



Enhancing Junior High School Students' Numeracy through the Implementation of the GASING Learning Method

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Abstract

Numeracy is one of the essential skills for students in the 21st century, as it represents an individual's ability to apply mathematical concepts and skills, especially integers in everyday life and was the major domain in PISA 2022. However, in reality, Indonesia ranked 69th out of 80 countries in PISA 2022, indicating that Indonesian students' mathematical abilities, especially in numeracy, remain far below expectations. The GASING learning method offers a potential solution to address this issue. This study aims to analyze enhancement in junior high school students' numeracy using the GASING learning method. This research is quantitative in nature, employing a quasi-experimental method with a pretest-posttest control group design. The sample consisted of 98 junior high school students from Morotai Island Regency, selected via purposive sampling. Data were collected through written numeracy tests. The pretest and posttest scores were used to calculate each student's N-Gain value, followed by an independent t-test. Based on the data analysis, the average N-Gain scores for the experimental and control groups were 0.81 (high category) and 0.61 (medium category), respectively. With $\alpha = 0.01$, the t-test revealed a significant difference in numeracy enhancement between the experimental and control groups. In conclusion, the GASING learning method effectively enhances junior high school students' numeracy.

Keywords: Numeracy, Integers; GASING Learning Method

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How to Cite: Anwar, M., Kusumah, Y. S., & Priatna, N. (2026). Enhancing Junior High School Students' Numeracy through the Implementation of the GASING Learning Method. *Formatif : Jurnal Ilmiah Pendidikan MIPA*, 16(1), 103-114. <https://doi.org/10.30998/pck79691>

INTRODUCTION

Numeracy is an essential skill to develop, as it encompasses various domains, both in mathematics such as data analysis, relations, geometry, dimensions and measurement, and numbers and operations as well as in social and financial fields (Bellini et al., 2019). Numeracy is more than just computation; it involves understanding, reasoning, and applying mathematics in contextual ways (OECD, 2019), since numeracy represents an individual's ability to use mathematical concepts and skills in everyday life (Adelia et al., 2024; Andriatna et al., 2024; OECD, 2019). It is evident that numeracy and mathematics are distinct yet interdependent. Mathematics serves as the "concept," while numeracy provides the "context." Numeracy relies on mathematical concepts to apply them in real-life situations, and mathematics depends on numeracy to make it beneficial for the individuals learning it.

The importance of numeracy does not automatically make this skill easy to develop. Results from the Program for International Student Assessment (PISA) 2022 indicate that Indonesia's average mathematics score declined by 13 points, from 379 in 2018 to 366, a figure that trails the global average by 106 points, placing Indonesia 69th out of 80 countries (Kemendikbudristek, 2023; Lubis, 2023). In fact, numeracy was the

major domain measured in PISA 2022 (OECD, 2019). These results indicate that Indonesian students' mathematical abilities, especially in numeracy, remain far below expectations.

One factor contributing to Indonesian students' low numeracy skills is that many students and prospective mathematics teachers struggle to apply mathematical concepts to practical situations, due to an overreliance on memorizing formulas rather than developing a deep conceptual understanding (Winarni et al., 2025). Additionally, Andriatna et al. (2024) found that students' numeracy (particularly in geometry and measurement content) falls into the "requires special intervention" category, underscoring the need for enhanced learning processes with a stronger focus on improving student numeracy. Accordingly, mathematics instruction should foster students' capacity to utilize mathematical concepts in real-life contexts.

In cognitive skills (numeracy), there is a fundamental mathematical thinking skill: number sense. Numbers are a crucial topic for students to learn due to their numerous benefits. First, number concepts form the foundation for other mathematical concepts. A solid understanding of number concepts provides a strong foundation for students' future success in mathematics, as it helps them transition from concrete to abstract representations (Woods et al., 2018). Second, mastery of number concepts can develop mathematical critical thinking skills (Agustina et al., 2020). Third, it enables application in real-life situations and other fields (Kraft & Washington, 2014). Fourth, it fosters conceptual understanding (Schiller et al., 2022). Thus, mastery of number concepts is essential for students.

