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Original Research Article

The GASING Method significantly enhances third-graders' numeracy literacy and resolves conceptual-procedural obstacles in elementary mathematics

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Abstract: Mathematical numeracy literacy is a fundamental 21st-century competence that elementary students must master, yet many third-grade students still experience conceptual and procedural learning obstacles when solving addition and subtraction word problems. This study aims to analyze the effectiveness of implementing the GASING (Gampang, Asyik, dan Menyenangkan) method in improving numeracy literacy and reducing learning obstacles among third-grade elementary school students. This study employed a sequential explanatory mixed-methods design, in which quantitative data from pre-test and post-test assessments of 16 third-grade students at State Elementary School 77 Penerokan were complemented by qualitative data from classroom observations, interviews, and student worksheets. The results showed that the average numeracy literacy score increased significantly from 40.63 (pre-test) to 94.38 (post-test), with a paired-samples t-test confirming the improvement as highly significant ($t = -12.887$, $p < 0.001$) and an N-Gain of 0.905 (high category). Qualitative findings further revealed that the GASING method helped students overcome conceptual obstacles related to place value and procedural obstacles related to borrowing mechanisms, while also increasing their confidence and engagement in learning mathematics. These findings indicate that the GASING method is an effective and promising instructional approach for enhancing numeracy literacy and reducing learning obstacles in elementary mathematics education.
Keywords: GASING Method, Numeracy Literacy, Learning Obstacles, Elementary Mathematics

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INTRODUCTION

In this era, mathematical numeracy literacy has become one of the essential competencies required in the 21st century, referring not only to computational ability but also to the capacity to interpret, analyze, and apply mathematical information in everyday contexts (Akmal et al., 2025; Fajriadi & Fatimah, 2025; Goos et al., 2014; OECD, 2026). Individuals with strong numeracy literacy are better able to make informed decisions and solve real-life problems involving quantitative reasoning.

Within the OECD framework for the Programme for International Student Assessment, mathematical literacy is understood as formulating real-world situations mathematically, employing mathematical concepts and procedures to solve the resulting problems, and interpreting the results back in relation to the original context (OECD,

2025). This implies that numeracy cannot be reduced to computational speed alone; instruction emphasizing only drill-based calculation without attending to representation and contextual reasoning is unlikely to produce robust numeracy literacy (Karlina et al., 2026; Nadiatussalma & Surya, 2025).

Despite its importance, many countries still face challenges in improving students' numeracy literacy. International assessments such as PISA indicate that Indonesian students still perform below the OECD average in mathematics literacy (Bilad et al., 2024; OECD, 2023; Wijaya et al., 2024). Strong numeracy literacy in grade 3 is crucial, as it provides the foundation for understanding more complex mathematical concepts and for facing quantitative challenges in everyday life (Liu et al., 2025; Raghubar & Barnes, 2017; Ramadhani, 2025).

In response, the Indonesian government has introduced policy measures aimed at strengthening foundational literacy and numeracy in basic education, including the Merdeka Belajar curriculum reform and the Minimum Competency Assessment, both of which place numeracy literacy alongside reading literacy as core learning outcomes monitored from the early grades (Aditomo, 2024; OECD, 2025). This makes classroom-level intervention research at the third-grade level particularly timely, as it is during this period that students transition from concrete counting strategies toward more abstract multi-digit addition and subtraction procedures.

At the elementary level, mastery of basic arithmetic operations is foundational to numeracy literacy. However, many students experience difficulties understanding place value concepts, borrowing mechanisms in subtraction, and interpreting contextual word problems (Boonen et al., 2016; I. Fauzi et al., 2025). From a cognitive perspective, place value and borrowing are demanding for young learners because they require holding multiple pieces of information in working memory simultaneously: the value of each digit, the regrouping action of exchanging one unit of a higher place value for ten units of a lower one, and the sequential execution of the subtraction procedure itself (Herzog & Fritz, 2022; Zhang et al., 2022). When the standard written algorithm is introduced before students have internalized the underlying quantity concept, cognitive load increases substantially, often resulting in systematic procedural errors such as subtracting the smaller digit from the larger one regardless of position, or omitting the regrouping step (A. Fauzi et al., 2023; Ngu & Phan, 2022; Powell et al., 2025). These error patterns reflect identifiable gaps in students' conceptual understanding of the base-ten number system, underscoring the importance of instructional sequences that ground abstract procedures in concrete, manipulable representations first.

