



READING LITERACY AND NUMERACY ACHIEVEMENT OF ELEMENTARY SCHOOL STUDENTS: EVIDENCE FROM INDONESIA AND THE INDONESIAN SCHOOL OF SINGAPORE

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Submit: 1 Februari 2026, **Revision:** 3 Februari 2026, **Approve:** 8 April 2026

Abstract

This study aims to compare reading literacy and numeracy achievement of elementary school students in domestic and international educational contexts, specifically between the Indonesian School of Singapore (SIS) and elementary schools in Yogyakarta. A quantitative comparative descriptive design with a cross-sectional survey approach was employed. The sample consisted of approximately 100 fifth-grade students selected through purposive sampling. Data were collected using standardized reading literacy and numeracy tests based on the OECD framework, which had been validated and proven reliable. Data analysis involved descriptive and inferential statistics, including tests of normality, homogeneity, and group differences. The findings reveal that reading literacy achievement remains relatively stable across learning phases but continues to show weaknesses in higher-order thinking skills. In contrast, numeracy exhibits more severe gaps, particularly in reasoning and application skills, with an unexpected regression observed at the upper grade level. These results indicate a substantial literacy–numeracy gap, especially in complex problem-solving abilities. The study highlights the urgent need for early numeracy interventions, a pedagogical shift in mathematics instruction toward conceptual understanding, and systematic integration of higher-order thinking skills in both literacy and numeracy learning to support equitable and sustainable student achievement.

Keywords: Reading Literacy, Numeracy, Elementary School Students

Quotation: Firdaus, Fery Muhammad, et.al. (2026). Reading Literacy and Numeracy Achievement of Elementary School Students: Evidence from Indonesia and the Indonesian School of Singapore. *JMIE: Journal of Madrasah Ibtidaiyah Education*, 10 (1), 2026, 1-14. [jmie.v10i1.911](https://doi.org/10.32934/jmie.v10i1.911).

Permalink/DOI: <http://dx.doi.org/10.32934/jmie.v10i1.911>

INTRODUCTION

Literacy and numeracy skills constitute the primary foundation for the academic development of elementary school students, as both are directly related to critical thinking and problem-solving abilities across various learning contexts. Reading literacy and numeracy are two fundamental competencies that strongly determine the quality of a nation's human resources, particularly in facing the challenges of globalization and the digital era (Gust et al., 2024). Boman (2024) emphasizes that literacy and numeracy are among the key skills that define a nation's quality. Reading literacy skills do not merely involve mechanical reading abilities but also encompass comprehension, reasoning, and the ability to analyze information from texts. Chimbutane et al. (2026) assert that literacy skills go beyond decoding and include inference, interpretation, and critical analysis. Meanwhile, numeracy literacy involves logical thinking, problem-solving, and the application of mathematical concepts in everyday life (Gal et al., 2020; Rahayu & Subekti, 2025a). A high level of literacy and numeracy mastery reflects the quality of education in a country (Kappassova et al., 2025). Moreover, in the current era of globalization, individuals must possess strong literacy and numeracy skills to remain competitive at the international level (Yulindaria et al., 2025).

National data indicate an improvement in literacy and numeracy achievement among elementary school students in recent years. Based on the 2024 National Assessment results, the proportion of students achieving minimum competency in literacy increased from 59.49% in 2022 to 70.03% in 2024. Similarly, numeracy achievement increased from 45.24% in 2022 to 67.94% in 2024 (Kemendikbudristek, 2024). However, these achievements are not evenly distributed across all regions of Indonesia, particularly in areas that still face limitations in access to education, learning infrastructure, and the availability and quality of educators. This condition indicates that despite a positive trend in minimum competency achievement, structural and contextual barriers continue to affect the equitable distribution of student learning outcomes. This issue aligns with findings from bibliometric studies showing that challenges in improving literacy and numeracy in primary education involve factors such as resource availability, teacher readiness, and unequal access to educational technology across developing countries (Widiawati et al., 2025a). Furthermore, the measurement of literacy and numeracy achievement is not limited to students residing and studying domestically but also includes Indonesian students enrolled in Indonesian Overseas Schools (Sekolah Indonesia Luar Negeri/SILN), thereby providing a comprehensive picture of national education quality within a global context.

