p-ISSN 2355-5343
e-ISSN 2502-4795
http://ejournal.upi.edu/index.php/mimbar

Received: 29/01/2026; Revised: 22/04/2026; Accepted: 26/04/2026
Mimbar Sekolah Dasar, Vol.13(2), 267-287
DOI: 10.17509/mimbar-sd.v13i2.39

Development of Multiplication and Division Card (MDC) Game Using the GASING Method for Elementary Students: A Multiplication Pilot Study

Tsalitsa El May✉[1], Turmudi[2] & Mubarok Somantri[1]

[1] Master of Elementary Education, Faculty of Education, Universitas Pendidikan Indonesia, Bandung, Indonesia
[2] Mathematics Education Program, Faculty of Mathematics and Science Education, Universitas Pendidikan Indonesia, Bandung, Indonesia

✉ tsalitsaelmay@upi.edu

Abstract: Elementary students often experience difficulties in understanding multiplication concepts due to the abstract nature of arithmetic instruction and the limited use of engaging learning media. This research aims to design and develop the Multiplication and Division Card (MDC) Game based on the GASING *(Gampang, Asyik, dan Menyenangkan)* method as a game-oriented learning medium to support students' conceptual understanding of multiplication. The research employed a Research and Development (R&D) approach using a simplified ADDIE model, consisting of needs analysis, product design, product development, implementation, and evaluation stages. The MDC Game was specifically prepared and tested for multiplication learning through a limited trial involving Phase B (Grade III) elementary students. Data were collected using expert validation instruments, teacher and student response questionnaires, classroom observations, and interviews, and were analyzed using descriptive quantitative and qualitative methods. The results indicate that the MDC Game is feasible in terms of content accuracy, usability, and visual design, with minor revisions needed for instructional clarity. It is also considered practical and positively received by teachers and students, as it promotes active participation, collaboration, and motivation. The limited trial findings show students' learning progression, with the mean score increasing from 46.31 (pretest) to 87.34 (posttest). In conclusion, the MDC Game demonstrates strong potential as a GASING-based learning medium for elementary multiplication instruction. Although limited to a pilot context, these findings provide preliminary evidence for further large-scale implementation and more rigorous investigation.

Keywords: Elementary Mathematics; GASING Method; Game-Based Learning; MDC Game; Multiplication Learning

1. Introduction

Merdeka Curriculum is the latest education policy designed to respond to the needs of more flexible, contextual, and student-centered learning in Indonesia. This curriculum emphasizes the importance of deep learning rather than broad but shallow learning of the material. In the *Merdeka* Curriculum, there is a structure of Learning Outcomes which is the minimum competency that students must achieve at the end of a certain learning phase (Badan Standar Kurikulum dan Asesmen Pendidikan, 2025).

One of the important components in developing the potential of students, especially at the elementary school level, is mathematics learning. Mathematics is one of the subjects that has a central role in forming a logical, systematic, and critical mindset in students. This is summarized as the purpose of learning mathematics. Through mathematics, students are invited to understand patterns, relationships, and structures that can be used in solving problems in real life, both individually and in groups. Mathematics learning also plays a role in forming positive attitudes towards mathematics, such as curiosity, perseverance, and confidence in solving problems. In his research Posicelskaya et al., (2023) in various Russian schools that implement an experimental-based curriculum concluded that students must be ready to face the world of Volatile, Uncertain, Complex, and Ambiguous (VUCA) where

mathematics is not just about calculating but must be taught modeling, experimentation and reflection.

However, the facts show that mathematics is still a subject that many students dislike and consider difficult, especially in elementary school students. The results of the 2022 Programme for International Student Assessment (PISA) survey show that the mathematics skills of Indonesian students are ranked 65 out of 81 countries with an average score of 366, far below the international average of 472 (OECD, 2023).

1.1. Problem Statement

Observations that have been made in each area that have been visited by the researcher in his duty to become a GASING *(Gampang, Asyik dan Menyenangkan)* Mathematics Trainer are in Banyuwangi Regency (East Java), Central Buton Regency and West Muna Regency (Southeast Sulawesi), the last is Tebo Regency (Jambi), revealed that elementary students consistently experience difficulties in solving multiplication problems. These findings were supported by pretest results administered during GASING training involving 64 students in each region. The results show low average scores on a scale of 0-100, with Banyuwangi at 30, Central Buton at 20, West Muna at 20, and Tebo at 35, indicating that students achieved only a small proportion of the maximum possible score. This suggests limited conceptual understanding of multiplication across different contexts. Classroom observations further revealed that instruction tended to rely on conventional approaches, with limited use of engaging methods and insufficient learning media due to infrastructure constraints. As a result, students often struggle to understand multiplication concepts meaningfully. This condition is consistent with previous research indicating that many learners rely on roe memorization without understanding fundamental concepts such as repeated addition and multiplicative reasoning, leading to superficial and easily forgotten knowledge (Killpatrick et al., 2001). Therefore, there is a need for innovative learning media that can present multiplication concepts in a more concrete, structured, and engaging manner, such as the MDC Game based on GASING principles.