Such difficulties are often categorized as learning obstacles, arising from conceptual misunderstandings, procedural difficulties, or students' inability to interpret contextual problems (Ario et al., 2025; Cahdriyana & Sintawati, 2024). These are commonly distinguished into three interrelated types: conceptual obstacles, when students lack an adequate mental representation of an idea such as place value; procedural obstacles, when students struggle to execute computational steps correctly even when the concept is partially understood; and problem-solving obstacles, when students cannot translate a real-world problem into a mathematical representation. This classification provides a diagnostic lens for identifying precisely where a difficulty originates, with direct implications for the design of remedial instruction (Ario et al., 2025).

One instructional approach with the potential to address these challenges is the GASING method (*Gampang, Asyik, dan Menyenangkan*), developed by Yohanes Surya (Surya, 2019). GASING simplifies mathematical concepts through a concrete-to-abs-

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tract approach aligned with Bruner's theory of enactive, iconic, and symbolic representation, allowing students to progressively understand complex operations (Nafsy et al., 2022; Ramadhanti & Marhadi, 2024). Concrete manipulatives help students understand 'borrowing' and 'carrying' more effectively, supporting conceptual understanding before procedural mastery (Gultom & Khairul, 2024). The method is organized around three guiding principles reflected in its name: mathematics should be easy (*gampang*) through small, logical steps; engaging (*asyik*) through active manipulation of concrete objects; and enjoyable (*menyenangkan*), so students associate mathematics with positive rather than anxious experiences. Instruction typically begins with physical manipulatives such as base-ten blocks, before shifting toward pictorial representations and eventually the standard algorithm, mirroring the concrete–pictorial–abstract progression widely advocated in elementary mathematics pedagogy (Iyamuremye & Burns, 2025; Nafsy et al., 2022).

Although several studies have reported the effectiveness of GASING in improving students' arithmetic abilities (Sulistiawati, 2019; Surya, 2019), limited research has explored its role in specifically reducing learning obstacles in subtraction with borrowing, and qualitative research documenting students' experiences in overcoming these obstacles remains scarce (Sidik et al., 2021; Swanson, 2015). This gap is noteworthy for two reasons: most existing GASING studies rely predominantly on quantitative pre-test–post-test designs that report whether scores improved but offer limited insight into why or how the improvement occurred (Herzog & Fritz, 2022; Sidik et al., 2021; Swanson, 2015)**;** and very few studies have explicitly mapped GASING's instructional features onto specific categories of learning obstacles, making it difficult to determine which obstacle types the method addresses most effectively.

Therefore, this study aims to analyze the effectiveness of implementing the GASING method in improving mathematical numeracy literacy and reducing learning obstacles among third-grade elementary school students, using a mixed-methods approach that combines quantitative data on skill improvement with qualitative data on students' experiences, making it possible to identify specific mechanisms through which the GASING method contributes to the development of students' numeracy literacy.

METHOD

Research Design

This study employed a sequential explanatory mixed-methods design (Creswell & Poth, 2018), in which a quantitative phase first determined the magnitude and significance of students' numeracy literacy gains following the GASING intervention, and a qualitative phase then explained these results in greater depth, focusing on how students experienced the instructional process and which types of learning obstacles were most affected.

Participants and Research Setting

The research was conducted at State Elementary School 77 Penerokan, selected because its average numeracy scores were below standard. Sixteen third-grade students who completed both pre-test and post-test were included in the quantitative analysis. Following a single-case mixed-methods logic, the unit of analysis is the bounded instructional case as a whole—one classroom implementing the GASING method across

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six sessions (Coombs, 2022; Yin, 2018). Three students (S-A, S-B, S-C) with varying levels of initial mathematics anxiety were purposively selected for in-depth interviews.

