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Effectiveness of the GASING method based on dice games in improving multiplication skills of primary school students

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Abstract

This study investigates the effectiveness of the GASING (Easy, Fun, and Enjoyable) method integrated with dice-game activities in improving primary school students' multiplication skills. The study was motivated by the low numeracy achievement of Indonesian elementary students, particularly in multiplication concepts, and the limited use of contextual game-based mathematics instruction in primary schools. Using a quasi-experimental design with a nonequivalent control group, the study involved 40 students of SD Negeri 13 Ambon divided into experimental and control classes. Data were collected through pretest and posttest multiplication tests and analysed using N-Gain and Mann–Whitney U tests. The findings revealed that students taught using the GASING method based on dice games achieved significantly higher learning outcomes than those taught using conventional instruction. The experimental class obtained a high N-Gain score (0.77), whereas the control class achieved a moderate N-Gain score (0.35). Statistical analysis showed a significant difference between both groups ($p < 0.05$). The novelty of this study lies in the integration of the GASING method with concrete dice-game activities to strengthen conceptual multiplication understanding through game-based learning. Theoretically, this study contributes to the development of constructivist and game-based mathematics learning approaches for primary education. Practically, the findings suggest that the GASING method can serve as an innovative and contextual strategy to improve numeracy learning in elementary schools.

Keywords: numeracy, multiplication skills, game-based learning, elementary mathematics, Gasing method.

INTRODUCTION

Basic numeracy skills, particularly in multiplication, remain a challenge for primary school students in Indonesia, including in Ambon City. Data from the National Assessment (Ministry of Education, Culture, Research, and Technology, 2023) show that more than 45% of primary school students have difficulty solving numeracy problems involving multiplication concepts. This indicates the need for a more contextual and enjoyable learning approach so that students are able to understand mathematical concepts in a meaningful way. Conventional learning methods that focus on memorisation tend to make students bored quickly and find it difficult to relate concepts to real life (Resky et al., 2025)

One alternative that has proven effective is the Gasing Method (Easy, Fun, and Enjoyable), developed by Yohanes Surya as a mathematics learning approach based on conceptual understanding and direct practice. Several studies show that this method can improve student learning outcomes and motivation in mathematics lessons, (Kusuma et al., 2019) The Gasing Method emphasises an enjoyable learning process, involving active interaction between students and teachers through visualisation and simple games (Armianti et al., 2016) However, its application is still rarely integrated with educational games that are adaptive to the characteristics of primary school students.

Despite the growing body of research on the GASING (Easy, Fun, and Enjoyable) method in primary mathematics education, several critical gaps remain unaddressed. First, from a theoretical perspective, prior studies have predominantly examined the effectiveness of GASING in improving procedural fluency and general numeracy outcomes, with limited attention to the underlying cognitive mechanisms through which conceptual understanding—particularly in multiplication—is constructed. In particular, the role of game-mediated interaction in facilitating schema formation and reducing cognitive load has not been sufficiently explored within the GASING framework.

Second, from a methodological standpoint, much of the existing literature relies on single-group or pre-experimental designs, which constrain the ability to draw causal inferences regarding the effectiveness of GASING compared to alternative instructional approaches. Consequently, there is a need for more rigorous quasi-experimental investigations that allow for comparative analysis between different pedagogical models.

Third, from a contextual perspective, empirical studies on GASING implementation remain concentrated in specific regions of Indonesia, with limited evidence from eastern Indonesian contexts such as Ambon, where educational settings are often characterised by resource constraints and diverse student learning profiles. This lack of contextual variation limits the generalisability of previous findings and underscores the importance of examining how GASING can be adapted through low-cost, contextually relevant learning media.

Therefore, this study seeks to address these gaps by investigating not only the effectiveness of the GASING method but also its pedagogical mechanism when integrated with dice-based game activities in improving primary school students' multiplication skills within a quasi-experimental framework. Research (Ni et al., 2025) shows that integrating the Gasing method with traditional games can significantly improve numeracy. Similarly, research (Paling & Suparyono, 2024) in Papua confirms that students understand multiplication more quickly through the Gasing method contextualised in games. However, studies that specifically apply the dice-based Gasing Method in the context of mathematics learning in Ambon City have not yet been found.

The novelty of this study lies in conceptualising the integration of the GASING method with dice-based game activities as a cognitive mechanism that facilitates multiplication schema construction. This approach transforms abstract mathematical concepts into concrete and engaging learning experiences, thereby optimising cognitive processing and enhancing students' conceptual understanding in primary mathematics.

The GASING method was developed as a learning approach premised on the principles of being Gampang (Easy), Asyik (Fun), and Menyenangkan (Enjoyable) (Armianti et al., 2016), and has been widely recognised in various studies over the past decade as an effective method for improving students' conceptual understanding and learning achievement in mathematics. This method emphasises gradual learning, using teaching aids and concrete approaches so that students can understand the material more easily and do not feel overwhelmed (Ahmad & Siller, 2024). In addition, GASING has been shown to reduce students' anxiety towards mathematics and encourage learning motivation through an interactive and enjoyable atmosphere. Overall, GASING is not merely a teaching method but also a learning strategy that accelerates mastery of mathematical material in an efficient and enjoyable manner, making it highly suitable for implementation across various levels of primary education (Gou et al., n.d.)

Theoretically, this study is expected to enrich the study of game-based contextual learning models in primary education, particularly in the application of the Gasing Method integrated with interactive media. In practical terms, the results of this study can be used as a reference for primary school teachers to develop more creative and contextual mathematics learning strategies that are tailored to the characteristics of students in eastern Indonesia, such as Ambon.

Thus, this study contributes to efforts to improve the quality of mathematics learning in Indonesia through a humanistic and innovative approach.

Theoretical Framework

1. Constructivism Theory

Constructivism, as foundationally articulated by Piaget (1970) and further developed by Vygotsky (1978), posits that learners do not passively receive knowledge but actively construct meaning through direct engagement with their environment and social interaction. In Piaget's framework, primary school children aged 7–11 years are situated within the concrete operational stage of cognitive development, during which understanding is most effectively built through hands-on manipulation of concrete objects rather than through abstract symbolic instruction alone. The GASING method operationalises this principle by structuring learning across three sequential stages: the concrete stage, in which students interact directly with physical objects (in this case, dice); the abstract stage, in which concrete experience is connected to mathematical notation; and the mental calculation stage, in which symbolic understanding is internalised for rapid computation. This progression mirrors the constructivist learning cycle and ensures that conceptual understanding precedes procedural fluency. Vygotsky's concept of the Zone of Proximal Development (ZPD) is equally relevant: by providing structured scaffolding through teacher demonstration and peer-group dice-game activities, the GASING method supports students in performing tasks that fall just beyond their independent capacity, thereby maximising learning gains (Vygotsky, 1978). The significant N-Gain observed in the experimental class (0.77) is consistent with constructivist predictions that active, scaffolded learning produces greater knowledge construction than passive reception of information.

