How to Cite (APA Style):
Murnaka, N. P., Haryanti, H., Huda, M. N., Seva, K., & Lutog, J. P. (2026). Implementation of the GASING Approach Integrated with the STAD Model in Teaching Integer Operations through Local Wisdom. *Jurnal Ilmiah Pendidikan Dasar*, *13* (2), 496-517. http://dx.doi.org/10.30659/pendas.13.2.496-517

JURNAL ILMIAH
PENDIDIKAN DASAR
p-ISSN: 2354-9580
e-ISSN: 2685-211X

Implementation of the GASING Approach Integrated with the STAD Model in Teaching Integer Operations through Local Wisdom

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Submitted: June 15th, 2026 **DOI: 10.30659/pendas.13.2.496-517**
Revised: July 14th, 2026
Accepted: July 31st, 2026

Keywords:
elementary mathematics; integer arithmetic operations; gasing; local wisdom-based games; stad cooperative learning

Abstract
The relatively low numeracy achievement of Indonesian students in national and international assessments highlights the need for more innovative and student-centred mathematics instruction. Learning activities that primarily emphasise procedural exercises often limit students' conceptual understanding and interest in mathematics. Therefore, instructional approaches that integrate collaboration, educational games, and local cultural contexts are needed to create meaningful and enjoyable learning experiences. This study aimed to examine the implementation of the GASING Approach integrated with the Student Teams Achievement Division (STAD) model and local wisdom-based games in improving students' learning outcomes on integer arithmetic operations. This study employed a quantitative approach using a pre-experimental method with a One-Group Pretest–Posttest Design. The participants were 28 fifth-grade students of SD Tlogosari Kulon 05. Data were collected through pretest and posttest instruments covering addition, subtraction, multiplication, and division of integers. The data were analysed using descriptive statistics and the Normalised Gain (N-Gain) test. The findings showed an improvement in students' mathematics learning outcomes after the intervention. The mean pretest score

increased from 50.54 to 84.61 on the posttest. Learning mastery improved from 0% to 75%, while the average N-Gain score was 0.689, indicating a medium level of improvement. These results suggest that the implemented learning approach effectively enhanced students' understanding of integer arithmetic operations. The integration of the GASING Approach, the STAD model, and local wisdom-based games created an enjoyable, collaborative, and meaningful learning environment that supported the improvement of elementary students' mathematics achievement in integer arithmetic operations.

INTRODUCTION

Background of the Study

Mathematics education at the elementary school level provides a crucial foundation for developing students' mathematical thinking and problem-solving skills. At this educational stage, students learn to develop an understanding of fundamental mathematical concepts that serve as the basis for learning at subsequent levels (Ashcraft & Faust, 1994; Demirci & Ergül, 2026). This is consistent with the objectives of mathematics education established by the Ministry of Education, Culture, Research, and Technology of the Republic of Indonesia (2020), which state that mathematics is a compulsory discipline taught from elementary school through higher education because of its essential role in developing students' logical, analytical, systematic, and critical thinking abilities. These abilities equip students to address various problems encountered in everyday life and provide a foundation for learning more complex mathematical concepts at subsequent levels of education (Partnership for 21st Century Learning, 2022).

Mathematics education in elementary schools encompasses a range of interrelated competencies, including number sense, measurement, algebra, geometry, statistics, and problem-solving skills (NCTM, 2020). Among these competencies, one of the most fundamental abilities that students must acquire is mastery of arithmetic operations, including addition, subtraction, multiplication, and division (Yılmazer & Masal, 2023). These arithmetic operations function not only as computational skills (Canobi et al., 2022; Purwono et al., 2026), but also as a conceptual foundation and prerequisite for understanding more complex mathematical concepts (Jordan et al., 2021; Kilpatrick et al., 2021; Yılmazer & Masal, 2023).

Despite the critical role of arithmetic operations, various national and international reports indicate that students' mastery of mathematical skills continues to face serious challenges. The results of the Programme for International Student Assessment (PISA) (OECD, 2021) and the Trends in International Mathematics and Science Study (TIMSS) (2025) indicate that Indonesian students' mathematical performance remains below that of students in many other countries. This finding is further supported by the 2024 Indonesia Education Report Card published by the Center for Educational Assessment (Pusmendik, 2024), which indicates that students' numeracy skills, particularly at the elementary school level, have not yet reached the proficient category and therefore require further improvement (Pusmendik, 2024). These findings suggest that students continue to experience difficulties in developing a sound understanding of mathematical concepts and applying them in various contexts. Table 1 presents the numeracy achievement of Indonesian elementary school students over the past three years.

Table 1. Numeracy Achievement of Elementary School Students in Indonesia, 2023–2025

Year	Percentage of Students Achieving Minimum Numeracy Competency	Category
2023	47,97p	Moderate
2024	62,62	Moderate
2025	59,45	Moderate

Source : https://raporpendidikan.kemendikdasmen.go.id

As shown in the table above, students' numeracy achievement remained in the moderate category. This finding indicates the need to strengthen students' mathematical competencies, particularly the most fundamental competency, namely arithmetic operations. Mastery of basic arithmetic operations provides a foundation for the development of students' mathematical thinking and has long-term implications for their academic success, particularly in mathematics. The National Mathematics Advisory Panel (NMAP) (2022) emphasized that procedural fluency and conceptual understanding of numerical operations are essential prerequisites for learning algebra. In addition, Siegler et.al. (2025) stated that students' mastery of arithmetic concepts at the elementary school level is a strong predictor of their mathematics achievement at subsequent levels of education. Conversely, weaknesses in mastering basic arithmetic operations often lead to persistent misconceptions and become barriers to understanding more advanced mathematical concepts (Baroody, 2006; Booth & Newton, 2022; Reys et al., 2021; W.Chu et al., 2025).