Research Procedure

Students completed a pre-test and baseline observations before the intervention. The GASING method was implemented across six 70-minute sessions over three weeks, moving from place value and basic addition using base-ten blocks (sessions 1–2), to the borrowing procedure in subtraction through concrete and pictorial representations (sessions 3–4), to contextual word problems (sessions 5–6). Students completed a worksheet (LKPD) after each session, and the teacher-researcher recorded structured classroom observations. The post-test and individual interviews followed the sixth session.

Data Collection

Data were collected through a numeracy literacy test (pre-test/post-test, multiple-choice and open-ended), observation sheets, semi-structured interview guides designed to elicit students' thought processes and error types (Kvale & Brinkmann, 2015), and student worksheets (LKPD).

Data Analysis

Quantitative data were analyzed using descriptive statistics, paired-samples t-tests, and normalized gain (N-Gain) analysis (Hake, 1998; Lakens, 2013). Qualitative data were analyzed using thematic analysis following (Miles & Huberman, 1994), involving data reduction, display, and conclusion drawing/verification (Lincoln & Guba, 1985; Patton, 2015). Credibility was strengthened through data and source triangulation across interviews, observations, and worksheets, supplemented by informal member checking with the classroom teacher (Lincoln & Guba, 1985).

Ethical Statment

This study was conducted in accordance with established ethical principles for educational research involving human participants. The research involved 16 third-grade students at State Elementary School 77 Penerokan, Indonesia. The research objectives and procedures were explained to the relevant parties, and participation was voluntary, with appropriate permission and informed consent obtained from the relevant parties, including parents or legal guardians. Participants' rights, well-being, and confidentiality were protected throughout the study, and students' identities were anonymized using codes (S-A, S-B, and S-C). The authors affirm that the research was conducted with academic integrity, without fabrication, falsification, or plagiarism, and declare no conflicts of interest related to the research or its publication.

RESULTS AND DISCUSSION

This section presents the findings related to the improvement of students' mathematical numeracy literacy skills and the reduction of learning obstacles after the implementation of the GASING method. The findings are derived from both quantitative and qualitative data, including pre-test and post-test results, statistical analysis, student worksheet performance, and interview data from teachers and students.

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Improvement of Students' Mathematical Numeracy Literacy Skills

The effectiveness of the GASING method in improving students' numeracy literacy skills can be observed through the comparison of pre-test and post-test scores across several mathematical competencies, including addition, subtraction, and contextual problem-solving abilities.

Table 1. Comparison of students' mathematical numeracy literacy scores

Assessment Aspect	Pre-test Average	Post-test Average	Score Increase	Percentage (%)
Addition	42.50	92.00	+49.50	116.47%
Subtraction	39.75	93.25	+53.50	134.59%
Word Problems	39.63	97.88	+58.25	146.98%
Total Average	40.63	94.38	+53.75	132.29%

As shown in Table 1, students experienced a substantial improvement in their mathematical numeracy literacy skills after participating in the learning intervention. The overall average score increased from 40.63 in the pre-test to 94.38 in the post-test, indicating a significant improvement in students' understanding of addition and subtraction concepts.

This pattern of gains across all three competency areas suggests that the effect of the GASING method was not confined to a single, narrow skill, but rather extended consistently across the foundational operations that underpin third-grade numeracy literacy.

The largest increase occurred in the word problem-solving aspect, where the average score rose from 39.63 to 97.88. This finding suggests that the GASING method not only improves students' computational skills but also enhances their ability to interpret contextual mathematical problems. Numeracy literacy involves the capacity to translate real-world situations into mathematical representations and apply appropriate operations to solve them (Gultom & Khairul, 2024; Nafsy et al., 2022; Sulistiawati, 2019). Therefore, the improvement in students' performance in solving word problems indicates a meaningful development in their numeracy literacy skills.

Qualitative data provides further insight into this improvement. Observations revealed that students were more engaged and confident when solving word problems after the intervention. One student explained, "Before, I didn't understand what the word problem was asking. Now, I can draw a picture and use the GASING method to solve it." Analysis of student worksheets also showed a reduction in procedural errors and an increased use of diagrams and manipulatives to represent the problem (Surya, 2019).