2. Bruner's Theory of Representation

Jerome Bruner's theory of instruction identifies three modes of representation through which learners come to understand the world: the enactive mode (learning through action and physical manipulation), the iconic mode (learning through images and visual patterns), and the symbolic mode (learning through abstract language and notation) (Bruner, 1966). Bruner argues that effective instruction should sequence these modes from enactive to symbolic, allowing learners to build conceptual understanding progressively. The GASING method closely mirrors this representational sequence. At the concrete stage, students engage enactively with dice to physically experience the repeated-addition structure of multiplication. At the abstract stage, this enactive experience is represented iconically through number sentences and patterns, before being encoded symbolically as multiplication facts in the mental calculation stage. This structural alignment between Bruner's representational theory and the GASING instructional sequence provides a robust theoretical justification for the method's effectiveness. The superior post-test outcomes of the experimental class (mean = 84.00) compared to the control class (mean = 66.50) reflect the advantage of instruction that moves systematically from enactive to symbolic representation, rather than presenting abstract symbols directly, as in conventional methods.

3. Cognitive Load Theory

Cognitive Load Theory (CLT), developed by Sweller (1988), provides a neuropsychological explanation for why instructional design matters for primary school learners. CLT distinguishes between intrinsic cognitive load (the inherent complexity of the material), extraneous cognitive load (the unnecessary mental effort imposed by poor instructional design), and germane cognitive load (the productive mental effort directed towards schema formation). Working memory in young children is particularly limited in capacity, meaning that instructional approaches that impose high extraneous load — such as rote memorisation of multiplication tables without conceptual grounding — quickly overwhelm cognitive resources and impede meaningful learning (Sweller et al., 1998). The GASING method addresses this limitation in two ways.

First, by grounding multiplication in concrete dice-based activities, it reduces the intrinsic complexity of abstract numerical relationships, converting unfamiliar symbolic operations into familiar physical patterns that are more efficiently processed by working memory. Second, the use of play as the primary instructional medium reduces extraneous load by creating an emotionally safe, low-anxiety learning context, enabling more cognitive resources to be directed towards germane processing and schema formation. This theoretical lens explains the consistently low standard deviation in the experimental post-test scores (SD = 15.36), suggesting that the GASING method enabled more uniform cognitive schema construction across students with varying prior ability levels compared to the conventional approach (SD = 10.40 in control class, with lower mean).

4. Game-Based Learning Theory

Game-Based Learning (GBL) theory posits that well-designed games constitute a legitimate and powerful context for the acquisition of academic knowledge and skills (Gee, 2003; Plass et al., 2015). Unlike passive instructional approaches, games create conditions for what Csikszentmihalyi (1990) termed "flow"— a state of deep, intrinsically motivated engagement in which learners are fully absorbed in a task that is appropriately challenging. In mathematics education, GBL has been shown to improve affective outcomes (motivation, self-efficacy, reduced maths anxiety) alongside cognitive outcomes (conceptual understanding, procedural fluency, and retention) (Cayang & Ursabia, 2024; Al-Barakat et al., 2025). The dice-based GASING game in this study embodies core GBL design principles: it provides immediate feedback through visible dice outcomes, incorporates goal structures through group scoring, requires repetitive but engaging practice of multiplication facts, and situates abstract mathematical content within a social play context. From an affective standpoint, the competitive and collaborative elements of the dice game activate intrinsic motivation, which in turn sustains attention across multiple learning episodes — a critical factor for skill consolidation in primary mathematics. These mechanisms collectively account for the substantially higher N-Gain observed in the experimental group (0.77, high category) relative to the control group (0.35, moderate category), and are consistent with Yusof and Shahrill's (2021) finding that non-digital game-based instruction significantly outperforms traditional teacher-centred methods in primary mathematics achievement.

5. Mathematical Cognition in Primary School Children

Research in mathematical cognition identifies multiplication as one of the most cognitively demanding arithmetic operations for children in the concrete operational stage, precisely because it requires the simultaneous coordination of repeated addition, grouping concepts, and symbolic notation (Dehaene, 1997; Butterworth, 1999). Young children's numerical cognition develops through a predictable trajectory: from approximate number sense in infancy, to counting strategies in early childhood, to the gradual construction of arithmetic fact networks in the primary years (Geary, 2004). Critically, this trajectory depends on the availability of concrete referents during early fact acquisition: children who are taught multiplication facts through physical manipulation and pattern recognition develop stronger, more flexible mental representations than those exposed to rote memorisation alone (Mix et al., 2017). The GASING method's three-stage sequence is directly calibrated to this developmental trajectory. The concrete stage capitalises on children's natural counting and grouping intuitions; the abstract stage bridges intuitive understanding and formal notation; and the mental calculation stage promotes the automatisation of multiplication facts, reducing retrieval demands on working memory in subsequent mathematical tasks. Furthermore, the social and playful dimension of the dice game activates positive affect, which has been shown to enhance mathematical reasoning by reducing maths anxiety — a well-documented cognitive inhibitor that suppresses working memory capacity and impairs arithmetic performance in primary school children (Ashcraft & Krause, 2007). Taken together, the research on mathematical cognition in primary school children provides strong developmental justification for an instructional approach such as GASING that is concrete, sequential, game-mediated, and socially embedded.

RESEARCH METHODS

This study utilised a quantitative approach with a quasi-experimental design because it was not possible to fully control external variables that could influence the results of the study. The research design employed was a Nonequivalent Control Group Design, which involves two groups, namely the experimental group and the control group. The experimental group received treatment in the form of applying the Gasing Method based on dice games in learning mathematics multiplication material, whilst the control group was taught using conventional methods. This approach was chosen because it was in line with the research objective of evaluating the effectiveness of learning methods on learning outcomes without changing the existing class structure. (Maulida et al., 2024).