As shown in the table above, students' numeracy achievement remained in the moderate category. This finding indicates the need to strengthen students' mathematical competencies, particularly the most fundamental competency, namely arithmetic operations. Mastery of basic arithmetic operations provides a foundation for the development of students' mathematical thinking and has long-term implications for their academic success, particularly in mathematics. The National Mathematics Advisory Panel (NMAP, 2022) emphasized that procedural fluency and conceptual understanding of numerical operations are essential prerequisites for learning algebra. In addition, Siegler et al. (2025) stated that students' mastery of arithmetic concepts at the elementary school level is a strong predictor of their mathematics achievement at subsequent levels of education. Conversely, weaknesses in mastering basic arithmetic operations often lead to persistent misconceptions and become barriers to understanding more advanced mathematical concepts (Baroody, 2006; Booth & Newton, 2022; Reys et al., 2021; W. Chu et al., 2015).

Previous studies have also indicated that the low mathematical proficiency of elementary school students is generally associated with inadequate understanding of fundamental number concepts and arithmetic operations (Demirci & Ergül, 2026; Prananto et al., 2025; Purwono et al., 2026; Siegler & Lortie-Forgues, 2025). Students who have not mastered arithmetic operations both conceptually and procedurally tend to experience difficulties in solving more complex mathematical problems. Furthermore, limited computational fluency may also restrict the development of students' creativity (Balhinez & Shaul, 2022; Qushem et al., 2022; Schoppek & Tulis, 2021; Thornhill-Miller et al., 2023). Therefore, improving the quality of instruction in arithmetic operations at the elementary school level represents a strategic step toward sustainably strengthening students' numeracy foundations.

In addition to conceptual mastery, successful mathematics learning, particularly in the area of arithmetic operations, is strongly influenced by the quality of the instructional process designed by teachers. When teachers continue to dominate classroom instruction and focus primarily on procedural explanations and repetitive exercises, students' motivation and engagement in the learning process may remain low Ruseffendi (2025). Therefore, students need to be actively engaged and motivated during instruction, as meaningful participation can contribute to improved learning outcomes (ATCS, 2020; Hattie, 2012; Joyce & Weil, 2025).

The importance of students' active engagement in learning is consistent with Piaget's theory of cognitive development (Piaget & Inhelder, 2021), which suggests that elementary school students are generally in the concrete operational stage. Accordingly, helping students understand mathematical concepts requires hands-on activities, visualization, and concrete representations before they progress to abstract forms of reasoning (Gita et al., 2015; Nubatonic et al., 2023). Instructional strategies should therefore be designed to be active, contextual, and meaningful so that they can facilitate students' construction of knowledge in accordance with their developmental level.

One approach that has been widely recommended for increasing student engagement is game-based learning. Previous studies have demonstrated that educational games can enhance students' motivation, participation, and learning outcomes (Plass et al., 2015; Wouters et al., 2023). Games can also create an enjoyable and engaging learning environment in which abstract mathematical concepts can be represented in more concrete and comprehensible forms.

However, the rapid development of digital technology has transformed children's patterns of play. Many students are currently more familiar with digital devices and are becoming less involved in traditional games that have historically developed within their local communities. Consequently, various traditional games that embody valuable cultural values are gradually being abandoned by younger generations (Livingstone & Blum-Ross, 2021; Marini et al., 2023). In fact, traditional games contain numerous positive values and skills, including cooperation, communication, strategic thinking, creativity, and problem-solving.

Within the Indonesian educational context, local wisdom has considerable potential to be integrated into the learning process because it can connect instructional content with the social and cultural realities that are closely related to students' everyday lives. Local wisdom-based learning helps students understand concepts more contextually, thereby making learning experiences more meaningful, relevant, and accessible (Choirunnisa et al., 2025; Putra & Mudra, 2022). The integration of local wisdom into instruction can also strengthen students' cultural identity and values, foster character development, and enhance their active engagement through learning experiences that are consistent with the environments in which they live (Choirunnisa et al., 2025; Khalid et al., 2026; UNESCO, 2021).

One form of local wisdom integration that can be implemented in instruction is the use of local wisdom-based games. These are educational games that incorporate traditional games, cultural values, or aspects of local community life into learning activities. Through visually engaging, interactive, exciting, and enjoyable game-based activities, students can more easily understand mathematical concepts while simultaneously being introduced to cultural values and encouraged to preserve them (Choirunnisa et al., 2025).

The successful implementation of local wisdom-based games is determined not only by the quality of the instructional media but also by teachers' ability to design appropriate instructional strategies so that students' learning activities can be effectively organized and managed. In other words, effective instructional media require a learning model that can optimize interaction, collaboration, and student engagement to ensure that the intended learning objectives are achieved.