The characteristics of students' literacy and numeracy skills show significant variation across regions and countries, primarily due to differences in learning environments, the availability of educational resources, and unequal literacy cultures (Durrroh et al., 2025). Comparisons of literacy achievement at the elementary school level indicate that social factors, institutional quality, and instructional models have a substantial influence on the mastery of

basic literacy and numeracy competencies (Widiawati et al., 2025b; Telaumbanua et al., 2024; Wianie et al., 2024). In addition, parental involvement in reading activities and numeracy learning consistently contributes to strengthening these foundational skills from an early age (Fajri et al., 2025; Hendriyani & Suryadi, 2023). The availability of culturally relevant reading materials that align with students' developmental stages also plays an important role in enhancing motivation and sustaining literacy achievement (Rahayu & Subekti, 2025b).

An important point highlighted in this context is the role of social factors in shaping literacy and numeracy quality (Habibi et al., 2025). Social factors include the cultural values and habitual practices of the local community. Several studies indicate that differences in school literacy environments between densely populated urban areas and international settings influence the development of early reading and numeracy skills (AKIN, 2022). Disparities between urban and rural school environments are also correlated with differences in students' early literacy and numeracy achievement (John Richards & Mohammad Shahidul Islam, 2018).

Research on reading literacy and numeracy among elementary school students over the past decade shows growing scholarly interest in factors influencing learning outcomes, particularly in cross-regional and cross-national comparative contexts. International studies emphasize that literacy and numeracy skills are strongly influenced by socioeconomic characteristics, instructional quality, and school environmental contexts. Mullis and Martin (2021), in the PIRLS and TIMSS reports, found that cross-country performance differences are often driven by variations in access to learning resources and pedagogical effectiveness, making school location context a significant determinant.

Conversely, international research focusing on Indonesian schools abroad remains very limited. Indonesia operates schools in several countries, one of which is the Indonesian School of Singapore (Sekolah Indonesia Singapura/SIS). This school operates within a global educational context that provides greater exposure to multilingualism, academic competition, and richer educational resources. Studies on diaspora education suggest that international learning environments tend to produce higher literacy achievement due to greater language exposure and more intensive academic interactions (Li et al., 2025). However, literature directly comparing the literacy and numeracy achievement of Indonesian students in diaspora schools with those in domestic schools is scarce, creating a research gap that warrants further investigation.

Despite extensive international research on cross-national literacy and numeracy achievement, empirical studies comparing Indonesian students in domestic schools and Indonesian schools abroad remain scarce. This gap limits understanding of how diaspora educational contexts shape students' foundational competencies. Therefore, this study aims to compare reading literacy and numeracy achievement of elementary school students at the

Indonesian School of Singapore and selected elementary schools in Yogyakarta, with particular attention to disparities in higher-order thinking and application skills.

Previous studies indicate that contemporary comparative analyses do not focus solely on assessment scores but also examine mediating factors such as family support, language of instruction, teacher competence, and the social learning environment (Indrawatiningsih et al., 2024; Chun et al., 2025). This approach is particularly relevant for the present study, given that sociocultural differences between students in Singapore and Yogyakarta may influence their literacy and numeracy performance. By comparing the Indonesian School of Singapore with elementary schools in Yogyakarta, this study not only fills a gap in the existing literature but also contributes to a deeper understanding of how diaspora educational contexts affect Indonesian students' literacy and numeracy achievement. Moreover, the study offers practical implications for educational policy development, particularly in relation to equity in educational quality and strategies for improving literacy and numeracy in a global context. This study aims to compare literacy and numeracy achievement between Indonesian schools abroad and domestic elementary schools to provide insights into how educational cultural contexts and school environments influence students' academic development.

METHODS

This study employed a quantitative comparative descriptive research design using a cross-sectional survey approach (Creswell & Creswell, 2022; Takona, 2024). The design enabled systematic comparison of reading literacy and numeracy competencies across different grade levels and educational contexts. The study population comprised elementary students from Indonesian School Singapore, SDN Jetis 2, and SDN Panembahan Yogyakarta. Using purposive sampling technique (Cohen et al., 2018), approximately 100 Grade 5 students were selected based on accessibility and representation criteria. The sample distribution ensured representation across different phases of elementary education (Berndt, 2020). Two standardized assessment instruments were employed. The reading literacy test consisted of 15 items measuring three key competencies: (1) accessing and retrieving information, (2) interpreting and integrating content, and (3) evaluating and reflecting (OECD, 2023). The numeracy assessment comprised 10 items evaluating: number concepts, algebraic thinking, geometry, measurement, and data literacy (OECD, 2023). Both instruments were validated through expert judgment and pilot testing ($\alpha > 0.70$).