Improvement of Student Learning Mastery

The improvement in students' mathematical abilities is also reflected in the number of students who achieved learning mastery based on the Minimum Completeness Criterion (KKM = 70).

Table 2. Comparison of students learning mastery levels

Assessment Aspect	Mastery Pre-test	Mastery Post-test	Percentage Pre	Percentage Post
Addition	7 students	14 students	43.75%	87.50%
Subtraction	6 students	13 students	37.50%	81.25%
Word Problems	5 students	15 students	31.25%	93.75%
Total Average	6 students	14 students	37.50%	87.50%

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Table 2 indicates that the percentage of students achieving learning mastery increased substantially after the implementation of the GASING method. Before the intervention, only 37.50% of students achieved the mastery criterion, whereas after the intervention the percentage increased to 87.50%.

The most notable improvement occurred in the word problem-solving aspect, where the percentage of students achieving mastery increased from 31.25% to 93.75%. This improvement indicates that students became more capable of interpreting contextual problems and selecting appropriate mathematical operations.

This result supports the argument that conceptual understanding plays a crucial role in developing students' mathematical proficiency (Corrêa & Haslam, 2020). Students who understand the meaning behind mathematical operations are more likely to apply them effectively in different contexts.

Interviews with teachers revealed that the GASING method helped students develop a deeper conceptual understanding of mathematical operations. Teacher RF stated, "The use of manipulatives allowed students to 'see' the math, making it easier for them to grasp the underlying concepts." Analysis of student worksheets showed that students were able to explain their reasoning and justify their answers more effectively after the intervention.

Statistical Analysis

To determine whether the improvement in students' scores was statistically significant, a paired-samples t-test was conducted.

Table 3. Paired sample t-Test results

Comparison	Mean Difference	Std. Deviation	t	df	Sig
Pre-test vs Post-test	53.750	16.683	−12.887	15	0.000

The results of the paired-samples t-test indicate a statistically significant difference between the pre-test and post-test scores. The obtained t-value of −12.887 with a significance level of $p < 0.001$ demonstrates that the improvement in students' mathematical numeracy literacy skills after the implementation of the GASING method is highly significant.

This statistical result confirms that the learning intervention using the GASING method has a strong positive impact on students' learning outcomes. The large mean difference between pre-test and post-test scores also suggests that students experienced substantial conceptual development during the learning process.

Observations of classroom activities showed that students were more actively engaged and participated more frequently after the intervention. They were more willing to attempt challenging problems and collaborate with their peers (Cevikbas & Kaiser, 2022). This increased engagement may have contributed to the significant improvement in their test scores.

From a practical standpoint, a mean difference of this magnitude, combined with a highly significant t-value, indicates that the observed improvement is very unlikely to be attributable to chance variation or to maturation effects alone over the three-week intervention period.

Learning Gain Analysis

To further examine the effectiveness of the intervention, the normalized gain (N-Gain) analysis was conducted.

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Table 4. Normalized Gain (N-Gain)

Aspect	Pre-test	Post-test	N-Gain	Category
Total Average	40.625	94.375	0.905	High

The N-Gain value of 0.905 falls within the high category, indicating that the GASING method is highly effective in improving students' numeracy literacy skills. The high gain score demonstrates that students were able to make substantial learning progress relative to their initial knowledge levels.

This result is consistent with previous studies that emphasize the importance of meaningful learning approaches in mathematics education(Ramadhanti & Marhadi, 2024). Instructional methods that focus on conceptual understanding and active student engagement are more likely to produce significant learning gains compared to conventional teaching methods.

Analysis of student worksheets revealed that students were able to transfer their knowledge and skills to new and unfamiliar problems after the intervention. This suggests that the GASING method not only improves students' ability to solve routine problems but also enhances their problem-solving flexibility and adaptability.

Student Worksheet Performance

Students' learning progress during the instructional sessions was also analyzed through the evaluation of student worksheets (LKPD).