One instructional model that has been shown to be effective in improving mathematics learning outcomes is Student Teams Achievement Divisions (STAD). This model emphasizes group cooperation, individual accountability, and team recognition, thereby promoting students' social interaction and participation in learning activities (Slavin, 2013). Previous studies have shown that cooperative learning has a more positive effect on learning outcomes than individualistic or competitive learning structures (Roseth et al., 2022).

Nevertheless, STAD primarily functions as a framework for social interaction and does not specifically provide conceptual stages through which students can gradually develop mathematical understanding. In this context, the GASING approach (Easy, Fun, and Enjoyable) developed by Yohanes Surya is relevant for integration with the STAD model. GASING emphasizes mathematics instruction through simple, concrete, and progressive stages, enabling students to understand mathematical concepts more easily and enjoyably. Previous studies have demonstrated that the GASING approach contributes to improvements in students' conceptual understanding, learning motivation, and mathematics achievement (Gita et al., 2015; Kusuma & Sulistiawati, 2024; Nubatonic et al., 2023).

Therefore, integrating the GASING approach, the STAD model, and local wisdom-based games has the potential to create mathematics instruction that is more effective, collaborative, contextual, and enjoyable, thereby improving students' learning outcomes. Such integration is particularly important in the teaching of integer arithmetic operations, which constitute a fundamental component of numeracy development among elementary school students.

The Problem of The Study

The central problem addressed in this study is whether the implementation of the GASING approach integrated with the STAD model and supported by local wisdom-based games has a significant effect on the mathematics learning outcomes of fifth-grade students at Tlogosari Kulon 05 Elementary School in the topic of integer arithmetic operations.

Research's State of the Art

Research on mathematics education at the elementary school level has continued to evolve in response to the need for instructional strategies that not only improve learning outcomes but also strengthen conceptual understanding, promote student engagement, and develop mathematical thinking skills (National Research Council, 2021; OECD, 2021). These developments indicate three major trends: the implementation of cooperative learning, the application of conceptually oriented approaches, and the use of educational media to support the learning process.

One instructional model that has been shown to improve student interaction, motivation, and learning outcomes through group cooperation and individual accountability is Student Teams Achievement Divisions (STAD) (Manalu & Murnaka, 2021; Roseth et al., 2022; Slavin, 2013). However, its implementation has tended to place greater emphasis on collaboration than on strengthening students' conceptual understanding.

In contrast, the GASING approach has been found to be effective in helping students understand mathematical concepts and improve their computational skills through a sequence of concrete activities, pattern recognition, critical points, and mental arithmetic exercises (Gita et al., 2015; Kusuma & Sulistiawati, 2024; Nubatonic et al., 2023). Nevertheless, the approach has generally been implemented through individual or whole-class instruction and has rarely been integrated with cooperative learning.

Research on game-based learning has also demonstrated its positive contribution to students' motivation, engagement, and learning experiences (Plass et al., 2010, 2015; Wouters et al., 2023). Recent developments have begun to emphasize the use of local wisdom-based games as a means of creating more contextualized learning. However, such games have generally been used only as supplementary instructional media and have not been systematically integrated with a conceptual approach or a specific instructional model.

Based on this review, previous studies have tended to develop these three components separately. Therefore, the present study proposes the integration of the GASING approach, the STAD model, and local wisdom-based games through Fogarty's integration framework. In this integration, GASING serves to strengthen students' conceptual understanding, STAD provides a structure for cooperative learning, and local wisdom-based games offer a meaningful learning context for teaching integer arithmetic operations at the elementary school level.

Novelty, Research Gap, & Objective

The novelty of this study lies in the development of an instructional design based on Fogarty's integration model that combines the GASING approach, the STAD model, and local wisdom-based games within a coherent instructional sequence. In this design, the GASING approach facilitates the gradual development of conceptual understanding and computational skills. The STAD model organizes collaborative activities and promotes students' individual accountability, while local wisdom-based games provide a learning context that is more concrete, closely connected to students' everyday lives, and enjoyable. Fogarty's framework is used to connect these three components within a unified instructional sequence rather than merely implementing them alongside one another.

This study aims to analyze the effect of the GASING approach integrated with the STAD model and supported by local wisdom-based games on the mathematics learning outcomes of fifth-grade students at Tlogosari Kulon 05 Elementary School in the topic of integer arithmetic operations.

