

Implementation of In-Depth Learning With The GASING Method Based on Mathematical Games for Elementary School Student

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Abstract

This study aims to describe and analyze the implementation of deep learning through the GASING Method, a mathematical game-based approach to addition operations in elementary schools. The research background is based on the low achievement of Indonesian students' numeracy literacy, as reflected in the results of the 2022 PISA and the National Assessment, which indicate that mathematics learning is still predominantly procedural and has not fully developed conceptual understanding. This study integrates the principles of deep learning, the Gasing Method stages (concrete–semi-concrete–abstract–conjecture), and the game-based learning approach in one systematic implementation model. The learning implementation was designed through manipulative activities, number pattern exploration, mental arithmetic strategies, and metacognitive reflection based on tiered games. Mathematical games were used as a pedagogical medium to enhance students' cognitive and affective engagement. The implementation results showed that in-depth learning based on the GASING Method encouraged the formation of relational understanding in addition operations, increased the flexibility of counting strategies, strengthened concept transfer, and increased students' self-confidence. Theoretically, this model aligns with cognitive constructivism, concrete operational development theory, cognitive load theory, and learning transfer theory. These findings demonstrate that the integration of in-depth learning with the GASING Method, a mathematical game-based approach, is relevant to the demands of the Independent Curriculum and contributes to strengthening

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elementary school numeracy literacy. The resulting conceptual model can be replicated as an alternative design for systemic, reflective, and contextual mathematics learning..

Keywords: Deep Learning, GASING Method, Math Games, Addition, Numeracy Literacy, Elementary School

INTRODUCTION

Mathematics is an essential subject in elementary education, playing a strategic role in developing students' logical, analytical, systematic, and creative thinking skills. At the elementary school level, mathematics learning serves as the foundation for developing numeracy literacy, a key competency for the 21st century (Sariningsih et al., 2025). This ability is needed not only to solve academic problems but also to navigate the increasingly complex challenges of everyday life (Jediut et al., 2025).

However, various national and international evaluation reports indicate that Indonesian students' numeracy literacy skills still require significant improvement. The 2022 Programme for International Student Assessment (PISA) results, released by the Organisation for Economic Co-operation and Development, show that Indonesian students' math scores remain below the OECD average (Andriani et al., 2019). This indicates that most students have not yet achieved high levels of conceptual understanding and mathematical reasoning. (Pratiwi et al., 2021).

At the national level, the results of the National Assessment (AN) conducted by the Ministry of Education, Culture, Research, and Technology of the Republic of Indonesia in recent years also show that elementary school students' numeracy literacy remains in the basic and early proficient categories (Mujib et al., 2020). This means that some students still experience difficulties in understanding context-based questions and solving non-routine problems. This indicates that mathematics learning in elementary schools still tends to be oriented towards procedures and memorizing formulas, rather than in-depth conceptual understanding. (Munir & Awiria, 2020).

This phenomenon indicates a gap between curriculum objectives and classroom learning practices. The Independent Curriculum, which began its national implementation in 2022, emphasizes the importance of student-centered learning, strengthening numeracy literacy, and developing the Pancasila Student Profile. Learning is no longer simply about transferring knowledge; it must foster in-depth understanding, reflection, and the ability to transfer concepts



across various situations. In this context, a deep learning approach *becomes* highly relevant (Aini & Hidayat, 2022).

Deep learning emphasizes the interconnectedness of concepts, the exploration of meaning, reflection, and the application of knowledge in authentic contexts. Several studies over the past five years have shown that learning oriented toward *deep conceptual understanding* is more effective in improving problem-solving skills and knowledge transfer than traditional approaches (Muslim, 2020). In the context of elementary school mathematics, deep learning helps students understand "why" a procedure works, not just "how" it is calculated (Russo et al., 2024).

Unfortunately, mathematics learning practices in elementary schools are still dominated by expository methods, routine practice problems, and an emphasis on final results. This model tends to result in *surface learning*, where students are able to solve certain types of problems but fail when the context changes. This condition results in low cognitive flexibility and weak higher-order thinking *skills* (Capraro & Perc, 2021).

As an innovative alternative, the Gasing Method (Easy, Fun, and Enjoyable) developed by Yohanes Surya offers a gradual and systematic approach to mathematics learning based on conceptual understanding. This method emphasizes concrete–semi-concrete–abstract stages, pattern exploration, and tiered exercises designed to build students' numerical intuition.

Various studies over the past 5–6 years have shown that the implementation of the Gasing Method has a positive effect on improving students' numeracy skills, conceptual understanding, and self-confidence (Umbara et al., 2021). Furthermore, the pattern-based approach and step-by-step exercises used in the Gasing Method align with constructivist theory, which emphasizes the formation of cognitive schemas through active learning experiences.