Teachers should make good use of the use of props, repetition of materials, fun learning, peer tutoring and provide a conducive learning environment (Adistira & Jiwandono, 2022). Although the GASING method emphasizes learning mathematics in a simple, logical, and enjoyable manner, structured instructional media that systematically embody GASING principles remain limited. Existing classroom implementations of GASING often depend heavily on teacher explanations and improvisation, which can result in inconsistent learning ecperiences across different classrooms (Surya, 2024). Educational design research highlights that well-structured learning media are crucial for ensuring instructional consistency and supporting students independent exploration of concepts (Plomp, 2013).

To evaluate the feasibility of the developed Multiplication and Division Card (MDC) Game using the GASING method, this study adopts a development-oriented pilot study that emphasizes expert validity and user responses. The investigation is carried out by developing a prototype of the MDC Game and subjecting it to expert validation to examine content accuracy, instructional alignment with GASING principles, and media design quality. Expert judgment is a critical step in development research to ensure that instructional products meet academic and pedagogical standards before classroom use (Plomp, 2013; Richey & Klein, 2007). In addition, user response data are collected from teachers and students through structured questionnaires to assess practicality, clarity, attractiveness, and ease of use in a limited implementation setting.

This evaluation is important because validity and positive user responses are primary indicators of learning media feasibility prior to effectiveness testing. Educational development studies emphasize that products lacking adequate validity may lead to misleading findings when implemented at a larger scale (Plomp, 2013). Moreover, while the GASING method promotes simple, logical, and enjoyable mathematics learning, empirical evidence is required to confirm that these principles are accurately embodied in structured learning media (Surya, 2024).

Evaluating user responses is also essential, as learners and teachers acceptance of instructional media strongly influences its successful adoption in classroom practice (Hwang et al., 2012). Therefore, evaluating expert validity and user responses to the MDC Game is necessary to ensure that the developed media is feasible, functional, and meaningful for elementary students, as well as to provide a solid foundation for subsequent effectiveness studies.

1.2. Related Research

Diah & Siregar (2023) conducted a research *"The Effect of the TGT (Teams Games Tournament) Learning Model of Modifying the Gasing Method on Students' Mathematics Learning Outcomes*". The subject of the research is a third grade student of SD Muhammadiyah 06 Medan. The result of this research is that the TGT learning model modified with the GASING method has a significant effect on improving student learning outcomes. This approach increases student engagement, enthusiasm, and a well-rounded understanding. The similarity between the previous and the present research lies in the use of the GASING method and the same research subject, namely grade III elementary school students. Both are also oriented towards improving mathematics learning outcomes through innovative and fun approaches. The differences in Diah and Siregar's research focus on the group competition-based learning model (TGT) and mathematics learning outcomes in general, while this study combines the GASING method with the MDC game, and specifically measures the understanding of multiplication concepts and mathematical problem-solving skills.

As one of the most recent studies, Vita-Barrull et al., (2023) conducted a research on board games titled *"Board game-based intervention to improve executive functions and academic skills in rural schools: A randomized controlled trial*". The subject of the study was a student in rural Western Catalonia, Spain. The results showed that participation in game-based learning sessions led to improvements in mathematical cognitive abilities. This study highlights the relevance of game-based learning as an effective approach to support students' mathematical thinking. However, unlike the present research, Vita-Barrull et all., utilized general strategy-based board games aimed at enhancing cognitive and executive functions, rather than focusing on specific mathematical content such as multiplication.

Oktafiyani et al., (2022) with the research title *"The Effect of the Use of Multiplication Number Card Learning Media on Interest in Learning Mathematics*". The subject of the research was the participants in class III in Cluster 01 Darek, Southwest Praya District. Proving that number cards in multiplication material prove to be important for elementary school-age students in accordance with Piaget's theory of cognitive development. The similarity is because both use card media as a math learning tool in multiplication materials. However, there is a difference in the focus of the variables studied, which is only focusing on students' learning interests. This research offers a variety of tools by developing a special card media entitled Multiplication and Division Card Game (MDC Game) which is systematically designed by supporting the GASING mathematical method, which is known to emphasize concrete, gradual, and fun thinking processes.