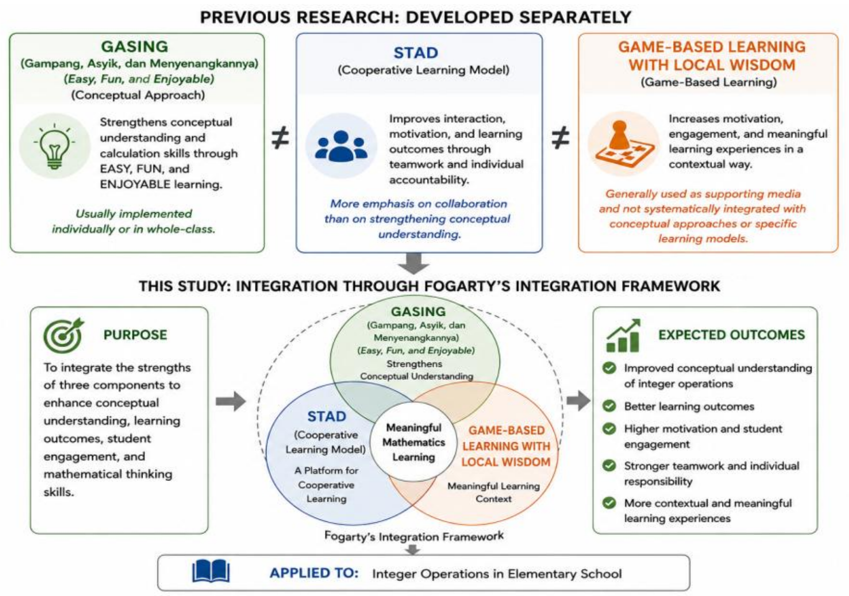

Figure 1. Fogarty's integration model, which combines the GASING approach, the STAD model, and local wisdom-based games.

METHOD

Type and Design

This study employed a quantitative approach using a pre-experimental design, specifically a one-group pretest–posttest design. This design involved a single group of participants whose learning outcomes were measured before and after the intervention. The initial assessment (*pretest*) was administered to determine the students' baseline abilities, whereas the final assessment (*posttest*) was administered after the completion of the intervention to measure their learning outcomes (Fraenkel et al., 2023).

The one-group pretest–posttest design was selected because the study focused on measuring changes in mathematics learning outcomes within the same group of students after they participated in instruction using the GASING approach integrated with the STAD model and local wisdom-based games.

The research design is illustrated as follows:

Figure 2. One-Group Pretest–Posttest Design

The study was conducted over five instructional sessions. During the first session, a pretest was administered to identify the students' baseline abilities. The second, third, and fourth sessions were devoted to teaching integer arithmetic operations using the GASING approach integrated with the STAD model and supported by local wisdom-based games. During the fifth session, a posttest was administered to measure the students' learning outcomes after they had completed the series of instructional activities.

Research Setting and Participants

The study was conducted at SDN Tlogosari Kulon 05 during the first semester of the 2025/2026 academic year. The school was selected as the research site based on the characteristics of its students, the accessibility of the research setting, and the school's readiness to support the implementation of the instructional intervention.

The population of this study comprised all fifth-grade students at SDN Tlogosari Kulon 05. The sample consisted of all 28 students enrolled in Class V-B. The class was selected using convenience sampling, in which participants were chosen based on accessibility, participant availability, and the feasibility of conducting the study (Fraenkel et al., 2023).

This sampling procedure enabled the study to be conducted effectively because the researcher had direct access to the instructional process, the students' characteristics, and the classroom conditions. Furthermore, the researcher's involvement as the teacher of the participating class facilitated the consistent implementation of the intervention, classroom observations, and data collection throughout the study.

Learning Procedures

The instructional intervention in this study employed a Fogarty-based STAD–GASING design, which integrated the GASING approach (Easy, Fun, and Enjoyable)with the Student

Teams Achievement Divisions (STAD) cooperative learning model through Fogarty's Connected and Nested integration models.

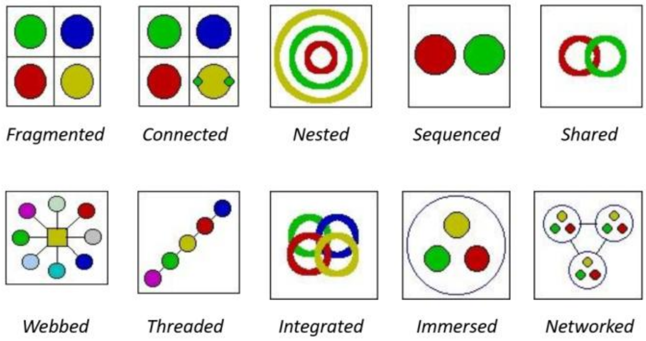

Figure 3. Fogarty's Integrated Learning Model (Fogarty, 2021)

In the Connected model, the principles of GASING were linked to each phase of the STAD syntax so that mathematics instruction could be implemented progressively, concretely, and enjoyably. Meanwhile, in the Nested model, GASING elements such as concrete activities, games, rapid-response challenges, reflection, and recognition were embedded within each stage of STAD.

The instructional process was implemented through the following eight stages.

1) Communicating Learning Objectives and Providing Motivation

The teacher communicated the learning objectives related to integer arithmetic operations and explained their relevance to everyday life. To develop students' learning motivation, the teacher introduced the lesson through brief games, contextual stories, number-guessing activities, or simple demonstrations using concrete objects.

At this stage, the teacher emphasized the central principle of GASING: mathematics is not a difficult subject but can be understood by all students through easy and enjoyable learning steps.

2) Presenting the Learning Material Using the GASING Approach

The teacher explained the concepts of integer arithmetic operations through concrete, simple, and progressive stages in accordance with the GASING principles. Instruction began with concrete activities, followed by pattern recognition, the introduction of GASING critical points for addition, subtraction, multiplication, and division, progressive practice, and the solution of contextual problems.

3) Forming STAD Groups

The students were divided into heterogeneous groups of four based on academic ability, gender, and learning characteristics, resulting in seven groups in the class. Each group developed a team identity consisting of: (1) a team name, (2) a team chant, (3) membership cards, and (4) a team scoreboard.

This stage was intended to foster a sense of belonging, cooperation, and collective responsibility among group members.