The link between weak numeracy and students' abilities in the numbers domain is also supported by findings that number concepts require strong conceptual understanding and contextual application. This is reinforced by research results confirming that students' weak numeracy in the numbers domain is closely related to inappropriate teaching methods and a lack of relevant learning contexts, which ultimately hinder students' ability to solve numeracy problems effectively (Fatimah & Wahyudin, 2025). Additionally, the lack of adaptation of teaching methods to diverse student needs—including limited learning resources and environmental support—exacerbates numeracy difficulties. For instance, in remote elementary schools, teachers' inability to adapt teaching methods to students' conditions and environments leads to challenges in mastering numeracy, particularly in complex numbers domains (Jumadain & Sarino, 2025). Thus, the use of effective and appropriate teaching methods in mathematics instruction is expected to improve students' numeracy.

One method that is expected to enhance students' numeracy is the GASING Learning Method, as it uses concrete objects as the foundation for initiating instruction. The GASING Learning Method is an approach developed by Prof. Yohanes Surya, an Indonesian physicist. GASING itself is an acronym for "Gampang" (Easy), "Asyik" (Fun), and "Menyenangkan" (Enjoyable). The "Gampang" (Easy) principle in the GASING Learning Method focuses on simplifying complex mathematical concepts into logical and digestible steps for students. Meanwhile, the "Asyik" (Fun) and "Menyenangkan" (Enjoyable) principles emphasize the importance of the affective aspect in mathematics learning. Thus, mathematics learning through the GASING method involves studying mathematics in an easy manner that makes students feel excited and happy about learning mathematics (Surya, 2024).

The GASING Learning Method consists of three main stages: Concrete, Abstract, and *Mencongak* (mental calculation) (Surya, 2024). In the concrete stage, students learn through play and exploration using real objects or teaching aids. Students touch, move, and manipulate objects to illustrate mathematical concepts, enabling them to directly

understand abstract mathematical ideas. The use of concrete in mathematics learning can enhance conceptual understanding and problem-solving skill (Fitria et al., 2025; Hinton & Flores, 2022). In the abstract stage, students engage in cognitive mathematical processes, such as using mathematical symbols. To make it easier for students to understand mathematics learning, a generalization process from concrete objects to abstract forms is required. This generalization process is also known as abstraction. Abstraction is fundamental in building mathematical knowledge. It encourages students to utilize prior knowledge and experiences, thereby facilitating deeper understanding and critical thinking (Andriatna et al., 2025; Nurjannah & Kusnandi, 2021). Abstraction enables students to identify relationships and properties within a problem, transitioning from trial-and-error methods to more efficient solutions. This transition is crucial for developing advanced problem-solving strategies (Izu, 2022; Ningsih & Hidayati, 2022). In the final stage, *mencongak* (mental calculation), students can understand concepts and their applications without requiring calculation tools and can think quickly and automatically (Sulistiawati, 2019).

The concrete and abstract stages in the GASING Learning Method nearly perfectly reflect Bruner's (1966) theory of three modes of representation: enactive, iconic, and symbolic. The enactive mode corresponds to the concrete stage in the GASING Learning Method, where knowledge is encoded through motoric actions. Although not explicitly mentioned, the iconic mode is implicitly positioned between the concrete and abstract stages in the GASING Learning Method. When students begin to visualize the concrete objects used, they have entered the iconic stage, which serves as a crucial bridge to the abstraction process. Meanwhile, the abstract stage in the GASING Learning Method aligns with Bruner's symbolic mode, where students employ mathematical symbols to represent the prior actions and images from the concrete materials.