Philosophically and pedagogically, there is a strong alignment between deep learning and the Gasing Method. Both emphasize (Barbero et al., 2020):

1. Conceptual understanding
2. Reflection process
3. The relationship between concepts
4. Active and meaningful learning

In the context of the Independent Curriculum, the implementation of in-depth learning through the Gasing Method supports the achievement of elementary school mathematics



learning, especially in the domain of numbers and arithmetic operations that require relational understanding, not just procedural.

Elementary school students are in the concrete operational stage according to Piaget's theory of cognitive development. At this stage, effective learning is supported by visualization, object manipulation, and pattern exploration (R. K. Sari, 2019) The Gasing method, based on numerical patterns and concrete visualization, is highly relevant to supporting these developmental characteristics (Hattie, 2019b).

Based on the gap between the demands of the Independent Curriculum, the results of national and international numeracy literacy evaluations, and the need for learning oriented towards in-depth understanding, this research is relevant and important to conduct (Fullan et al., 2020a).

FORMULATION OF THE PROBLEM

1. How is the implementation of in-depth learning with the Gasing Method for elementary school students?

RESEARCH NOVELTY

This research has the following novelties:

1. Explicitly integrating the concept of *deep learning* with the Gasing Method in the context of the Independent Curriculum.
2. Examining implementation in the context of the latest education policies (National Assessment and Independent Curriculum).

LITERATURE REVIEW

1. Deep Learning in Elementary Mathematics

Deep learning *is* an approach that emphasizes conceptual understanding, reflection, connections between concepts, and the ability to transfer knowledge to new situations (Nugroho, Pramudita, et al., 2022). Unlike *surface learning*, which focuses on memorizing procedures, deep learning encourages students to understand the mathematical reasoning behind an operation.

In the context of elementary school mathematics, deep learning is important because numeracy skills require not only computational skills but also an understanding of number structures and the relationships between operations (Hattie, 2019). Recent studies have shown



that conceptually based learning improves long-term retention and flexibility of numeracy strategies (OECD, 2023).

In the Independent Curriculum, mathematics learning emphasizes *reasoning*, *problem-solving*, and *conceptual understanding*, as outlined in the learning outcomes for Phase B (grades III–IV) formulated by the Ministry of Education, Culture, Research, and Technology of the Republic of Indonesia (D. Prasetyo, 2023). Thus, the implementation of in-depth learning aligns with national policy.

2. The Gasing Method in Learning Addition Operations

The Gasing (Easy, Fun, and Enjoyable) method developed by Yohanes Surya focuses on building numerical intuition through concrete–semi-concrete–abstract patterns and stages. In addition operations, this method:

- a. Using number pattern visualization
- b. Developing mental arithmetic strategies
- c. Train speed and accuracy through graduated exercises

Research by Sari & Widodo ((M. Sari & Widodo, 2021a) showed a significant increase in understanding of basic operations after implementing a Gasing-based approach. Nugroho et al. (2022) found that this method increased students' confidence in completing arithmetic operations. A recent study (Kementerian Pendidikan Riset, dan Teknologi, 2023) showed that numerical pattern-based learning helps students develop flexible strategies for multi-digit addition.

3. Addition Operation as the Foundation of Numeracy

Addition is a basic operation that forms the foundation for multiplication, subtraction, fractions, and early algebra. According to an international numeracy study by the Organization for Economic Co-operation and Development (2023), weaknesses in basic operations are directly correlated with poor performance in advanced problem-solving.

A longitudinal study by Canobi (Canobi, 2021) showed that relational understanding of addition (not just algorithms) contributes significantly to long-term mathematical thinking skills.



DESIGN OF IMPLEMENTATION OF DEEP LEARNING BASED ON THE GASING METHOD AND MATHEMATICAL GAMES

Conceptual Framework for Implementation

The implementation of deep learning based on the Gasing Method in this study was designed by integrating three main components, namely:

1. **Deep Learning Principles**
 - a. Conceptual understanding
 - b. Connections between concepts
 - c. Metacognitive reflection
 - d. Knowledge transfer
2. **Gasing Method Stages**
 - a. Concrete stage
 - b. Semi-concrete stage
 - c. Abstract stage
 - d. Pattern-based graded training (leaning)
3. **Game-Based Learning**
 - a. Gradual challenges (leveling)
 - b. Scoring and reflection system
 - c. Healthy competition and collaboration
 - d. Immediate feedback

The integration of these three components aims to build a learning experience that is active, enjoyable, and conceptually meaningful (Fullan et al., 2020b).