4) Local Wisdom-Based Game Activities

Each group participated in games adapted from Indonesian traditional games, such as sack racing, bamboo-stilt racing, and panjat pinang—a traditional competition involving climbing a greased pole. These games were modified in accordance with the learning objectives for integer arithmetic operations so that they could function simultaneously as instructional activities and enjoyable forms of play.

(a) (b)

Figure 4. (a) The teacher explains the rules of the game to the students; (b) The students participate in traditional games.

During each game, the groups were required to solve problems involving integer arithmetic operations. Each correct answer provided an advantage in the game, such as allowing the group to move one step forward in the bamboo-stilt or sack-racing game or awarding additional points. When a group gave an incorrect answer, it did not receive an additional step or point. The question was then immediately replaced with a new one, which all groups could compete to answer.

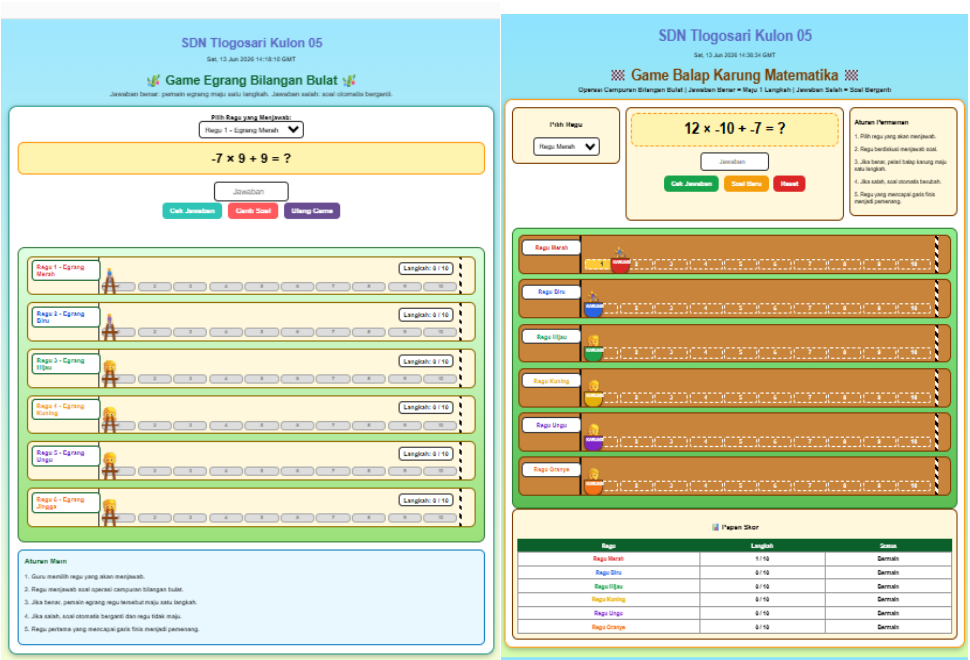

Figure 5. Traditional Games

5) Group Discussion and Teamwork

Group members worked collaboratively to solve the assigned problems and challenges. Students with higher levels of proficiency assisted group members who experienced difficulties, thereby providing each student with an opportunity to develop a better understanding of the material.

Before submitting an answer, group members discussed the problem to determine the most accurate and efficient solution. This activity provided students with opportunities to collaborate, support one another, exchange ideas, and explain their solution strategies to their teammates. Consequently, all group members were actively engaged in the learning process.

Through these activities, students not only practiced solving integer arithmetic problems but also learned to cooperate, communicate effectively, and respect the opinions of others. In addition, the use of traditional games made the learning experience more closely connected to students' everyday lives while reintroducing the local wisdom values embedded in these games.

6) Individual Quizzes

After the group activities were completed, students completed an individual quiz without assistance from their teammates. The quiz was administered to measure each student's level of conceptual mastery after participating in the instructional activities. The individual quiz results served as the basis for calculating team improvement scores in accordance with the STAD procedures.

7) Team Recognition

The teacher calculated each team's improvement score based on the progress achieved by its individual members. The team with the highest score received recognition in the form of a certificate, a best-team badge, or another form of appreciation. This stage was intended to enhance students' learning motivation, self-confidence, and commitment to collaboration throughout the instructional process.

Data and Data Sources

The data collected in this study consisted of quantitative data obtained from students' test results on integer arithmetic operations. The data sources included: (1) students' pretest results obtained before the instructional intervention; (2) students' posttest results obtained after the instructional intervention; and (3) documentation of the instructional process.

The primary data consisted of students' mathematics learning outcome scores on the topic of integer arithmetic operations.

Data Collection Technique

The data were collected through tests and documentation. The tests were used to measure students' ability to solve problems involving integer arithmetic operations, including: (1) integer addition; (2) integer subtraction; (3) integer multiplication; and (4) integer division.

The test was administered twice: (1) as a pretest before the instructional intervention was implemented and (2) as a posttest after the instructional process had been completed. The test instrument consisted of open-ended questions aligned with the established learning indicators.

Documentation was used to obtain supporting data, including: (1) student records; (2) photographs of the instructional activities; (3) student worksheets; and (4) learning evaluation results.

Data Analysis

Data analysis was conducted using IBM SPSS Statistics software. Descriptive and inferential statistical analyses were performed to determine the improvement in students' learning outcomes after participating in instruction using the GASING approach integrated with the STAD model and supported by local wisdom-based games.