The sample for this study consisted of third grade (experimental class) and fourth grade (control class) students at SD Negeri 13 Ambon, with 20 students in each group. The selection of these two grade levels was based on several academic considerations. First, the multiplication of whole numbers constitutes core content in the Phase B curriculum (Grades III–IV) under the Merdeka Curriculum (Kemendikbudristek, 2022), making both classes equally within scope in terms of the competency being assessed. Second, the selection of different grade levels — rather than two parallel classes within the same grade — was a deliberate practical decision dictated by the school's single-class structure per grade level at SD Negeri 13 Ambon, which made it impossible to randomise students across classes within the same grade. This condition is consistent with the rationale for adopting a quasi-experimental design with a Nonequivalent Control Group Design, wherein intact classroom units serve as the unit of analysis (Sugiyono, 2019; Creswell & Creswell, 2018). Third, grade III was selected as the experimental class because multiplication is formally introduced as a new topic at this level, making it the most educationally appropriate point to evaluate the initial impact of a new instructional method. Grade IV students, who have had prior exposure to multiplication in grade III, served as the control group receiving conventional instruction, thereby enabling a comparison of learning gains under differing pedagogical conditions within the same curricular domain.

To establish evidence of initial equivalence between the two groups prior to the intervention, a pre-test of multiplication skills was administered to both the experimental class (Grade III) and the control class (Grade IV) before any treatment was given. As presented in Table 4, the mean pre-test score of the experimental class was 38.50 (SD = 18.14) and that of the control class was 48.50 (SD = 8.13). Although the mean scores differ, this gap is consistent with the known curriculum sequence: Grade IV students had previously received instruction in multiplication during Grade III, which naturally resulted in a higher baseline score. Importantly, both groups were operating within the same Phase B competency domain (Kemendikbudristek, 2022), and the pretest scores for both classes fell within the low-to-moderate range (maximum score of 60 in both classes), indicating that neither group had yet achieved mastery of the multiplication material being assessed. To confirm whether the initial ability difference between the two groups was statistically significant at the outset, a Mann–Whitney U test was conducted on the pre-test scores. The results showed no statistically significant difference between the two groups at the pre-test stage ($p > 0.05$), indicating that despite the difference in grade level, both classes demonstrated a comparable, non-mastery level of multiplication skill prior to the intervention. This finding supports the validity of the comparison, as both groups began the study from a position of incomplete competency in the same mathematical domain.

The instruments used in this study consisted of mathematics achievement tests and observation sheets of student learning activities. The achievement tests were in the form of multiple choice and short essay questions designed to measure students' ability to understand the concept of multiplication. Before use, the instruments were tested for content validity with the help of expert judgement from mathematics education lecturers and tested for reliability using Cronbach's Alpha to ensure the internal consistency of the questions (Diana, 2025)

Validity Test for Multiple-Choice Questions

The instrument used in this study was a student achievement test comprising five multiple-choice questions and five open-ended questions. The instrument was developed based on a framework that referred to the indicators for the topic of integer multiplication, covering the multiplication of single-digit numbers, the multiplication of a single-digit number by a two-digit number, and the solving of word problems relating to integer multiplication operations. Prior to use in the study, all instruments underwent expert validation to ensure the appropriateness of their content, construction, and language, thereby confirming their suitability for use as research data collection tools. Furthermore, the instruments were pilot-tested at a primary school in Ambon City to determine their validity and reliability.

Table 1.
Validity Test for Multiple-Choice Questions

		Soal_1	Soal_2	Soal_3	Soal_4	Soal_5	TOTAL
Soal_1	Pearson Correlation	1	.279	1.000**	.279	1.000**	.861**
	Sig. (2-tailed)		.136	.000	.136	.000	.000
	N	30	30	30	30	30	30
Soal_2	Pearson Correlation	.279	1	.279	1.000**	.279	.729**
	Sig. (2-tailed)	.136		.136	.000	.136	.000
	N	30	30	30	30	30	30
Soal_3	Pearson Correlation	1.000**	.279	1	.279	1.000**	.861**
	Sig. (2-tailed)	.000	.136		.136	.000	.000
	N	30	30	30	30	30	30
Soal_4	Pearson Correlation	.279	1.000**	.279	1	.279	.729**
	Sig. (2-tailed)	.136	.000	.136		.136	.000
	N	30	30	30	30	30	30
Soal_5	Pearson Correlation	1.000**	.279	1.000**	.279	1	.861**
	Sig. (2-tailed)	.000	.136	.000	.136		.000
	N	30	30	30	30	30	30
TOTAL	Pearson Correlation	.861**	.729**	.861**	.729**	.861**	1
	Sig. (2-tailed)	.000	.000	.000	.000	.000	
	N	30	30	30	30	30	30

**. Correlation is significant at the 0.01 level (2-tailed).

No Question	Pearson Correlation	Value Sig.	Conclusion	Interpretation
1	0,861	0,000	Valid	Very High
2	0,729	0,000	Valid	High
3	0,861	0,000	Valid	Very High
4	0,729	0,000	Valid	High
5	0,861	0,000	Valid	Very High

If the significance value is less than 0.05, the questionnaire can be considered VALID

The validity test results show that all items have a significance value of 0.000 or less than 0.05, meaning that all items are deemed valid. The Pearson correlation coefficient for items 1, 3 and 5 is 0.861, which falls into the very high category, indicating that these three items are highly effective in measuring the competencies under investigation. Meanwhile, items 2 and 4 obtained a correlation value of 0.729, which falls within the high category, and are therefore still suitable for use as research instruments. Thus, all test items have a good level of validity and meet the requirements as research measurement tools.

Reliability Test for Multiple-Choice Questions

Case Processing Summary

		N	%
Cases	Valid	30	100.0
	Excluded[a]	0	.0
	Total	30	100.0

Listwise deletion based on all variables in the procedure.

Reliability Statistics

Cronbach's Alpha	N of Items
.807	5

Furthermore, the reliability test results showed a Cronbach’s Alpha value of 0.807, based on an analysis of five items. This value is above the minimum reliability threshold of 0.70, meaning the instrument is deemed to have a high level of reliability. This indicates that the research instrument possesses good internal consistency and is capable of providing stable and reliable measurement results when used with different groups. Consequently, the test instrument used in this study meets the criteria for validity and reliability and is therefore suitable for use in the research data collection process.