Principles of Learning Implementation

The implementation is designed based on the following principles:

1. **Learning by Doing** – Students actively manipulate objects and patterns.
2. **Concept Before Procedure** – Understanding the structure of addition comes before formal algorithms.
3. **Pattern Recognition** – Students find numerical patterns.
4. **Scaffolded Practice** – Questions graded from simple to complex.
5. **Reflective Thinking** – Students explain their thinking strategies.



Stages of Implementation in Class

1. Apperception and Schema Activation Stage

The teacher asks a provocative question:

- "Why can we change $8 + 7$ into $10 + 5$?"
- "What happens if we break down the numbers?"

Goal: activate initial schemas and build mild cognitive conflict.

2. Concrete Stage (Manipulative Games)

Game 1: Pair of 10 Cards

- Students are given number cards 1–9.
- Challenge: find a pair that adds up to 10.
- Discussion: why do the pairs always add up to 10?

Deep learning occurs when students realize the concept of complementarity 10 as a basic strategy.

3. Semi-Concrete Stage (Number Pattern Game)

Game 2: Ladder Addition Pattern

Example pattern:

$$12 + 9$$

$$12 + 19$$

$$12 + 29$$

$$12 + 39$$

Students are asked to:

- Observing patterns of change
- Explaining the fastest strategy

Students discover that adding tens is simply adding the tens place value.

4. Abstract Stage (Mental Strategy Game)

Game 3: 30 Second Challenge

- Students solve two-digit problems without constructing a hierarchical algorithm.
- Example: $47 + 38$
- Expected strategy:
 - $47 + 30 = 77$
 - $77 + 8 = 85$

Focus: strategic flexibility, not one standard approach.



5. Deep Reflection

The teacher facilitates the discussion:

- a. Which strategy is the fastest?
- b. Why is the number splitting strategy effective?
- c. When can this strategy be used?

Reflection strengthens knowledge transfer.

D. Game Structure in One Learning Cycle

Table1. Game Structure in One Learning Cycle

Stage	Game Activities	Conceptual Objectives	Cognitive Level
Concrete	Pair of 10 cards	Complementary numbers	Basic understanding
Semi-Concrete	Stair pattern	Place value structure	Pattern analysis
Abstract	30 second challenge	Strategy flexibility	Strategy evaluation
Reflection	Strategy discussion	Transfer & metacognition	Reflective

IMPLEMENTATION OF LEARNING IN ELEMENTARY SCHOOLS

A. Implementation Scenario

Learning is carried out in several meetings with the following flow:

1. Game orientation
2. Gasing strategy demonstration
3. Group games
4. Individual challenges
5. Class reflection

B. Example of a Series of Addition Games

Game Level 1 – “Quick and Accurate 10”

Focus: building complementary intuition.

Game Level 2 – “Climb the Tens Ladder”

Focus: place value change patterns.

Game Level 3 – “Secret Strategy”

Students were asked to explain the quickest way they could solve the problem.



C. The Role of Teachers

1. Exploration facilitator
2. Scaffolding provider
3. Effective strategy booster
4. Game dynamics manager

The teacher does not directly provide a formal algorithm, but guides students to find a strategy.

D. Impact of Implementation on Learning

During implementation, the following changes occurred:

- a. Students are more active in asking questions
- b. Strategy discussions increase
- c. Procedural errors decreased
- d. Increased self-confidence

Game-based Gasing encourages both emotional and cognitive engagement (Hattie, 2019a).

THEORETICAL DISCUSSION AND CONCEPTUAL MODEL OF IMPLEMENTATION

A. Strengthening the Theoretical Foundation

1. Cognitive Constructivism Perspective

The implementation of immersive learning based on the Gasing Method, a mathematical game, is firmly rooted in cognitive constructivism theory. From this perspective, knowledge is not passively transferred from teacher to student, but rather constructed through active interaction with the learning environment (Kementerian Pendidikan Riset, dan Teknologi Republik Indonesia, 2022).

In learning addition operations, students are not immediately given a stacked algorithm, but are invited to:

- a. Observing number patterns
- b. Manipulating complementary pairs
- c. Explaining his thinking strategy

This process shows the occurrence of **assimilation and accommodation of cognitive schemes**. When students realize that $8 + 7$ can be changed to $(8 + 2) + 5$, there is a restructuring of understanding of the concepts of place value and number decomposition.

Thus, learning does not stop at mechanistic procedures, but builds relational conceptual structures (Nugroho, Rahmawati, et al., 2022).



2. Cognitive Development Theory Perspective

Elementary school students are in the concrete operational stage. At this stage, children:

1. Able to think logically about concrete objects
2. Understanding conservation of quantity
3. Able to carry out classification and serialization

The Gasing method uses the following stages:

1. Concrete and Semi-concrete
2. Abstract
3. Looking up

Very much in line with these characteristics, manipulative games and visual patterns help bridge the transition from concrete experience to symbolic representation.