Based on the reviewed studies, it can be seen that previous research has explored the use of game-based learning, card media, and the GASING method in mathematics education. However, most studies have not specifically developed a structured and integrated learning medium that combines the GASING method with a card-based game focusing on multiplication concepts at the elementary level. Therefore, this study aims to fill this gap by developing the MDC game as an innovative and structured learning medium to support students' conceptual understanding of multiplication. This study contributes to the existing literature by providing a practical and engaging game-based learning tool specifically designed for multiplication learning in elementary schools.

1.3. Research Objectives

This research focuses on the systematic design and development of a Multiplication and Division Card (MDC) Game grounded in the principles of the GASING method to strengthen elementary students' conceptual understanding of arithmetic operations. Although the MDC

Game is conceptually designed to accommodate both multiplication and division, the scope of this study is specifically limited to multiplication learning. The development emphasizes the creation of an innovative, interactive, and instructionally sound learning medium that enhances accessibility to arithmetic concepts through visual and kinesthetic learning activities. By adopting the GASING approach—characterized by a concrete-to-abstract learning sequence and an emphasis on enjoyable learning—this research seeks to transform abstract numerical concepts into meaningful hands-on experiences that support deeper internalization of mathematical patterns and relationships (Aryfien et al., 2025). The development process also prioritizes alignment with curriculum requirements while embedding GASING principles to support both cognitive outcomes and positive learning attitudes.

In addition, the study aims to assess the practicality and usability of the MDC Game through a pilot implementation with elementary students. This evaluation examines aspects such as user interaction, engagement, conceptual clarity, and operational ease to determine how effectively the MDC Game fosters an engaging learning environment and sustains students' motivation in mathematics learning (Alali & Al-Barakat, 2024). The expected outcomes of this research include a validated MDC Game prototype, empirical evidence regarding its instructional potential, and practical recommendations for integrating GASING-based game learning into classroom practice. Overall, this study is expected to contribute to the growing body of empirical research on game-based mathematics instruction and to extend the application of the GASING method within both tangible and technology-enhanced learning media (Zaranis & Alexandraki, 2021). Based on the above rationale, the research objectives are as follows: (1) to design and develop the Multiplication and Division Card (MDC) Game based on GASING principles for elementary multiplication learning; and (2) to evaluate the practicality, usability and initial learning outcomes of the MDC Game through a pilot study involving elementary students.

2. Theoretical Framework

2.1. Mathematics Leaning Through Games: Enhancing Engagement and Conceptual Understanding

Within the framework of contemporary education, game-based learning has been widely recognized as an effective approach for supporting the learning process, including in mathematics instruction. This approach is grounded in the assumption that games, due to their inherently enjoyable and challenging nature, are capable of substantially increasing students' learning motivation, strengthening their engagement with instructional content, and ultimately improving knowledge retention (Astriani & Khairani, 2022). Games foster a dynamic and interactive learning environment that is relatively low in pressure, allowing students to explore ideas, make mistakes, and learn through experience without fear of failure (Mujahadah et al., 2021).

One of the primary advantages of game-based learning lies in its ability to present abstract mathematical concepts, such as multiplication, in more concrete and appealing forms. Through carefully designed games, students actively participate in object manipulation, problem-solvong activities, and structured competitions that are intended to assess and reinforce their conceptual understanding. Various types of games can be effectively integrated into mathematics learning, including card-based games that require matching multiplication results or responding quickly to arithmetic problems, mathematical puzzles that embed multiplication operations within logical challenges, and board games in which progression depends on successfully solving numerical tasks.

In addition, interactive digital games and educational applications provide visually engaging and responsive platforms for practicing multiplication in meaningful contexts. The adaptability of games enables teachers to modify levels of difficulty and forms of challenge in accordance with students' abilities and learning needs. Moreover, game-based activites often promote collaboration, communication, and critical thinking as students work together to achieve shared objectives. These social and cognitive interactions contribute indirectly to deeper

mathematical understanding and more sustainable conceptual learning (Wibowo et al., 2022).

2.2. Multiplication and Division Card Game (MDC Game)

The Multiplication and Division Card (MDC) Game is and educational game-based learning medium developed to facilitate elementary students' understanding and mastery of the fundamental concepts of multiplication and division in a more meaningful way. This game utilize a set of cards containing numbers and simple arithmetic problems that must be solved by players accurately and within a limited time. The interactive nature of the MDC Game promotes active student involvement through the integration of competition, collaboration, and strategic thinking, thereby fostering intrinsic motivation in mathematics learning. Card-based mathematics games have been shown to effectively enhance students' interest and engagement in learning number operations, particularly multiplication and division, by creating a challenging yet enjoyable learning atmosphere (Kusuma & Retnowati, 2021).