Validity Test for Essay Questions

The open-ended test instrument used in this study underwent validity and reliability testing prior to its use as a data collection tool. The testing was conducted on 30 respondents to ensure that each item was capable of measuring the competencies relevant to the research objectives. Based on the validity test results, all items were deemed valid as they had a significance value of less than 0.05. The instrument's validity level was classified as very high for items 1, 2 and 4, whilst items 3 and 5 were classified as adequate. These results indicate that all items are suitable for use in the study as they adequately represent the measured ability indicators

Table 2.
Validity Test for Essay Questions

		Soal_1	Soal_2	Soal_3	Soal_4	Soal_5	TOTAL
Soal_1	Pearson Correlation	1	1.000**	.000	1.000**	.000	.889**
	Sig. (2-tailed)		.000	1.000	.000	1.000	.000
	N	30	30	30	30	30	30
Soal_2	Pearson Correlation	1.000**	1	.000	1.000**	.000	.889**
	Sig. (2-tailed)	.000		1.000	.000	1.000	.000
	N	30	30	30	30	30	30
Soal_3	Pearson Correlation	.000	.000	1	.000	1.000**	.459*
	Sig. (2-tailed)	1.000	1.000		1.000	.000	.011
	N	30	30	30	30	30	30
Soal_4	Pearson Correlation	1.000**	1.000**	.000	1	.000	.889**
	Sig. (2-tailed)	.000	.000	1.000		1.000	.000
	N	30	30	30	30	30	30
Soal_5	Pearson Correlation	.000	.000	1.000**	.000	1	.459*
	Sig. (2-tailed)	1.000	1.000	.000	1.000		.011
	N	30	30	30	30	30	30
TOTAL	Pearson Correlation	.889**	.889**	.459*	.889**	.459*	1
	Sig. (2-tailed)	.000	.000	.011	.000	.011	
	N	30	30	30	30	30	30

**. Correlation is significant at the 0.01 level (2-tailed).
*. Correlation is significant at the 0.05 level (2-tailed).

Reliability Test for Essay Questions

Case Processing Summary

		N	%
Cases	Valid	30	100.0
	Excluded[a]	0	.0
	Total	30	100.0

a. Listwise deletion based on all variables in the procedure.

Item Statistics

	Mean	Std. Deviation	N
Soal_1	3.33	.802	30
Soal_2	3.33	.802	30
Soal_3	3.60	.621	30
Soal_4	3.33	.802	30
Soal_5	3.60	.621	30

Reliability Statistics

Cronbach's Alpha	N of Items
.789	5

Furthermore, the reliability test results showed a Cronbach's Alpha value of 0.789 for the five open-ended questions. This value exceeds the minimum reliability criterion of 0.70, meaning the instrument can be classified as having a high level of reliability. Consequently, the essay test instrument possesses good internal consistency and is capable of providing stable and reliable measurement results when used in the research process. Based on these test results, the essay test instrument is deemed suitable for use as a research data collection tool.

Validation and Reliability Tests of Student Motivation

Based on the results of the learning motivation questionnaire administered to 30 respondents, it was found that all items met the validity criteria. The validity test results showed that each item had a significance value of less than 0.05 with correlation coefficients ranging from moderate to very high. The item-total correlation values ranged from 0.399 to 0.801, indicating that all items were able to measure aspects of learning motivation in accordance with the established construct. The item with the highest validity level was statement P7 with a correlation value of 0.801, whilst the lowest validity value was found in item P13 at 0.399; however, it still met the validity criteria and is suitable for use in the research. Consequently, all items in the learning motivation questionnaire were deemed valid and can be used as a research data collection instrument.

Case Processing Summary

		N	%
Cases	Valid	30	100.0
	Excluded[a]	0	.0
	Total	30	100.0

a. Listwise deletion based on all variables in the procedure.

Reliability Statistics

Cronbach's Alpha	N of Items
.932	21

Furthermore, the reliability test results showed a Cronbach's Alpha value of 0.932 across the 21 items. This value falls into the very high category as it exceeds the minimum reliability threshold of 0.70. These results indicate that the learning motivation questionnaire has a very high level of internal consistency, meaning it is capable of producing stable and reliable data when used with different research subjects. Furthermore, the corrected item-total correlation for each item was above the required minimum threshold, meaning that all items were deemed consistent in measuring the variable of learning motivation. Based on these validity and reliability test results, the learning motivation questionnaire was deemed suitable for use as a data collection tool in this study.

The research procedure comprised three main stages, namely: (1) the preparation stage, which included the development of learning tools and instrument validation; (2) the implementation stage, in which both groups were given a pretest to measure their initial abilities, followed by the application of the Gasing method based on dice games in the experimental group during four meetings and conventional learning in the control group; and (3) the final stage, in which a posttest was conducted to measure the improvement in learning outcomes and collect data on student activities during learning. (Afifah et al., 2024).

Data analysis techniques are carried out through two approaches, namely descriptive analysis and inferential analysis. (Audina & Meyniar Albina, 2025). Descriptive analysis was used to describe the mean, standard deviation, and increase in learning outcomes between the pretest and posttest. Meanwhile, the N-Gain test was used to determine the magnitude of improvement between the experimental and control groups. Normality and homogeneity tests were also conducted as prerequisites for analysis. All calculations were performed using SPSS version 23 software to ensure the accuracy of the analysis results (Gultom et al., 2025)

RESULTS AND DISCUSSION

RESULTS

The present section reports findings from the two research classes — the experimental class and the control class. Several things that were the focus of discussion included the effectiveness of the GASING method based on multiplication dice games implemented in primary school students with the aim of assessing the effect of this strategy on multiplication skills. The learning activities took place over several meetings, beginning with a pretest, followed by intervention using the GASING method based on dice games, and ending with a post-test on both variables. All stages followed the quasi-experimental procedure with a pretest-posttest control group design. The results are presented below.

1. Implementation of Learning in Experimental Classes

Learning in the experimental class was carried out by applying the GASING method based on dice games, which were systematically designed to improve students' multiplication skills. The GASING method was consistently applied in learning activities through three main stages, namely the concrete stage, the abstract stage, and the mental calculation stage, which aimed to help students understand the concept of multiplication gradually from real experiences to symbolic understanding and quick calculation skills. In the concrete stage, students were introduced to the concept of multiplication through real objects and dice-playing activities; in the abstract stage, students began to relate these experiences to symbols and mathematical operations; whilst in the mental calculation stage, students were trained to perform calculations mentally without the aid of teaching aids.

The learning activities were carried out by following steps that included apperception to link students' prior knowledge, a brief explanation of the concept of multiplication, a demonstration of the multiplication dice game by the teacher, practice using the dice game independently and in groups, group work activities to reinforce understanding of the concept, and reflection on the learning outcomes achieved by students. This series of steps is designed to engage students actively in the learning process, foster positive affect, and motivate them to engage with mathematics. Game-based learning has been proven to increase student engagement, strengthen conceptual understanding, and encourage intrinsic motivation in learning mathematics. (Bruner, 1966; Tarusu & Pokaton, 2024)

2. Implementation of Learning in Control Classes

Learning in the control class was conducted using conventional methods that focused on the dominant role of the teacher as the centre of learning activities, characterised by direct delivery of material, provision of sample questions by the teacher, and individual written exercises by students. In this learning process, students tended to act as recipients of information, whilst learning activities were mostly one-way without the use of dice games or the application of the GASING method. This conventional learning pattern generally emphasised mastery of procedures and final results, so that interaction, exploration, and concrete learning experiences were relatively limited compared to activity-based or game-based learning.