This approach prevents premature cognitive leaps, which are when students are forced to understand symbols without prior concrete experience.

3. Cognitive Load Theory

In traditional mathematics learning, students often experience excessive cognitive load because they have to:

- a. Remembering the algorithm steps
- b. Managing place value
- c. Avoiding technical errors

The Gasing method is based on patterns and number decomposition precisely:

- a. Reduce working memory load
- b. Shifting focus to number structure
- c. Developing mental strategy automation

The step-by-step design of math games also regulates complexity progressively, thus avoiding cognitive overload. Thus, this learning design aligns with the principles of *intrinsic load management and German load optimization*.

4. Transfer Theory and Deep Conceptual Understanding

Deep learning is characterized by the ability to transfer concepts to new situations. In this implementation, transfer occurs when students:

- a. Using the 10 pair strategy on two digit problems
- b. Applying decomposition to different contexts
- c. Change the numeric representation as needed



Post-game reflection plays a crucial role in reinforcing transfer. Discussing the strategies helps students realize that they are general and can be applied to a wide variety of problems.

This shows that learning has moved fromx (Development, 2023):

- a. Surface learning (memorization of algorithms)
- b. Deep relational understanding (structure and connections of concepts)

5. Perspectives on Motivation and Affection in Game-Based Learning

An important novel aspect of this implementation is the integration of math games as a pedagogical medium. Games not only increase motivation but also:

- a. Increase cognitive engagement
- b. Reducing math anxiety
- c. Encouraging social collaboration

In the context of educational psychology, games based on tiered challenges create *optimal challenge conditions* , where the difficulty level is slightly above the student's actual ability. This condition encourages maximum engagement without causing frustration. Thus, learning is not only cognitively effective but also emotionally healthy (R. Prasetyo, 2023).

6. Integration with the Independent Curriculum

This implementation supports the learning outcomes of phase B in several aspects:

- a. Mathematical reasoning
- b. Understanding place value
- c. Flexible strategies in arithmetic operations
- d. Reflection of the thinking process

In addition, this approach strengthens the dimensions of the Pancasila Student Profile, in particular:

- a. Critical reasoning
- b. Independent
- c. Creative

Thus, in-depth learning based on the Gasing Method is not only theoretically relevant, but also contextually relevant to national education policy (M. Sari & Widodo, 2021b).

B. Conceptual Model of Implementation

The following is a conceptual model of the implementation of deep learning based on the Gasing Method and mathematical games on addition operations. (Schneider et al., 2022).



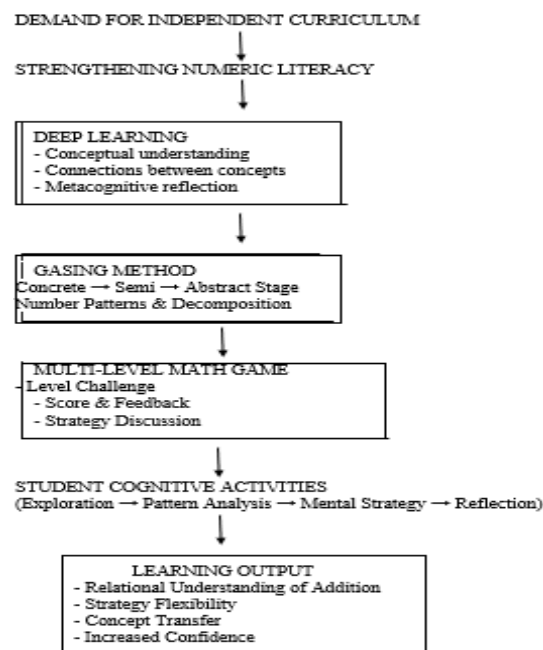


Figure 1. Conceptual Model Diagram

C. Model Synthesis

This model shows that:

1. Deep learning serves as a philosophical foundation.
2. The Gasing method becomes an operational pedagogical framework.
3. Math games become an implementative medium.
4. Students' cognitive activities become a mechanism of transformation.
5. The end result is a strengthening of relational understanding and transfer of numeracy.

With this structure, implementation is not partial, but rather systemic and integrated (Surya, 2019).

D. Academic Implications for Sinta 3 Publication

This theoretical strengthening and conceptual model shows that research does not merely describe learning practices, but (Creswell & Creswell, 2022):

- a. Have a clear epistemological basis
- b. Integrated with modern cognitive theory
- c. Relevant to national education policy
- d. Offers a replicable implementation model

This strengthens scientific contributions at the level of:

1. Conceptual (integration of deep learning–Gasing–game)
2. Pedagogical (systematic implementation design)
Practical (concrete application in elementary school)

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