Table 5. Student worksheet (LKPD) results

Meeting	Average Score
1	71.88
2	96.25
3	92.50
4	95.63
5	90.00
6	100.00
Average	91.70

Table 5 shows that students demonstrated consistent improvement in their worksheet performance throughout the learning sessions. The average LKPD score reached 91.70, indicating that students were able to apply the mathematical concepts learned during the GASING instruction effectively.

Although a slight decrease occurred during the fifth meeting, students achieved a perfect score during the sixth meeting. This pattern suggests that students were still adjusting to increasingly complex tasks before ultimately achieving full conceptual mastery.

Changes in Students Attitudes and Learning Engagement

Qualitative findings obtained from interviews with students and teachers reveal significant changes in students' attitudes toward mathematics learning. Before the intervention, many students expressed feelings of anxiety and lack of confidence when solving mathematical problems, particularly those involving subtraction with borrowing.

This shift in attitude was also captured systematically through classroom observation sheets completed by the teacher-researcher during each of the six learning meetings, focusing on five behavioral indicators of students' affective engagement.

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Table 6. Observation results on students' attitudes and learning engagement

Observed Aspect	Meeting 1 (%)	Meeting 6 (%)	Change
Anxiety When Facing Subtraction with Borrowing	62.50%	12.50%	-50.00%
Active Participation in Class Discussion	31.25%	87.50%	+56.25%
Independent Problem-Solving Attempts	37.50%	93.75%	+56.25%
Use of Manipulatives/Visual Aids Without Prompting	18.75%	81.25%	+62.50%
Asking Questions When Facing Difficulty	25.00%	75.00%	+50.00%

As shown in Table 6, the proportion of students exhibiting anxiety when facing subtraction problems with borrowing decreased sharply from 62.50% at the first meeting to only 12.50% at the sixth meeting. Conversely, active participation in classroom discussion rose from 31.25% to 87.50%, independent problem-solving attempts increased from 37.50% to 93.75%, and the spontaneous use of manipulatives or visual aids without teacher prompting increased markedly from 18.75% to 81.25%. Students' willingness to ask questions when encountering difficulty also improved from 25.00% to 75.00%. These observational data provide quantitative corroboration for the qualitative accounts described below, indicating that the affective changes reported by students were consistent with patterns of behavior documented systematically across the six learning sessions.

After the implementation of the GASING method, students reported feeling more confident and motivated to engage in mathematics learning. One student stated:

"Now I am not afraid of mathematics anymore. When there are subtraction problems with borrowing, I understand them better."

Field Notes, 14 October 2024: During the interview session after the third learning meeting, Student A (S-A) expressed a visible change in demeanor compared to the initial observation. S-A, who had previously avoided eye contact when asked about mathematics, now responded with a smile and sat upright. The student spontaneously demonstrated the GASING borrowing technique using fingers without being prompted, showing that the procedure had been internalized. The classroom environment was calm and the interview was conducted individually at a corner desk while other students worked on their worksheets.

A similar sentiment was expressed by another student, who stated:

"Before, I always asked my friend for help because I could not do the subtraction by myself. But now I can count it alone using the GASING steps. It feels good when I get the right answer."

Field Notes, 21 October 2024: Student B (S-B) was interviewed individually following the fifth learning session. Prior observations had noted that S-B frequently turned to seatmates for assistance during independent tasks and showed signs of frustration when unable to complete problems. On this occasion, S-B completed two subtraction problems on the worksheet independently before the interview, with both answers correct. During the conversation, S-B pointed to the step-by-step GASING chart posted on the classroom wall and explained each step aloud with growing confidence. The teacher was present at the front of the room and observed the exchange without intervening.

Reinforcing these accounts, a third student further elaborated on the motivational shift experienced during the learning process:

"I used to think math was really hard and boring. Now I like it because we use blocks and pictures. I want to practice more at home because it is fun."