1) Descriptive Statistical Analysis

Descriptive statistical analysis was used to provide an overview of students' learning outcomes before and after the intervention. The descriptive statistics calculated included: (1) minimum score; (2) maximum score; (3) mean score; and (4) standard deviation.

The analysis was conducted on both the pretest and posttest data to identify changes in students' learning outcomes after participating in the instructional intervention.

2) Normality Test

Before hypothesis testing was conducted, the normality of the data was examined to determine whether the data were normally distributed. The Shapiro–Wilk test was used because the sample size was fewer than 50 students ($n = 28$).

The decision-making criteria were as follows:

a. If the significance value (Sig.) was greater than 0.05, the data were considered normally distributed.
b. If the significance value (Sig.) was less than or equal to 0.05, the data were considered not normally distributed.

3) One-Sample t-Test

Hypothesis testing was conducted using a one-sample t-test to determine whether the mean posttest score exceeded the Minimum Mastery Criterion established by the school.

In this study, the comparison value, or test value, was the school's Minimum Mastery Criterion, which was set at 75. The research hypotheses were formulated as follows:

a. H_0: $\mu \leq 75$ (The mean student learning outcome did not exceed the Minimum Mastery Criterion.)
b. H_a: $\mu > 75$ (The mean student learning outcome exceeded the Minimum Mastery Criterion.)

The decision-making criteria were as follows:

a. If the Sig. (2-tailed) value was less than 0.05, H_0 was rejected and H_a was accepted.

b. If the Sig. (2-tailed) value was greater than or equal to 0.05, H_0 was accepted and H_a was rejected.

4) N-Gain Analysis

The improvement in students' learning outcomes was analyzed using the normalized gain (N-Gain) formula developed by Hake (Hake, 2002).

$$\text{N−Gain} = \langle g \rangle = \frac{\text{Posttest} - \text{Pretest}}{100 - \text{Pretest}}$$

The criteria for interpreting the N-Gain scores are presented in Table 2.

Table 2. Criteria for Interpreting N-Gain Scores

Nilai N-Gain	Kategori
g < 0,30	Low
0,30 ≤ g < 0,70	Moderate
g ≥ 0,70	High

5) Research Hypothesis

The GASING approach integrated with the STAD model and supported by local wisdom-based games was considered effective when the following criteria were met:

a) The mean posttest score was higher than the mean pretest score.

b) The N-Gain score was at least within the moderate category.

c) The results of the one-sample t-test indicated that the mean posttest score was significantly higher than the Minimum Mastery Criterion established by the school.

RESULTS

This study aimed to analyze the effect of implementing the GASING approach integrated with the STAD model and supported by local wisdom-based games on the mathematics learning outcomes of fifth-grade students at SDN Tlogosari Kulon 05 in the topic of integer arithmetic operations. The study involved 28 students and employed a one-group pretest–posttest design.

1) Description of the Pretest and Posttest Results

Students' learning outcomes were measured using a test administered before the instructional intervention (pretest) and a test administered after the instructional intervention (posttest). The results of the descriptive statistical analysis are presented in Figure 6.

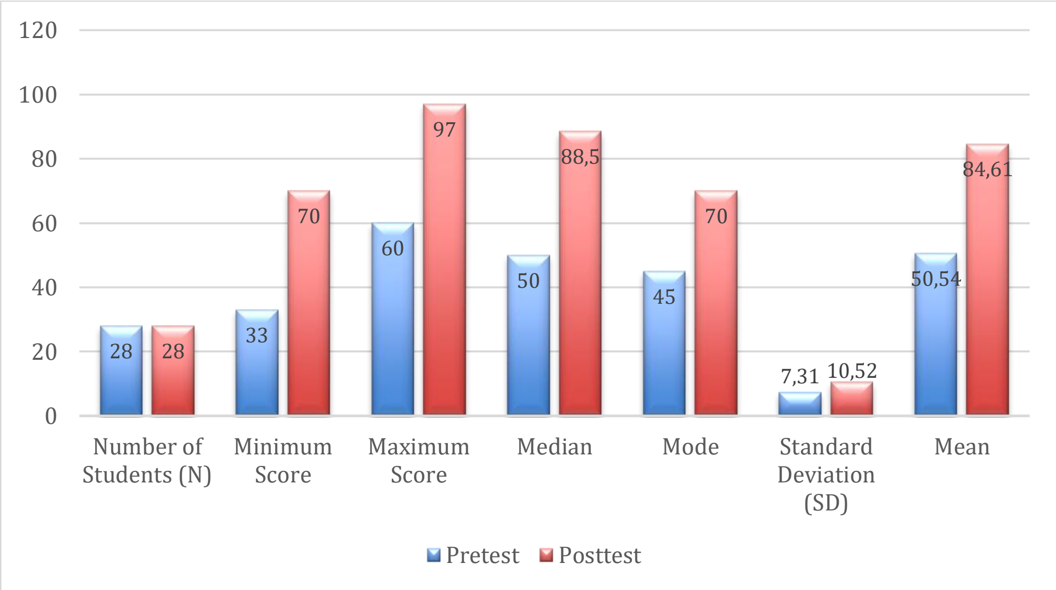

Figure 6. Descriptive Statistics of Students' Learning Outcomes

As shown in Figure 6, the students' mean learning outcome score increased from 50.54 on the pretest to 84.61 on the posttest. This represents an increase of 34.07 points after the students participated in instruction using the GASING approach integrated with the STAD model and supported by local wisdom-based games.