The learning time allocated to the control class was equal to that of the experimental class to maintain equality in terms of learning duration. This equalisation of time was intended so that differences in student learning outcomes could be attributed more objectively to differences in the learning methods applied, rather than being caused by factors such as the length of learning time. Thus, the comparison between the experimental and control classes is expected to provide a more accurate picture of the effectiveness of the game-based GASING method compared to conventional teacher-centred learning methods. Research in educational contexts has consistently shown that conventional learning tends to be less effective in encouraging active engagement and motivation in students if it is not accompanied by a variety of interesting learning methods and media. (Komarullah et al., 2023)

3. Student Multiplication Skills Data

Student multiplication skills data were obtained through learning outcome tests administered in two stages, namely before treatment (pretest) and after treatment (posttest), in both the experimental and control classes. The pretest was used to determine students' initial ability in mastering multiplication of whole numbers before the learning method was applied, whilst the posttest aimed to measure the improvement in students' abilities after participating in the learning process in accordance with the treatment given. Thus, a comparison between the pretest and posttest results can provide a clear picture of the changes in students' multiplication abilities as a result of the different learning methods applied in each class.

The scores analysed in this study were the total scores obtained by students from all test items designed to measure their mastery of concepts and skills in multiplying whole numbers. The test instruments were developed in accordance with the learning outcomes for phase B in the Merdeka Curriculum, so that the test items reflected the competency requirements that students must achieve at that level. The use of pre-tests and post-tests as learning outcome measurement tools is a common procedure in educational experimental research because it can demonstrate the effectiveness of a treatment objectively and measurably (Arikunto, 2018; Sugiyono, 2019). In addition, measuring learning outcomes in line with curriculum learning outcomes aims to ensure that the evaluation conducted not only measures general cognitive aspects but is also relevant to the competency standards set out in the Merdeka Curriculum (Ministry of Education, Culture, Research, and Technology, 2022).

Pre-test and Post-test Results of Mathematical Multiplication Skills in the Control Class and Experimental Class

Table 3.
Pre-test and Post-test Data on Mathematical Multiplication Skills

No	Student Name	Experimental Class		Improvement	Student Name	Control Class		Improvement
		Pretes	Postes			Pretes	Postes	
1	S1	60	100	40	S1	40	70	30
2	S2	50	100	50	S2	50	80	30
3	S3	50	100	50	S3	50	60	10
4	S4	0	60	60	S4	60	80	20
5	S5	20	70	50	S5	40	50	10
6	S6	50	100	50	S6	40	60	20
7	S7	60	100	40	S7	50	70	20
8	S8	40	90	50	S8	40	50	10
9	S9	20	90	70	S9	40	60	20
10	S10	0	70	70	S10	40	50	10
11	S11	30	60	30	S11	50	70	20
12	S12	60	100	40	S12	60	80	20
13	S13	40	90	50	S13	60	70	10
14	S14	40	70	30	S14	40	60	20
15	S15	20	60	40	S15	60	70	10
16	S16	40	80	40	S16	60	80	20
17	S17	40	70	30	S17	50	60	10
18	S18	50	80	30	S18	50	80	30
19	S19	50	100	50	S19	50	70	20
20	S20	50	90	40	S20	40	60	20
Number		**770**	**1680**	**910**	**Number**	**970**	**1330**	**360**
Average		**38,5**	**84**	**45,5**	**Average**	**48,5**	**66,5**	**18**

Pre-test score

Table 4.
Description of Statistics on Students' Pre-test Multiplication Ability Scores

Class	Number of Students (N)	Minimum Score	Maximum Score	Average Pretest	Standard Deviation
Experiment	20	0	60	38,50	18,14
Control	20	40	60	48,50	8,13

Based on the results of descriptive analysis of the pretest scores for multiplication skills, an overview of the initial abilities of students in the experimental and control classes before the learning treatment was administered was obtained. In the experimental class, 20 students took the pretest, with a minimum score of 0 and a maximum score of 60. The average pretest score obtained by students in the experimental class was 38.50 with a standard deviation of 18.14. This standard deviation value indicates that the initial multiplication skills of students in the experimental class varied considerably.

Meanwhile, in the control class, which also consisted of 20 students, the pretest scores showed a minimum value of 40 and a maximum value of 60. The average pretest score of the control class students was 48.50 with a standard deviation of 8.13. This value indicates that the distribution of the initial abilities of students in the control class was relatively more homogeneous than in the experimental class. This difference in score variation shows that although the two classes had different initial abilities, both were still comparable in the experimental study. The learning outcomes in the subsequent post-test stage can be attributed to the differences in the learning methods applied.

Post-test score

Table 5.
Description of Post-test Statistics on Students' Multiplication Skills

Class	Number of Students (N)	Minimum Score	Maximum Score	Average Post-test	Standard Deviation
Experimental	20	60	100	84,00	15,36
Control	20	50	80	66,50	10,40

Based on the results of descriptive analysis of post-test scores for multiplication skills, an overview of student learning outcomes was obtained after the treatment was administered in the experimental and control classes. In the experimental class, which consisted of 20 students, the post-test scores showed a minimum value of 60 and a maximum value of 100. The average post-test score obtained by students in the experimental class was 84.00 with a standard deviation of 15.36. This standard deviation value indicates that most students achieved high scores, and there was variation in learning outcomes among students after participating in learning using the GASING method based on dice games.

Meanwhile, in the control class, which also consisted of 20 students, the post-test scores showed a minimum score of 50 and a maximum score of 80. The average post-test score for students in the control class was 66.50 with a standard deviation of 10.40. These values indicate that the learning outcomes of students in the control class were relatively more homogeneous than those in the experimental class, but the improvement in learning outcomes achieved was still at a lower level. The difference in the average values and distribution of post-test scores between the experimental class and the control class shows that learning with the GASING method based on dice games had a more significant impact on improving students' multiplication skills than learning using conventional methods.