Data Collection Procedures, Data were collected through direct testing in school settings using standardized protocols. Written informed consent was obtained from school administrators and parents prior to data collection, following ethical research guidelines (Johnson & Christensen, 2024). Testing was conducted in controlled classroom environments with consistent administration procedures across all sites. **Data Analysis.** Descriptive statistics

including mean, median, mode, standard deviation, and frequency distributions were calculated using SPSS (Field, 2024). Inferential analyses employed: (1) Kolmogorov-Smirnov test for normality assessment, (2) Levene's test for homogeneity of variance, (3) one-way ANOVA or Kruskal-Wallis test for group comparisons, and (4) post-hoc tests (Tukey HSD, Bonferroni, or Mann-Whitney U) for pairwise comparisons ($\alpha = 0.05$).

RESULTS AND DISCUSSION

This section presents the findings of reading literacy and numeracy assessments across three elementary education phases (A: Grades 1-2, B: Grades 3-4, C: Grades 5-6). Results are organized into four comprehensive tables examining: (1) comparative overview of literacy and numeracy performance by phase, (2) detailed reading literacy skills and success rates, (3) detailed numeracy skills and success rates, and (4) comparative gap analysis between literacy and numeracy domains. Data reveal substantial disparities between literacy and numeracy development, with numeracy demonstrating more severe deficits particularly in foundational number sense (Phase A), spatial reasoning and application skills (Phase B), and advanced problem-solving capabilities (Phase C). The unexpected regression in Grade 5 numeracy performance represents a critical finding requiring immediate educational intervention.

Table 1. Comparative Overview of Literacy and Numeracy Performance by Phase

Phase	Grade	Literacy	Numeracy	Finding
A	1–2	50–67	9–45	Numeracy is very weak in basic skills
B	3–4	67–75	6–81	Literacy is stable, numeracy is procedurally strong but weak in application
C	5–6	58–67	0–76	Numeracy regression on higher level thinking ability

Table 1 summarizes students' literacy and numeracy achievement across three learning phases. Overall, reading literacy remains relatively stable at moderate to good levels (50–75%) throughout elementary education. In contrast, numeracy performance is consistently lower and more variable. In Phase A (Grades 1–2), numeracy achievement is critically weak, indicating inadequate foundational number sense. Phase B (Grades 3–4) shows improvement in procedural numeracy skills, although application and reasoning remain limited. In Phase C (Grades 5–6), numeracy performance exhibits an alarming regression, with near-zero achievement in higher-order skills, while literacy remains stable. These findings indicate a widening literacy–numeracy gap, particularly in higher-order thinking and application domains..

Table 2. Reading Literacy Performance: Skills and Success Rates by Phase

Phase	Literacy Skills	Success Rate	Proficiency Level
A (Grades 1-2)	Character identification	67%	Moderate
	Cause-effect relationships	50%	Low
	Story morals	42%	Low
	Problem solutions	33%	Critical
B (Grades 3-4)	Character/trait identification	75%	Good
	Logical inference	67%	Moderate
	Infographic interpretation	50%	Low
C (Grades 5-6)	Text summarization	58%	Moderate
	Implicit emotion understanding	67%	Moderate
	Complex problem solving	17%	Critical

Reading literacy shows progressive improvement in basic skills from Phase A to B, with character identification reaching 75%. However, critical weaknesses persist across all phases in higher-order thinking: Phase A problem-solving (33%), Phase B multimodal literacy (50%), and Phase C complex problem-solving (17%) demonstrate inadequate development of critical analysis and evaluative reasoning.

Table 3. Numeracy Performance: Skills and Success Rates by Phase

Phase	Numeracy Skills	Success Rate	Proficiency Level
A (Grades 1-2)	Pattern recognition	45%	Low
	Weight measurement	27%	Critical
	Geometry basics	18%	Critical
	Basic fractions	18%	Critical
	Number application	9%	Severe
B (Grades 3-4)	Fractions	81%	Good
	Number operations	75%	Good
	Spatial geometry	38%	Low
	Area application	6%	Severe
	Basic statistics	6%	Severe
C (Grades 5-6)	Negative numbers	76%	Good
	Complex fractions	71%	Moderate
	Advanced patterns	24%	Critical
	Data analysis	0%	Severe
	Volume application	0%	Severe

Numeracy performance reveals critical systematic deficits. Phase A shows severe foundational gaps with most skills below 45%. Phase B demonstrates improvement in conceptual understanding (fractions 81%, operations 75%) but persistent application weaknesses (6%). Phase C exhibits the most concerning pattern: while basic computational skills remain adequate (negative numbers 76%, complex fractions 71%), advanced reasoning shows complete failure (data analysis 0%, volume application 0%).