Furthermore, the GASING Learning Method also aligns with Vygotsky's (1978) theory of the Zone of Proximal Development (ZPD) and scaffolding. The ZPD refers to the area where students cannot yet solve problems independently but can succeed with guidance. The "*Gampang*" (easy) principle in GASING is a smart application of the ZPD. The teacher acts as the More Knowledgeable Other (MKO), providing scaffolding (a support framework) by breaking down material into achievable small steps. This assistance is gradually reduced as student competence increases, until they can stand independently at the "*mencongak*" stage. The fun and collaborative learning environment also supports Vygotsky's theory that learning is a social process.

The GASING learning method includes the term "critical point," which represents a key milestone that students or learners must pass. Students who have reached the critical point can easily master subsequent concepts at that level (Surya, 2024). In addition, this method also integrates games, music, and songs into the learning process to create a more enjoyable learning atmosphere. Enjoyable mathematics learning can help transform students' negative attitudes toward mathematics into more positive ones and reduce their tendency to avoid mathematics (Marek, 2019).

Research conducted by Armianti et al. (2016) demonstrates a positive effect of the GASING learning method on integer multiplication learning outcomes among STKIP Surya matriculation participants, with an N-gain enhancement of 0.59, classified as moderate. Additionally, Situmorang et al. (2024) found that the GASING learning method significantly influences student learning outcomes. Similar results were reported by Lestari and Hardini (2022), who examined the effectiveness of the GASING learning method in enhancing sixth-grade elementary school students' conceptual understanding of two-digit multiplication. They concluded that the GASING method is more effective than conventional teaching methods.

Although numerous studies demonstrate the many benefits of the GASING learning method, research remains limited to general learning outcomes and mastery of basic arithmetic skills, with no specific exploration of its application in enhancing student numeracy. Therefore, this study was conducted to address this gap. The research aims to analyze the significant differences in numeracy enhancement between students taught using the GASING learning method and those taught using direct instruction.

METHODS

This study employs a quantitative methodology using a quasi-experimental pretest–posttest control-group design. The quantitative approach was selected because the collected data consist of numerical values that will be analyzed statistically, while the quasi-experimental design was chosen because the researcher couldn't fully control external variables that may influence the research outcomes, such as pre-assigned classroom arrangements by the school, students' ages, and academic abilities. This study involves two student groups: the experimental group and the control group. The experimental group consists of students taught using the GASING Learning Method, while the control group receives Direct Instruction. Both the experimental and control groups will undergo pretest and posttest assessments. The pretest was administered before the intervention, and the posttest was administered after.

The population in this research consists of seventh-grade junior high school students in Morotai Island Regency, North Maluku Province, comprising two groups—the experimental and control groups—from three schools with relatively equivalent abilities, conducted during the first semester of the 2025-2026 academic year. The sample in this research consists of 98 seventh-grade junior high school students, comprising 50 students in the experimental class and 48 in the control class, from 3 schools, selected purposively. The schools selected as samples were those accredited at level C (adequate) and located far from urban areas.

The data in this research were obtained through numeracy test questions that had been validated by three experts, consisting of one professor in the field of mathematics education and two lecturers in mathematics education. The following are the validation results from the three validators. The validation process focused on three main aspects: content, construct, and language. Based on the review results, all three validators concluded that this numeracy test instrument falls into the "feasible with revisions" category. Several improvement notes from the validators were subsequently addressed by the researcher to minimize ambiguity and enhance question readability before administering the test to the research subjects. Following the validation process, the instrument was first pilot-tested to assess its reliability. The results of the reliability test are shown in Table 1.

Instrument	<i>Cronbach's Alpha</i>	N
Student Numeracy Test Questions	0.758	5

Based on the data in Table 1, the Cronbach's Alpha value is 0.758, indicating that the student numeracy test instrument falls into the reliable category. Furthermore, the Cronbach's Alpha value of 0.758 lies between 0.70 and 0.80 ($0.70 \leq \alpha < 0.80$), signifying that the student numeracy test instrument has a good level of reliability.