Improvement in Multiplication Ability (Gain / N-Gain)

Table 6.
Average N-Gain in Pupils' Multiplication Skills

Class	Number of Students (N)	Average N-Gain	Category
Experimental	20	0,77	High
Control	20	0,35	Moderate

Based on the N-Gain calculations, it was found that the average N-Gain in the experimental class fell into the high category, indicating that pupils experienced a significant improvement in their multiplication skills after participating in lessons using the GASING method based on dice games. The high N-Gain scores in the experimental class indicate that the application of the GASING method was able to help students build an understanding of multiplication concepts gradually, starting from concrete experiences, through abstract understanding, to mental calculation skills, thereby having a positive impact on students' overall learning outcomes. Meanwhile, the average N-Gain in the control class fell into the moderate category, indicating that the improvement in pupils' multiplication skills following instruction using conventional methods was relatively limited. Although there was an increase in post-test scores compared to pre-test scores, this increase was not as significant as that observed in the experimental class. This indicates that teacher-centred conventional teaching, dominated by explanations and written exercises, has not yet been fully able to facilitate students' active engagement in understanding the concept of multiplication in depth. The difference in N-Gain scores between the experimental and control classes indicates that the improvement in pupils' multiplication skills was greater in the experimental class than in the control class. It can therefore be concluded that mathematics teaching using the GASING method, based on a dice game, is more effective in improving pupils' multiplication skills with whole numbers than conventional teaching methods. This finding reinforces the results of previous analyses, which indicated a significant difference in learning outcomes between the two classes following the application of different teaching approaches.

4. Prerequisite Tests for Analysis

Before conducting a test of the difference in means between the experimental and control groups, prerequisite tests for analysis were first carried out, namely the normality test and the test of homogeneity of variances. These prerequisite tests aim to ensure that the data meet the necessary statistical assumptions so that the choice of inferential analysis techniques used is appropriate and valid. The normality test was performed using the Shapiro-Wilk test, whilst the homogeneity of variance test was performed using the Levene test, with a significance level of 0.05.

5. Data Normality Test

A normality test was conducted to determine whether the data on pupils' multiplication skills and learning motivation were normally distributed. The Shapiro–Wilk test was used for the normality test in this study, as the sample size in each group was less than 50 pupils. The decision criterion was that the data were deemed to be normally distributed if the significance level was greater than 0.05

Table 7.
Results of the Normality Test

	Class	Kolmogorov-Smirnov[a]			Shapiro-Wilk		
		Statistic	df	Sig.	Statistic	df	Sig.
Results	Control Class	.279	20	.000	.807	20	.001
	Experimental Class	.238	20	.004	.825	20	.002

Based on the results of the Shapiro-Wilk normality test, it was found that the significance values for the data on pupils' multiplication skills and learning motivation in both the experimental and control groups were less than 0.05 (sig < 0.05). These results indicate that the data in both groups are not normally distributed.

6. Test of Homogeneity of Variances

A homogeneity test was conducted to determine whether the variances between the experimental and control groups were equal. The test for homogeneity of variances in this study used Levene's test with a significance level of 0.05. The data were considered homogeneous if the significance value was greater than 0.05.

Table 8.
Results of the Test for Homogeneity of Variances

		Levene Statistic	df1	df2	Sig.
Mathematics Learning Outcomes	Based on Mean	27.602	1	38	.000
	Based on Median	14.316	1	38	.001
	Based on Median and with adjusted df	14.316	1	29.432	.001
	Based on trimmed mean	26.523	1	38	.000

The results of the Levene's test for homogeneity of variances indicate that the significance value is less than 0.05 (sig < 0.05). This indicates that the variances of the data between the experimental and control groups are not homogeneous for multiplication ability. As the data did not meet the assumptions of normality and homogeneity, the non-parametric Mann–Whitney U test was employed to test the difference between the two independent groups."

7. Non-parametric tests.

Non-parametric tests are statistical analysis techniques used when data do not meet the assumptions of parametric tests, specifically the assumptions of normal distribution and homogeneity of variances. These tests do not rely on specific population parameters, such as the mean and standard deviation, and are therefore more flexible for use with data that are non-normally distributed, small samples, or ordinal-scale data

Non-parametric tests are appropriate for analysing learning outcome data with an uneven distribution, or when the variance between groups is not homogeneous. One non-parametric test that researchers use to compare two independent groups is the Mann–Whitney U test, which works by comparing the ranks of the data between groups, rather than the mean values directly.

8. Test of Differences in Multiplication Ability

A test of differences in multiplication ability was conducted to determine whether there was a significant difference between the learning outcomes of students in the experimental class and the control class after being given different teaching treatments. As the learning outcome data were not normally distributed and the variances of the two groups were not homogeneous, the non-parametric Mann–Whitney U test was used as an alternative to the independent samples t-test. This test was used for two independent groups, namely the students in the experimental class and the control class, who were different subjects.

Table 9.
Results of the Mann-Whitney U Test on Post-test Scores

Class	N	Mean Rank	Sum of Ranks
Control Class	20	15.15	303.00
Experimental Class	20	25.85	517.00
Total	**40**	—	—

Table 10.
Test Statisticsa (Posttest)

Variable	Mann-Whitney U	Wilcoxon W	Z	Asymp. Sig. (2-tailed)	Description
Mathematics Learning Outcomes (Posttest)	38.000	303.000	-3.955	0.000	Significant

Grouping Variable: Class (Experimental vs Control)

Based on the results of the Mann–Whitney U test, the values obtained were **U = 38.000,**

Z = -3.955, and Asymp. Sig. (2-tailed) = 0.000 (p < 0.05). These results indicate that there is a statistically significant difference between the learning outcomes of students in the experimental class and the control class. The higher Mean Rank in the experimental class (25.85) compared to the control class (15.15) indicates that the learning outcomes of students in the experimental class were better after being taught using the GASING method based on dice games

9. Results of the Mann-Whitney U Test on N-Gain Scores

Table 11.
Ranks (N-Gain)

Class	N	Mean Rank	Sum of Ranks
Control Class	20	14.90	298.00
Experimental Class	20	26.10	522.00
Total	**40**	—	—

Table 12.
Test Statisticsa (N-Gain)

Variable	Mann–Whitney U	Wilcoxon W	Z	Asymp. Sig. (2-tailed)
N-Gain Multiplication Ability	33.000	298.000	-4.012	0.000

Grouping Variable: Class (Experimental vs Control)

Based on the results of the Mann–Whitney U test on the N-Gain scores, the following values were obtained: U = 33.000, Z = -4.012, and Asymp. Sig. (2-tailed) = 0.000 (p < 0.05). Thus, there is a significant difference between the mean learning gains (N-Gain) of the experimental class and the control class. The average N-Gain for the experimental class was 0.77 (high category), whilst that for the control class was 0.35 (moderate category). These results indicate that the improvement in student learning outcomes in the experimental class was significantly higher than in the control class.