Table 4. Comparative Analysis: Literacy vs Numeracy Performance Gap

Phase	Skill Domain	Literacy Rate	Numeracy Rate	Gap	Gap Severity
A	Basic comprehension	67%	45%	-22%	Moderate
	Reasoning/Logic	50%	18%	-32%	Severe
	Application	33%	9%	-24%	Severe
B	Basic comprehension	75%	81%	+6%	Balanced
	Reasoning/Logic	67%	38%	-29%	Severe
	Application	50%	6%	-44%	Critical
C	Basic comprehension	67%	76%	+9%	Balanced
	Reasoning/Logic	58%	24%	-34%	Severe
	Complex problem-solving	17%	0%	-17%	Critical

Table 4 reveals systematic disparities between literacy and numeracy. While basic comprehension skills are relatively balanced in Phases B and C, severe gaps emerge in reasoning/logic (-29% to -34%) and critical gaps in application skills (-17% to -44%). The pattern indicates that numeracy instruction insufficiently develops conceptual understanding and transfer capabilities, particularly in spatial reasoning, measurement application, and data analysis domains requiring integrated mathematical thinking.

Reading Literacy Development Patterns

The progressive development of reading literacy across phases, despite persistent weaknesses in higher-order thinking, aligns with current research on reading comprehension development. Reading comprehension requires not just decoding skills but also executive functions including attention, working memory, and cognitive flexibility (Duke & Cartwright, 2017). The Phase A limitations in cause-effect reasoning and problem-solving reflect what (Kambach & Mesmer, 2024) describe as emergent readers' underdeveloped verbal reasoning and inferential capabilities, which require explicit instructional support beyond basic phonics instruction.

Phase B students' challenges with multimodal literacy—particularly in interpreting infographics confirm (Duke & Cartwright, 2017) findings that comprehension of complex texts requires integration of visual and linguistic information through explicit teaching of visual-textual relationship strategies. The persistent shallow conclusions despite improved thematic understanding suggest insufficient development of what (Fong et al., 2017) term the DIER framework components: drawing inferences, integrating information, evaluating arguments, and monitoring comprehension. These cognitive processes require working memory integration that develops gradually with targeted instruction (Cowan, 2022; Jia et al., 2025).

The Phase C critical thinking deficit—with only 17% providing comprehensive problem solutions—represents a significant educational concern. This limitation extends beyond basic comprehension to what the (Council et al., 2001) identifies as strategic competence: the ability to formulate, represent, and solve problems. The findings parallel Indonesia's National Assessment results, where literacy increased from 59.49% (2022) to 70.03% (2024),

yet remains unevenly distributed with significant gaps in higher-order skills. This suggests that while basic literacy improves, the curriculum insufficiently addresses critical analysis and complex reasoning development.

Numeracy Development Patterns and the Literacy-Numeracy Gap

The substantial performance gap between literacy and numeracy, particularly in reasoning and application domains, reveals fundamental differences in instructional effectiveness. While Phase B and C students achieve 67-76% success in basic comprehension for both domains, the gap widens dramatically in higher-order thinking: literacy reasoning averages 50-67% success compared to numeracy's 18-38%. This disparity suggests that numeracy instruction overemphasizes procedural computation at the expense of conceptual understanding and problem-solving (Rittle-Johnson et al., 2015; Rittle-Johnson & Schneider, 2015).

The Phase A critical numeracy deficits, particularly in Grade 1 where 50% scored zero, indicate severely inadequate early number sense development. Early numeracy skills including number recognition, counting, and basic operations are foundational for later mathematical reasoning and must be established through systematic, evidence-based instruction (Devlin et al., 2022; Duke & Cartwright, 2017). (Getenet, 2024) shows that prior numeracy achievement significantly influences subsequent mathematics and literacy success, making these early deficits particularly concerning. The low success rates in pattern recognition (45%) indicate what (Cartwright, 2020) describe as insufficient procedural fluency and adaptive reasoning the capacity to think logically about relationships among concepts and situations. The spatial geometry difficulties across all phases (18% in Phase A, 38% in Phase B) reflect underdeveloped spatial reasoning and visualization skills, which are critical for mathematical thinking (Aunio, 2019; Aunio et al., 2019). These weaknesses align with Indonesia's PISA 2023 mathematics performance, where students averaged 366 points 106 points below the international average, with 82% performing below level two(OECD, 2023). This persistent low performance suggests systemic instructional deficiencies in developing spatial-numerical integration.