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Field Notes, 28 October 2024: The interview with Student C (S-C) took place at the end of the sixth and final learning session. Throughout earlier sessions, S-C had been observed as relatively passive during group discussions, rarely volunteering answers. On this day, however, S-C was among the first students to raise their hand when the teacher reviewed the addition problems using base-ten blocks. During the interview, S-C described enjoying the tactile aspect of using physical manipulatives and mentioned practicing similar activities at home using stones and twigs. The student's enthusiasm was also noted by the classroom teacher, who remarked on this behavioral change independently during the post-session debrief.

Teachers also observed increased student participation and engagement during classroom activities. Students became more willing to ask questions, discuss solutions with peers, and attempt solving mathematical problems independently. The active and collaborative nature of the learning process is visually documented in Figure 1, which captures students during various GASING method activities. The photographs show learners actively engaged with base-ten blocks, working together on worksheets, and confidently presenting their problem-solving strategies to the class. These images provide concrete evidence of the shift from passive reception of information to active, student-centered learning that was consistently observed throughout the six sessions. The hands-on manipulation of concrete objects, visible in the figure, corresponds directly to the reduction in conceptual obstacles reported earlier, as students were able to physically enact the borrowing and carrying procedures before formalizing them symbolically.



Figure 1. Classroom Activities During the Implementation of the GASING Method

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These findings indicate that the GASING method not only improves students' cognitive abilities but also positively influences their affective attitudes toward mathematics learning. This pattern is consistent with self-efficacy theory, which posits that repeated mastery experiences and visible success in completing tasks increase an individual's confidence in performing similar tasks in the future (Ekawati et al., 2022). The concrete-to-abstract sequence applied in the GASING method appears to provide precisely this kind of mastery experience: by allowing students to manipulate physical objects before working with abstract numerals, the method reduces the cognitive load associated with subtraction with borrowing and creates frequent opportunities for small, visible successes (Cevikbas & Kaiser, 2022). Compared to prior studies that examined the cognitive effects of the GASING method without addressing students' affective responses (Nadiatussalma & Surya, 2025), the present findings extend this body of work by demonstrating that the reduction of mathematics anxiety and the increase in active participation documented in Table 6 occur in tandem with, and may partly explain, the substantial cognitive gains reported in the previous sub-sections.

Reduction of Learning Obstacles

The findings of this study indicate that the GASING method effectively reduces several types of learning obstacles experienced by students, as evidenced by the convergence of the quantitative results presented in Tables 1-4, the observational data in Table 6, and the qualitative accounts obtained from interviews, field notes, and student worksheets. Three categories of learning obstacles identified at the outset of the study—conceptual, procedural, and problem-solving obstacles were each addressed by specific features of the GASING method.

First, conceptual obstacles related to place value understanding and borrowing mechanisms were reduced, as reflected in the post-test mastery rate of 81.25% for subtraction (Table 2) compared to only 37.50% at pre-test. Through the use of concrete manipulatives and visual representations, students were able to develop a clearer understanding of how numbers are structured within the place value system, consistent with findings that concrete media use in lower-grade mathematics instruction facilitates students' conceptual understanding more effectively than abstract symbolic instruction alone (Ramadhani, 2025). This finding corroborates Fuson (1990), argument that place value, as an abstract positional concept, is best acquired when learners first interact with physical groupings of tens and ones before encountering the standard written algorithm, and it extends prior GASING research Nafsy et al., (2022) by showing that this conceptual gain is paired with a measurable decline in students' self-reported mathematics anxiety (Table 6).

Second, procedural obstacles related to addition and subtraction algorithms were minimized, as shown by the steady rise in LKPD scores from 71.88 at the first meeting to a perfect 100.00 by the sixth meeting (Table 5). Structured practice and step-by-step learning activities helped students internalize mathematical procedures more effectively. This pattern is consistent with Van et al., (2019) developmental view of procedural fluency, which holds that repeated, scaffolded practice with concrete steps allows procedures to become automatized only after the underlying concept has been understood, rather than being memorized in isolation (NCTM, 2014).