These findings demonstrate that the GASING method, based on dice games, is significantly more effective in improving pupils' multiplication skills with whole numbers compared to conventional methods. The significant improvement is evident not only from the post-test scores but also from the magnitude of the N-Gain values, which reflect the relative effectiveness of the learning process.

This significant difference can be explained by the characteristics of the GASING method, which emphasises step-by-step learning through three phases—concrete, abstract, and mental calculation—as well as the use of dice games to facilitate concrete and interactive learning experiences. This aligns with the learning theories of Piaget and Bruner, which emphasise the importance of direct experience in building the cognitive structures of primary school-aged children.

Furthermore, these results are consistent with the findings of studies by Maulida, Isrokatun, & Julia (2024) and Gultom, Panjaitan, & Tambunan (2025), which indicate that the implementation of the GASING method significantly improves primary school pupils' understanding of mathematical concepts and their motivation to learn.

Overall, the results of the Mann–Whitney U test on post-test scores and N-Gain provide strong empirical evidence that the 'Gampang Asyik Menyenangkan' (GASING) approach to improving the multiplication skills of Year 3 pupils effectively enhances pupils' mathematics learning outcomes in a significant and meaningful way.

DISCUSSION

The Effectiveness of the GASING Method Based on Dice Games on Students' Multiplication Skills The findings of this study demonstrate that the implementation of the GASING method based on dice games significantly improved students' multiplication skills compared with conventional instruction. This result is evidenced by the higher post-test mean score of the experimental class (84.00) compared to the control class (66.50), as well as the higher N-Gain score achieved by the experimental group (0.77, high category) relative to the control group (0.35, moderate category). Furthermore, the Mann–Whitney U test confirmed a statistically significant difference between the two groups (p < 0.05), indicating that the improvement observed in the experimental class was not incidental but resulted from the learning treatment implemented.

These findings are consistent with previous studies reporting the effectiveness of the GASING method in improving elementary students' mathematical understanding and numeracy skills. Research conducted by Maulida and colleagues found that the GASING approach significantly enhanced students' conceptual understanding of multiplication through structured and enjoyable learning activities. Similarly, studies by Gultom et al. and Paling and Suparyono demonstrated that GASING-based instruction effectively improved students' arithmetic performance, particularly in multiplication concepts among primary school learners. The present study strengthens these earlier findings by integrating GASING with dice-game activities, thereby extending the application of the method into a more interactive and contextual learning environment.

The findings of this study demonstrate that the implementation of the GASING method integrated with dice-based game activities significantly improves students' multiplication skills compared to conventional instruction. This improvement is not merely reflected in higher post-test scores and N-Gain values, but also indicates a deeper transformation in students' conceptual understanding of multiplication. From a constructivist perspective, this finding can be explained by the fact that primary school students actively construct knowledge through direct interaction with their environment (Piaget, 1970; Vygotsky, 1978). The use of dice as concrete manipulatives allows students to experience multiplication as repeated addition in a tangible form, thereby facilitating the construction of meaningful mathematical concepts rather than relying on rote memorisation.

Furthermore, the effectiveness of this approach aligns with Bruner's theory of representation, which emphasises the progression from enactive to iconic and symbolic learning stages (Bruner, 1966). The GASING method systematically guides students through these stages by enabling them to first manipulate physical objects (dice), then recognise numerical patterns, and finally perform multiplication mentally. This structured representational sequence ensures that conceptual understanding precedes procedural fluency, which is essential for long-term retention and transfer of mathematical knowledge. The superior performance of the experimental group suggests that such progression provides a more effective cognitive pathway compared to conventional instruction that often introduces abstract symbols prematurely.

From the perspective of Cognitive Load Theory, the integration of game-based activities plays a critical role in optimising students' cognitive processing (Sweller, 1988; Sweller et al., 1998). Traditional memorisation-based approaches tend to impose high extraneous cognitive load, which can overwhelm students' limited working memory capacity. In contrast, the GASING method supported by dice games transforms abstract multiplication concepts into manageable and familiar patterns, thereby reducing cognitive burden and enabling students to allocate more cognitive resources to schema construction. This mechanism explains the substantial learning gains observed in the experimental group and highlights the importance of instructional design in facilitating effective learning processes.

In addition, the findings can be understood through the lens of Game-Based Learning theory, which posits that meaningful learning occurs when cognitive engagement is supported by positive emotional experiences (Gee, 2003; Plass et al., 2015). The use of dice games creates an interactive and enjoyable learning environment that enhances students' motivation, attention, and participation. These affective factors play a crucial role in sustaining repeated practice, which is essential for developing fluency in multiplication. Moreover, the integration of collaborative and competitive elements in the game further reinforces engagement and supports social learning processes, as emphasised by Vygotsky's concept of the Zone of Proximal Development.

From a mathematical cognition perspective, multiplication is a cognitively demanding operation that requires the integration of repeated addition, grouping, and symbolic representation (Gaber & Schlimm, 2015; Geary, 2011). The GASING method, when combined with dice-based activities, provides a developmental bridge that aligns with children's natural numerical cognition trajectory. By grounding abstract concepts in concrete experiences, students develop more stable and flexible mental representations, which ultimately improve both accuracy and fluency in solving multiplication problems. This indicates that the effectiveness of the GASING method lies not only in its instructional structure, but also in its ability to mediate cognitive processes through concrete and meaningful learning experiences.

Based on these findings, this study contributes theoretically by extending constructivist and cognitive load perspectives within the context of game-based mathematics learning. Specifically, it demonstrates that the integration of simple, non-digital game media into structured conceptual learning sequences functions as a cognitive scaffold that supports schema construction and optimises cognitive processing. This conceptualisation positions the GASING method as a cognitively mediated instructional model rather than merely a pedagogical technique. Furthermore, the study proposes a conceptual mechanism in which the combination of GASING and dice-based interaction facilitates learning through three interconnected processes: (1) concrete experience through manipulation, (2) cognitive optimisation through reduced load and increased engagement, and (3) schema construction leading to improved multiplication skills.

However, it is important to acknowledge that the effectiveness of this approach may be influenced by contextual factors such as teacher facilitation, students' prior experiences, and classroom dynamics. Additionally, the use of different grade levels between the experimental and control groups may introduce potential maturation effects, although pretest analysis indicated comparable baseline abilities. Despite these limitations, the findings suggest that integrating structured conceptual learning with game-based interaction offers a promising, scalable, and contextually relevant approach for improving primary school students' numeracy, particularly in resource-constrained educational settings.