The numeracy test consisted of five essay questions covering three numeracy indicators: understanding procedures, formulating information, and applying computational operations. These three indicators are a synthesis of works from the Ministry

of Education and Culture of the Republic of Indonesia (2020), the Organization for Economic Co-operation and Development (OECD, 2019), Coben et al. (2003), and Yasukawa et al. (2018), adapted to the abilities of junior high school students in Morotai Island Regency.

After obtaining the pretest and posttest numeracy data from students, the scores were processed to calculate the N-Gain value for each student in both groups. These N-Gain values were then used for hypothesis testing. The data analysis technique employed an independent samples t-test using SPSS 27 as the statistical tool. Prior to the statistical test, normality and homogeneity tests were conducted as prerequisite analyses.

Overall, this study began with the selection of schools meeting the predetermined criteria, followed by the establishment of experimental and control groups based on school conditions. Subsequently, students in each group were administered a pretest as the initial step before implementing the intervention using the respective learning method assigned to their group, as shown in Figure 1. The learning method was applied offline across 8 meetings, consisting of 2 tests (pretest and posttest) and 6 sessions for delivering the relevant material. The collected data were used for hypothesis testing as the basis for drawing conclusions. The hypotheses employed in this study are as follows.

- H₀ : There is no significant difference in numeracy improvement between students receiving the GASING learning method and those receiving direct instruction.
- H₁ : There is a significant difference in numeracy improvement between students receiving the GASING learning method and those receiving direct instruction.

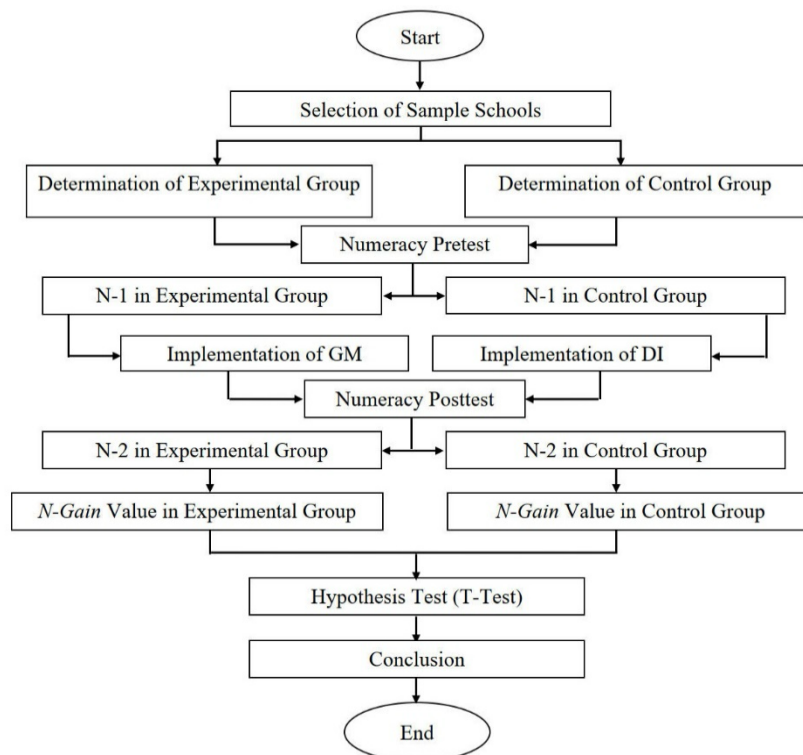


Figure 1. Research Procedures

Information:
 GM: GASING Learning Method
 DI: Direct Instruction
 N-1: Numeracy Pretest Score
 N-2: Numeracy Posttest Score

RESULTS & DISCUSSION

Results

Normality Test Result

Before processing the obtained data using the independent samples t-test, a normality test was conducted first. The normality test results for the data to be used are shown in Table 2.

