing learning, investigation, presenting work, process analysis) should be combined with RME principles (activity, reality, hierarchy, intertwining, interaction, guidance); (3) supporting media such as student worksheets, booklets, and videos should be systematically designed to guide students through the concept discovery process. Thus, the PBL-RME Model impacts not only numeracy score improvement but also the formation of positive mathematical dispositions in students.

CONCLUSION AND RECOMMENDATIONS

Based on the theoretical synthesis of ten relevant studies reviewed, it can be concluded that PBL and RME possess very strong theoretical synergy in improving the numeracy skills of fifth-grade elementary school students. This synergy lies in the fundamental commonality of both concepts: both are oriented toward contextual problem-solving, active student engagement, and the use of real-world situations as the starting point for learning. The integration of PBL and RME, subsequently referred to as the PBL-RME Model, has been theoretically proven to bridge the gap between procedural and mechanistic mathematics instruction and students' need for quantitative reasoning in everyday life. Various empirical studies demonstrate that PBL implementation independently has significantly improved numeracy skills, while research integrating RME principles into PBL syntax has shown more consistent improvement in numeracy indicators such as symbol and number use, information analysis, and interpretation of analysis results. Supporting factors such as students' curiosity, the use of learning media (student worksheets, booklets, videos), and the quality of contextual teaching materials collectively determine the success of this model's implementation. Thus, the PBL-RME Model functions not only as an innovative instructional approach but also as a comprehensive conceptual framework for developing students' numeracy skills in an integrated manner, from the realistic problem orientation stage, through collaborative investigation, to conclusion drawing based on quantitative reasoning.

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