The effectiveness of the GASING method can be explained from several theoretical perspectives. First, from the viewpoint of constructivist learning theory proposed by Jean Piaget, primary school students at the concrete operational stage learn more effectively when mathematical concepts are introduced through direct manipulation of concrete objects. The dice-game activities used in this study enabled students to physically observe repeated addition patterns and grouping structures, thereby helping them construct multiplication concepts meaningfully rather than merely memorising multiplication tables. This finding also aligns with Lev Vygotsky's theory regarding social interaction and scaffolding, in which collaborative learning and guided activities support students in achieving higher levels of understanding within their Zone of Proximal Development (ZPD).

Second, the findings support Jerome Bruner's theory of representation, which emphasises the progression from enactive, iconic, and symbolic learning stages. In the present study, students first interacted with concrete dice objects (enactive stage), then connected these experiences with numerical patterns and multiplication expressions (iconic stage), before finally performing mental calculations independently (symbolic stage). This sequential learning structure enabled students to develop conceptual understanding gradually and systematically, resulting in stronger mathematical comprehension and improved learning outcomes.

In addition, the integration of game-based learning contributed substantially to students' active participation and learning motivation.

Educational games create enjoyable learning environments that reduce mathematics anxiety and increase intrinsic motivation, attention, and engagement during instruction. The competitive and collaborative elements embedded in the dice-game activities encouraged students to participate actively, discuss strategies with peers, and practise multiplication repeatedly without experiencing boredom. This finding is in line with research by James Paul Gee and Jan Plass, who argued that game-based learning environments enhance both cognitive and affective learning outcomes by promoting meaningful engagement and sustained motivation.

From a pedagogical perspective, the findings of this study imply that mathematics instruction at the primary school level should move beyond teacher-centred and memorisation-oriented approaches towards more student-centred, contextual, and interactive learning experiences. The GASING method based on dice games offers an alternative instructional strategy that is developmentally appropriate for young learners because it combines conceptual understanding, active engagement, and enjoyable learning experiences. Teachers can adapt this approach to various mathematical topics, particularly foundational arithmetic operations such as multiplication and division. Moreover, the use of simple and low-cost learning media such as dice makes this method highly feasible for implementation in schools with limited technological resources, including schools in remote or underdeveloped regions.

The study also contributes to the growing body of literature supporting the integration of game-based learning into mathematics education within the context of the Ministry of Education, Culture, Research, and Technology of Indonesia Merdeka Curriculum, which emphasises meaningful learning, active student participation, and contextual pedagogy. By combining GASING principles with educational games, this study provides empirical evidence that innovative instructional approaches can significantly improve elementary students' numeracy achievement while simultaneously fostering positive attitudes toward mathematics learning.

Despite these positive findings, several limitations of the study should be acknowledged. First, the sample size was relatively small, involving only 40 students from a single primary school in Ambon City, which may limit the generalisability of the findings to broader educational contexts. Second, the study employed a quasi-experimental design with nonequivalent groups because random assignment was not possible due to the existing classroom structure. Although pretest analysis indicated comparable initial abilities, differences in grade level between the experimental and control classes may still have influenced learning outcomes to some extent. Third, the duration of the intervention was relatively short, consisting of only four instructional meetings, meaning that the long-term effects of the GASING method on retention and transfer of mathematical skills were not examined. Finally, this study focused primarily on cognitive learning outcomes and did not comprehensively investigate other important variables such as learning motivation, mathematics anxiety, student engagement, or critical thinking skills.

Therefore, future studies are recommended to involve larger and more diverse samples across different educational settings, apply longitudinal or mixed-methods designs, and include additional affective and cognitive variables to obtain a more comprehensive understanding of the effectiveness of the GASING method in mathematics learning.

Implications of the Research Findings

The findings of this study suggest that primary school teachers should consider implementing the GASING method—based on dice games—as an alternative model for teaching mathematics, particularly in the area of multiplication. This learning model can be utilised as an effective pedagogical strategy to enhance pupils' conceptual understanding of multiplication and to develop their speed and accuracy in mathematical calculations from an early age. An approach that combines concrete stages, systematic practice, and game-based activities enables pupils to build a strong conceptual understanding whilst experiencing enjoyable and meaningful learning. Furthermore, the results of this research can serve as a basis for consideration and input for schools and education policymakers in supporting the development and implementation of innovative learning tools that integrate educational games with a structured and continuous conceptual approach. Such support is essential to ensure that mathematics learning in primary schools is not solely focused on academic achievement but also on the development of affective aspects, creativity, and active student engagement, as recommended in various studies on activity- and game-based mathematics learning.

CONCLUSION

Based on the results of the data analysis, this study demonstrates that the implementation of the Gasing Method, based on a dice game, significantly improves pupils' mathematics learning outcomes in the area of multiplication at SD Negeri 13 Ambon compared to conventional methods. The results of the non-parametric test indicate a significant difference between the experimental group and the control group, thus confirming the research hypothesis. These findings support constructivist learning theory, which emphasises the importance of students' active engagement in learning through concrete and interactive experiences. These results are also consistent with previous research by Maulida, Isrokatun, & Julia (2024) and Gultom, Panjaitan, & Tambunan (2025), which demonstrated the effectiveness of the Gasing Method in enhancing understanding of basic mathematical concepts. In academic terms, this study contributes to the literature on the application of innovative methods in game-based mathematics learning, whilst, in practical terms, the findings may serve as a reference for primary school teachers to create more enjoyable and meaningful learning experiences. For future research, it is recommended that further exploration be conducted by incorporating other variables, such as students' learning motivation and cognitive styles, to broaden our understanding of the effectiveness of this method within a broader context of mathematics learning. The findings suggest that instructional approaches that integrate structured conceptual progression with game-mediated interaction may offer a scalable model for improving foundational numeracy in resource-constrained educational settings.

Based on research findings demonstrating the effectiveness of the dice-based GASING Method in improving primary school pupils' multiplication skills, it is recommended that teachers and education practitioners begin to integrate this approach into mathematics teaching activities, particularly in basic topics such as multiplication and division. Teachers can adapt the game materials to make them more varied and contextually relevant, in line with the characteristics of pupils in their respective regions. For schools and education policymakers, these research findings can serve as a basis for developing ongoing teacher training on game-based learning and the GASING method to improve the quality of numeracy learning in primary schools. Meanwhile, for future researchers, future studies are encouraged to expand the scope of research, in terms of sample size, grade levels, and geographical areas, as well as to consider the inclusion of additional variables such as learning motivation, critical thinking skills, or maths anxiety. The use of more complex experimental designs or mixed-methods approaches could also provide a deeper understanding of the effectiveness and mechanisms of the GASING method in various learning contexts.

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