The Phase C regression phenomenon where Grade 5 numeracy (0.93) drops below Grade 4 (1.49) alongside zero success in complex problem-solving represents the study's most alarming finding. This contradicts expected developmental progression and suggests either inadequate instructional continuity, curriculum misalignment, or accumulating conceptual gaps. Research demonstrates that mathematical reasoning requires explicit teaching and cannot develop incidentally through procedural practice alone (Ramaila & Ramaila, 2025; Smit et al., 2023). The complete failure in data analysis and volume applications, despite adequate performance in basic computation (71-76%), indicates that students possess procedural knowledge without the strategic competence and adaptive reasoning needed for novel applications.

The results indicate that reading literacy achievement remains relatively stable across learning phases, with moderate to good performance in basic comprehension. However, higher-order skills such as inference, evaluation, and complex problem-solving remain weak, particularly in Phase C. In contrast, numeracy achievement demonstrates severe and systematic deficits. Phase A students show critical weaknesses in foundational number sense, Phase B students improve in procedural computation but struggle with application, and Phase C students exhibit an unexpected regression, with near-zero performance in data analysis and measurement application. This pattern reveals a widening literacy–numeracy gap, especially in reasoning and application domains.

These findings suggest that while literacy instruction has partially succeeded in developing basic comprehension, both domains fail to adequately cultivate higher-order thinking. Numeracy instruction remains overly procedural and insufficiently supports conceptual understanding and transfer of knowledge. The regression observed in upper grades highlights potential curriculum misalignment and lack of instructional continuity.

Implications for Educational Practice

The comparative analysis reveals that literacy and numeracy require fundamentally different instructional approaches. While literacy instruction successfully develops basic comprehension, both domains fail to adequately develop higher order thinking and application skills. However, the severity is far greater in numeracy, suggesting that current mathematics pedagogy inadequately addresses conceptual understanding, reasoning, and problem-solving (Abdulah, 2025; Díez-palomar et al., 2023; Geiger & Schmid, 2022; Ncube et al., 2024).

These findings necessitate immediate, comprehensive educational reforms. First, urgent targeted interventions for Phase A numeracy deficits are critical, as early number sense predicts long-term mathematical achievement (Beliakoff et al., 2025). Second, systematic integration of higher order thinking skills in literacy instruction must begin in primary grades, with explicit teaching of inference, critical analysis, and evaluative reasoning (Whittingham et al., 2024). Third, numeracy instruction must fundamentally shift from procedural emphasis to conceptual understanding and reasoning development, addressing the severe gap in spatial reasoning, measurement application, and data analysis (Council et al., 2001; Rittle-Johnson et al., 2015; Rittle-Johnson & Schneider, 2015).

Fourth, curriculum and assessment systems need to be comprehensively evaluated to ensure learning continuity across grade levels and integration across subject areas, particularly to address the decline in student abilities in Phase C (Kreijkes & Greatorex, 2024). Fifth, comprehensive teacher professional development in evidence-based pedagogical practices is essential, focusing on developing students' mathematical reasoning, spatial visualization, and problem-solving alongside literacy critical thinking (Duffy & Pinilla, 2024; Lowrie & Logan, 2023; Margarita et al., 2024; Mukuka et al., 2023). Finally, establishing robust school-parent-community

partnerships can create supportive learning environments that reinforce classroom instruction (Haines et al., 2015).

CONCLUSION

This comparative study reveals critical patterns in elementary education. Reading literacy demonstrates progressive development with persistent higher order thinking weaknesses across all phases. Numeracy shows more severe systematic failures: Phase A critical foundational deficits (83% lacking number sense), Phase B incomplete development despite improved computation, and Phase C alarming regression with complete failure in advanced reasoning. The literacy-numeracy gap widens dramatically in higher-order domains, reaching 44% in Phase B application skills. These disparities underscore urgent need for comprehensive reforms: intensive early numeracy intervention, fundamental restructuring of mathematics pedagogy toward conceptual understanding and reasoning, systematic integration of higher-order thinking across both domains, curriculum realignment to prevent Phase C regression, and evidence-based teacher professional development to ensure all students develop competencies required for academic success and lifelong learning. This study demonstrates that elementary students' literacy and numeracy development follow divergent trajectories. Literacy shows gradual improvement with persistent higher-order thinking gaps, while numeracy exhibits critical foundational weaknesses and alarming regression in advanced grades. The findings underscore the urgent need for early numeracy intervention, a pedagogical shift toward conceptual and reasoning-based mathematics instruction, and systematic integration of higher-order thinking skills across the curriculum, particularly within diverse educational contexts such as Indonesian schools abroad.

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