Table 2. Test of Normality

Data	Group	Shapiro-Wilk		
		Statistic	df	Sig.
Value of Students' N-Gain	GASING	0.957	50	0.068
	DI	0.957	48	0.074

The data in Table 2 shows that the Sig. values for the GASING group and DI group are 0.68 and 0.74, respectively. Since the Sig. values for both groups are greater than $\alpha = 0.05$, the students' N-Gain scores to be used follow a normal distribution.

Homogeneity Test Result

After conducting the normality test, a homogeneity test was performed next to determine whether the data used were homogeneously distributed. The homogeneity test results are shown in Table 3.

Table 3. Test of Homogeneity of Variance

Data	Levene			
	Statistic	df1	df2	Sig.
Value of Students' N-Gain	0.509	1	96	0.477

The data in Table 3 shows that the homogeneity test using Levene's test yielded a Sig. value of 0.477. Since the Sig. value of $0.477 > \alpha = 0.05$, the data used are homogeneously distributed. These results indicate that the independent samples t-test can be used as a statistical test.

Distribution of The Students' N-Gain Values

After obtaining the students' numeracy data from the pretest and posttest, the data were processed to calculate the N-Gain values. The N-Gain scores for each student in both groups are shown in Table 4.

Table 4. Average Value of Student's N-Gain

Group	N	Average N-Gain	Interpretation
GASING	50	0.81	High
DI	48	0.61	Medium

Based on the data in Table 4 above, the average N-Gain scores for students in the GASING group and DI group are 0.81 and 0.61, respectively. These results indicate that the numeracy enhancement of students taught using the GASING learning method is higher than that of students taught using direct instruction. To determine whether this difference in numeracy enhancement is statistically significant, a statistical test using the independent samples t-test is required.

Statistic Test Result

The statistical test in this research uses the independent samples t-test with SPSS 27 software. This statistical test is intended to address the research hypothesis. The statistical test results are shown in Table 5.

Table 5. Independent Samples T-Test

	N	df	t	Sig. (2-tailed)
Value of Students' N-Gain	98	96	40.911	0.000

The data in Table 5 shows that for $\alpha = 0.05$, the Sig. (2-tailed) value obtained is 0.000. Since the Sig. (2-tailed) value of $0.000 < \alpha = 0.05$, the null hypothesis (H_0) is rejected, indicating a significant difference in numeracy enhancement between students taught using the GASING learning method and those taught using direct instruction.

Discussion

The analysis of the GASING learning method's effect on improving seventh-grade junior high school students' numeracy shows that the average numeracy enhancement for the GASING group (N-Gain = 0.81) was better than that of the DI group (N-Gain = 0.61). The significant difference in numeracy enhancement between the GASING and DI groups is also indicated by the t-test results (Sig. (2-tailed) = 0.000). This demonstrates that the GASING learning method can enhance students' numeracy more effectively than direct instruction. These findings align with previous research showing that the GASING method improves basic arithmetic skills such as addition, multiplication, subtraction, and division (Armianti et al., 2016; Hendriana et al., 2019; Lestari & Hardini, 2022; Rumajar et al., 2024; Situmorang et al., 2024), as well as conceptual understanding and student creativity (Pratiwi et al., 2021).

Additionally, the "concrete" stage in the GASING learning method requires students to learn mathematical concepts using concrete materials before being introduced to symbolic (abstract) elements, which helps students understand abstract mathematical concepts (Kaya & Yildiz, 2024; Prosser & Bismarck, 2023). The "concrete" stage in the GASING method is particularly crucial because it enables students to effectively understand and apply mathematical principles, making learning more meaningful (Hakim et al., 2019; Jumaat et al., 2017). Numerous studies have demonstrated the effectiveness of concrete-based approaches in enhancing computational skills. For instance, a meta-analysis by Ebner et al. (2025) showed statistically significant enhancements in students' mathematical performance, indicating that the use of concrete materials in mathematics learning is not only effective but also beneficial for diverse learners.