Before the instructional intervention, most students had not achieved the Minimum Mastery Criterion established by the school, which was set at 75. After the intervention, the majority of students had achieved or exceeded the established criterion.

2) Students' Learning Mastery

A comparison of students' learning mastery before and after the intervention is presented in Table 3.

Table 3. Students' Learning Mastery

Category	Pretest	Posttest
Mastery (≥ 75)	0 students (0%)	21 students (75,00%)
Non-Mastery (< 75)	28 students (100%)	7 students (25,00%)

The data show that the proportion of students who achieved mastery increased substantially from 0.00% to 75.00%. These results indicate that the instructional intervention helped most students develop a better understanding of integer arithmetic concepts.

3) N-Gain Analysis

A normalized gain (N-Gain) analysis was conducted to determine the magnitude of the improvement in students' learning outcomes.

$$\text{N-Gain} = \langle g \rangle = \frac{\text{Posttest} - \text{Pretest}}{100 - \text{Pretest}} = \mathbf{0{,}689}.$$

The calculation yielded a mean N-Gain score of **0,689**.

Table 4. Interpretation of the N-Gain Score

Mean Pretest	Mean Posttest	N-Gain	Category
50.54	84.61	0.689	Medium

Based on Hake's criteria, the N-Gain score of 0.689 was classified as moderate. This result indicates that the instructional intervention was reasonably effective in improving students' learning outcomes. The moderate level of improvement indicates that the students not only achieved higher scores but also demonstrated relatively substantial development in their conceptual understanding throughout the instructional process.

4) Normality Test

Before further analysis was conducted, the pretest and posttest data were tested for normality to determine whether they were normally distributed. The normality test was performed using the Shapiro–Wilk test with the assistance of SPSS software. The results are presented in Table 5.

Table 5. Results of the Tests of Normality

	Kolmogorov-Smirnov[a]			Shapiro-Wilk		
	Statistic	df	Sig.	Statistic	df	Sig.
Pretest	.169	28	.039	.907	28	.017
Posttest	.196	28	.007	.845	28	.001

a. Lilliefors Significance Correction

As shown in Table 5, the significance value (Sig.) was 0.017 for the pretest data and 0.001 for the posttest data. Because both significance values were less than 0.05 ($p < 0.05$), neither the pretest nor the posttest data met the assumption of normality.

A one-sample t-test was subsequently conducted to determine whether the mean student learning outcome after the intervention exceeded the Minimum Mastery Criterion established by the school. The comparison value, or test value, used in this study was the school's Minimum Mastery Criterion of 75.

5) Hypothesis Testing

Hypothesis testing was conducted using a one-sample t-test, with the school's Minimum Mastery Criterion of 75 used as the test value.

Table 6. Results of the One-Sample t-Test

	Test Value = 75					
	t	df	Sig. (2-tailed)	Mean Difference	95% Confidence Interval of the Difference	
					Lower	Upper
Posttest	4.830	27	.000	9.60714	5.5262	13.6881

The significance value of 0.000 was less than 0.05; therefore, H_0 was rejected and H_1 was accepted. Thus, the mean student learning outcome after the instructional intervention was significantly higher than the Minimum Mastery Criterion established by the school.

These results indicate that implementing the GASING approach integrated with the STAD model and supported by local wisdom-based games had a positive effect on students' mathematics learning outcomes in the topic of integer arithmetic operations.

DISCUSSIONS

The findings demonstrated that implementing the GASING approach integrated with the Student Teams Achievement Divisions (STAD) model and supported by local wisdom-based games improved elementary school students' mathematics learning outcomes, particularly in the topic of integer arithmetic operations. This improvement was reflected in the increase in the students' mean score from 50.54 on the pretest to 84.61 on the posttest. The N-Gain score was 0.689, which was classified as moderate. These findings indicate that the instructional intervention helped students develop a more effective understanding of integer arithmetic concepts.

The improvement in learning outcomes resulting from the integration of the GASING approach, the STAD model, and local wisdom-based games suggests that students developed a better understanding when they learned through social interaction and cooperation with their peers (Slavin, 2013). In the STAD model, students were organized into small heterogeneous groups, enabling them to support one another during the learning process. Students with higher levels of proficiency acted as peer tutors for group members who experienced difficulties. Through discussions and exchanges of ideas, students had opportunities to clarify their understanding and correct conceptual errors, thereby reducing the likelihood of persistent misconceptions. These conditions supported the development of students' conceptual understanding (Luthfi & Murtiyasa, 2024; Surjawati et al., 2025).

Among the stages of the STAD instructional syntax, the team-learning stage was considered to have made the greatest contribution to the improvement in students' learning outcomes. During this stage, students discussed possible strategies for solving the assigned problems. They explained concepts related to integer arithmetic operations to one another and verified the answers generated by their groups. According to Slavin, (2013), the effectiveness of STAD lies in the interactions among group members, which encourage cognitive elaboration. When students explain a concept to their peers, they indirectly reorganize their existing knowledge, resulting in a deeper understanding. This finding is consistent with those of Arnidha et al., (2025); and Luthfi & Murtiyasa, (2024) who reported that the STAD model significantly improved students' mathematical problem-solving abilities and learning outcomes.