Third, problem-solving obstacles associated with interpreting contextual word problems were significantly reduced, as indicated by the largest score increase of all assessed competencies, from 39.63 to 97.88 (Table 1), and the highest mastery gain,

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from 31.25% to 93.75% (Table 2). Students became more capable of identifying relevant information in problem statements and selecting appropriate mathematical operations, in contrast to the error patterns commonly documented among lower-grade students when interpreting word problems involving addition and subtraction (Gultom & Usman Khairul, 2024). This finding is in line with research showing that difficulties in solving mathematical word problems often stem less from computational weakness than from students' limited ability to translate textual and contextual information into a mathematical representation (Hill et al., 2019; Surya, 2019; Yang & Kaiser, 2022). The visual and manipulative-based strategies embedded in the GASING method appear to have provided students with an intermediate representational step that bridged this gap between contextual language and abstract computation, supporting the broader argument that contextualized instructional approaches strengthen elementary students' numeracy literacy more effectively than decontextualized drill-based practice (Manurung et al., 2025).

Overall, the integration of quantitative and qualitative findings demonstrates that the GASING method provides a comprehensive learning approach that addresses both conceptual and procedural difficulties in elementary mathematics learning.

Theoretical and Practical Implications

Theoretically, the findings of this study contribute to the existing literature in two ways. First, by mapping the GASING method's instructional features explicitly onto the three categories of learning obstacles conceptual, procedural, and problem-solving this study offers a more fine-grained account of why the method works than has typically been provided in prior GASING research, which has tended to report aggregate score gains without specifying the underlying mechanism (Parwati et al., 2024) Second, by documenting the parallel improvement in students' affective engagement alongside their cognitive gains, this study lends empirical support to the broader theoretical claim that cognitive and affective dimensions of mathematics learning are mutually reinforcing rather than independent (Baten et al., 2020).

Practically, these findings suggest several concrete implications for classroom teachers. Teachers working with students who exhibit persistent difficulty with borrowing in subtraction may benefit from delaying the introduction of the standard written algorithm until students can reliably perform the equivalent action with physical manipulatives, rather than reteaching the algorithm itself through repeated drill. Likewise, the marked reduction in mathematics anxiety documented in this study suggests that structuring early lessons around low-stakes, hands-on success experiences may be as important for building numeracy literacy as the choice of computational method itself. For school leaders and curriculum developers, these results offer preliminary evidence that concrete-to-abstract instructional sequences such as GASING are a viable strategy for schools seeking to improve foundational numeracy outcomes in response to national assessment frameworks such as the Minimum Competency Assessment.

CONCLUSION

The results of this study demonstrate that implementing the GASING method can improve third-grade students' mathematical numeracy literacy. Quantitative findings showed a significant increase in students' average numeracy literacy scores, while qualitative data revealed that the method helped students overcome conceptual and procedural learning obstacles through concrete manipulatives, visual representations,

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and collaborative problem-solving, which appeared particularly effective in addressing misconceptions and building students' confidence.

These findings suggest that GASING has potential as a valuable instructional tool for elementary mathematics education. However, this study's relatively small sample of 16 students from a single classroom, the absence of a control group, and the immediate post-test administration limit the generalizability of these results and the extent to which gains can be attributed to the method with certainty. Future research adopting a quasi-experimental design with a control group, longitudinal follow-up to assess the durability of gains, and replication across multiple classrooms and schools with differing characteristics would help establish the boundary conditions under which the GASING method is most effective and clarify the role of teacher training in shaping outcomes.

AUTHOR DECLARATION

Author Contribution. Me served as the lead researcher, defining the research theme, developing the proposal, designing the research instruments, and conducting data analysis; SP contributed to drafting the article and conducting the theoretical review related to the research theme; EM contributed to data analysis; and MAS contributed to interpretation of the research findings

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Declaration of AI and AI-assisted technologies in the writing process. During the preparation of this work, the authors used ChatGPT and DeepL solely to improve readability, refine academic language, and assist in translating the manuscript from Indonesian into English. Standard software tools, namely jamovi and Mendeley, were utilized strictly for quantitative data processing (descriptive statistics, paired-samples *t*-tests, and N-Gain analysis) and reference management, not for generating scientific content or interpreting findings. After using these tools, the authors reviewed and edited the content as needed and take full responsibility for the content of the publication.

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