The results of this research support the implementation of the GASING learning method in mathematics instruction. Theoretically, this study contributes to constructivist learning theory, which emphasizes the importance of active and contextual learning where students construct their own knowledge through experiences and social interactions (Jumaat et al., 2017). Additionally, this research contributes to Bruner's learning theory regarding the three modes of representation: Enactive, Iconic, and Symbolic. The enactive mode corresponds to the concrete stage in the GASING learning method, where knowledge is encoded through motor actions. Meanwhile, the symbolic mode aligns with the abstract stage in the GASING method, when students use mathematical symbols to represent the actions and concrete images used previously.

The GASING learning method also integrates games, music, and songs into the learning process. This integration creates a more enjoyable learning atmosphere (Cahyani et al., 2026; Milman & Paz-Baruch, 2025; Vankúš, 2021). Enjoyable learning can increase

students' motivation to learn mathematics (Amran & Rahman, 2017) and help students better understand mathematical concepts (Azizi & Fauzan, 2020). Furthermore, enjoyable mathematics learning creates a positive emotional environment that can enhance cognitive functions such as working memory. This is crucial for problem-solving, as anxiety can disrupt the cognitive mechanisms involved in mathematical reasoning (Caridade et al., 2025). Additionally, enjoyable learning experiences encourage students to think critically and creatively (Arvyaty et al., 2021). When students find joy in learning, they tend to engage more actively in the learning process, leading to better academic outcomes (Du et al., 2025).

Overall, the research findings indicate that the implementation of the GASING method has a significant effect on the numeracy abilities of seventh-grade students in the sampled classes. Given that the research sample was determined using purposive sampling, the results of this study are not intended for broad generalization to the entire population but rather describe the conditions in student groups with characteristics similar to the sample. Moreover, the results reinforce the value of the GASING method, as it not only improves general learning outcomes and mastery of basic arithmetic skills but also boosts students' numeracy. Equally important, this study expands our knowledge of applying the GASING method in the context of numeracy (which remains underexplored), particularly at the junior high school level, thereby highlighting the novelty of this research.

CONCLUSION

This study aims to analyze the differences in numeracy improvement between students receiving GASING method instruction and those receiving direct instruction on integer number material. Based on the data analysis results, the mean N-Gain score for the experimental group (0.81) falls in the high category, whereas the control group (0.61) falls in the medium category. The independent samples t-test results show a significance value (Sig. 2-tailed) of $0.000 < 0.05$, indicating a statistically significant difference in numeracy improvement between the two groups. Thus, the GASING learning method proves more effective in enhancing junior high school students' numeracy compared to direct instruction, especially in research samples.

Pedagogically, the effectiveness of the GASING method is inseparable from its systematic learning stages—concrete, abstract (image), and semi-concrete—which align with Bruner's theory of representation and the scaffolding concept within the Zone of Proximal Development (ZPD). These stages enable students to build conceptual understanding gradually, from concrete experiences to symbolic representations, thereby supporting their ability to apply mathematical concepts contextually as part of numeracy.

This study contributes theoretically by extending research on the effectiveness of the GASING method, which has previously focused more on basic arithmetic learning outcomes, to the enhancement of junior high school students' numeracy. Practically, these findings imply that mathematics teachers can adopt the GASING method as an alternative instructional strategy to improve numeracy, particularly for integer number material. Nevertheless, this study is limited to a single region and specific content, so future research is recommended to test the GASING method's effectiveness on other mathematical topics, different educational levels, and while considering moderator variables such as prior ability or learning styles.

CONFLICT OF INTEREST

The authors declare that there is no conflict of interest.

ACKNOWLEDGEMENT

The researcher wishes to express the deepest gratitude to the school parties for providing the time and facilities, as well as to the students who actively participated throughout the research process.

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