In addition to the STAD model, the improvement in students' learning outcomes may also have been influenced by the implementation of the GASING approach (Easy, Fun, and Enjoyable). Through this approach, the teacher presented the learning material progressively, moving from concrete representations to abstract concepts, while providing a series of activities and challenges that students were required to complete before reaching the GASING critical point and the intended learning objectives. In the GASING approach, each student was required to solve integer arithmetic problems correctly before proceeding to the next stage. Students were permitted to advance only after successfully completing the critical point. This strategy encouraged students to think systematically, maintain their focus, and work carefully when solving mathematical problems. According to Hayati et al., (2026), meaningful learning occurs when students are directly involved in the process of discovering concepts.

Another factor that may have contributed to the improvement in learning outcomes was the use of local wisdom-based games. In this study, games were used not merely as a form of entertainment but also as a means of connecting mathematical concepts with experiences closely related to students' lives. Familiar local cultural contexts enabled students to understand abstract concepts more easily by relating them to real-life experiences. Choirunnisa et al., (2025); Leton et al., (2024); and Putra & Mudra, (2022) found that integrating local wisdom into mathematics instruction improved students' mathematical literacy because it made learning more contextual and meaningful.

The findings of this study also support previous research on the implementation of game-based learning in classroom instruction. Permata Sari et al., (2026) found that game-based learning created a more interactive learning environment, enhanced student engagement, and positively influenced learning achievement. Similarly, Gui et al., (2023) and Hui & Mahmud, (2023) reported that the use of games in mathematics instruction improved students' cognitive abilities, motivation, engagement, and positive attitudes toward mathematics. In the present study, game activities integrated with the GASING approach actively engaged students in the learning process. Students did not merely complete mathematical exercises; they also worked collaboratively to overcome game-based challenges with their team members. These conditions created a more dynamic learning environment and encouraged students to participate without feeling pressured.

Exciting, engaging, and enjoyable learning experiences are central characteristics of the GASING approach and contribute to the creation of positive learning experiences for students. A positive learning environment helps students focus their attention, process information, and construct understanding, thereby making the concepts they learn more likely to be retained in long-term memory. This is consistent with Sanjaya (2023) assertion that learning involving activities, interaction, and direct experience enhances the meaningfulness of the learning process and makes acquired information easier to remember. In this study, enjoyment emerged through a combination of game activities (Figures 4a and 4b), group discussions, healthy competition, and exploration using the GASING approach. These activities enabled students to repeatedly practice integer arithmetic concepts in a natural manner without feeling as though they were memorizing procedures. Therefore, exciting, engaging, and enjoyable instruction not only increases learning motivation but also strengthens students' conceptual understanding and knowledge retention (Gui et al., 2023; Hui & Mahmud, 2023). The improvement in learning outcomes was also evident in the changes in the range of students' scores. The minimum score increased from 33 to 70, whereas the maximum score increased from 60 to 97. These findings suggest that the benefits of the instructional intervention were experienced not only by students with high initial proficiency but also by those who initially demonstrated lower levels of achievement. One factor that may explain this result was the opportunity provided for students to support one another within heterogeneous groups. Slavin (2013) demonstrated that cooperative learning can reduce disparities in academic achievement because students receive learning support from their peers.

Nevertheless, the N-Gain score obtained in this study remained within the moderate category. This result indicates that the instructional intervention was reasonably effective, although it did not achieve the highest level of effectiveness. One factor that may have influenced this result was the relatively short duration of the intervention, which consisted of only three instructional sessions. Furthermore, students required time to adapt to the new instructional approach. Implementing the intervention over a longer period and incorporating a wider variety of games may potentially result in learning gains within the high category.

Overall, the findings indicate that the improvement in students' mathematics learning outcomes resulted from the integration of the STAD model, the GASING approach, and local wisdom-based games. The team-learning stage of STAD, the exploratory activities incorporated into the GASING approach, and the enjoyable learning environment created through traditional games were the primary factors considered to have contributed to the improvement in students' understanding of integer arithmetic operations. These findings reinforce the view that active, collaborative, contextual, and enjoyable mathematics instruction can help students develop a stronger conceptual understanding while improving their retention of the concepts they have learned.

CONCLUSION

Based on the findings, it can be concluded that the implementation of the GASING approach integrated with the Student Teams Achievement Divisions (STAD) model and supported by local wisdom-based games had a positive effect on elementary school students' mathematics learning outcomes in the topic of integer arithmetic operations. This was demonstrated by the increase in the mean score from 50.54 on the pretest to 84.61 on the posttest. The N-Gain score was 0.689, which was classified as moderate. Therefore, the instructional intervention was effective in improving students' mathematics learning outcomes.

Future studies are recommended to involve a control group, include a larger sample, and examine the implementation of this approach in other mathematics topics to provide a more comprehensive understanding of the effectiveness of the GASING approach integrated with the Student Teams Achievement Divisions (STAD) model and supported by local wisdom-based games.

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Conflict of Interest Statement: The authors declare that the research was conducted in the absence of any commercial or financial relationships that could be constructed as a potential conflict of interest.