Conceptually, the MDC Game aligns with the definition of educational games proposed by Suherman et al. (2003), which emphasizes the integration of cognitive, affective, ad psychomotor domains within instructional activities. In this context, the MDC Game serves as a learning medium to support students' cognitive development in basic mathematical operations while also fostering affective aspects such as cooperation, honesty, and sportsmanship during gameplay. In addition, the psychomotor domain is engaged through activities involving quick decision-making, card selection, coordinated motor responses. Thus, mathematics learning through the MDC Game not only focuses on learning outcomes but also promotes holistic learning processes.

The implementation of the MDC Game is structured through systematic procedures to ensure that learning objectives are achieved despite being delivered in a game-based format. The teacher acts as a facilitator and game leader by preparing multiplication result cards, while students participate in small groups with an even number of players (max. 6 student). Gameplay involves matching multiplication result with corresponding number held by the the players, which demands both conceptual accuracy and rapid thinking. This structure enables teachers to directly observe students who experience difficulties in understanding multiplication and division concepts, as indicated by the number of cards remaining in their hands during the game. This approach is consistent with the view of (Aryfien et al., 2025), who emphasize that the stages pf educational games should be designed systematically to ensure that learning remains focused, effective, and meaningful, even within an enjoyable learning environment.

2.3. The GASING Method

The GASING method (Gampang, Asyik, dan Menyenangkan), introduced by Prof. Yohanes Surya, is a learning philosophy specifically developed to make mathematics more accessible and appealing to students, particularly at the elementary school level. This approach extends beyond the pursuit of high academic achievement by emphasizing a positive learning process that nurtures students' confidence and enjoyment in learning mathematics. At its core, the GASING method prioritizes deep conceptual understanding, strong use of visualization, and the simplication of complex mathematical ideas so they can be more easily comprehended by young learners (Sunarti, 2021).

Fundamentally, the GASING method is built upon several key principles tjat guide its instructional implementation. First, it stresses the importance of mastering basic concepts by encouraging students to understand the underlying reasoning behind mathematical operations and formulas, rather than relying solely on memorization. This principle supports the development of a solid conceptual foundation rooted in logical thinking, including the essential ideas of multiplication. Second, GASING extensively employs visual representations and concrete learning aids, such as images, manipulatives, and physical objects, to help students translate abstract concepts into observable forms. For instance, multiplication can be illustrated through grouped objects or structured arrangements that visually represent numerical relationships. Third, the method incorporates varied and progressive practice

activities, ranging from simpe tasks to more challenging problems, enabling students to reinforce and apply their understanding across different contexts.

Another central objective of the GASING method is to foster students' self-confidence in learning mathematics. By presenting mathematical content in an engaging, enjoyable, and step-by-step manner, this approach seeks to minimize anxiety and fear commonly associated with mathematics learning, replacing them with confidence and enthusiasm. Empirical studies have demonstrated that the application of the GASING method effectively increases students' learning interest, reduces negative perceptions of mathematics, and leads to significant improvements in learning outcomes (Safitri et al., 2025). The distinctive strength of this method lies in its emphasis on logical and easily understood reasoning processes, ensuring that students develop durable conceptual understanding rather than becoming dependent on mechanical memorization (Paling & Suparyono, 2024).

3. Method

3.1. Research Design

This research adopts a Research and Development (R&D) approach to produce an instructional learning medium. The development process is guided by a simplified ADDIE model, consisting of Analysis, Design, Development, Implementation, and Evaluation. The ADDIE model is selected due to its systematic and structured framework, which is widely applied in the development of educational media (Astriani & Khairani, 2022; Dasopang, 2020). In this research, however, the primary emphasis is placed on three core stages; analysis, design, and development (prototype creation). The implementation and evaluation stages are conducted on a limited scale through a pilot trial with students to examine the feasibility and initial effectiveness of the developed media (Listriani & Nasution, 2022).

The first stage is the analysis phase, which focuses on identifying instructional needs related to the teaching and learning of multiplication. This stage involves ecamining existing learning problems and analyzing the characteristics of students as the target users of the media. Needs analysis is carried out through classroom observations, interviews with teachers, and questionnaires distributed to students to identify learning difficulties in multiplication as well as students' interest in mathematics learning. In addition, this phase incorporates the core principles of the GASING method to ensure that the instructional media is conceptually aligned and pedagogically relevant.

The second stage is the design phase, in which the MDC Game integrated with the GASING method is systematically planned. This stage includes defining learning objectives, selecting instructional content, determining game rules, designing visual elements such as colors. Images, and fonts, and organizing the structure of multiplication materials presented on the cards. The design of the MDC Game is intentionally aligned with GASING principles, particularly the use of visualization, simplification of mathematical concepts, and the creation of an enjoyable learning atmosphere that supports active student engagement.

The third stage is the development phase, which involves producing a prototype of the MDC Game based on the established design. The card prototype is developed by considering visual clarity, ease of use, and alignment with multiplication content. In addition, a user guide is prepared to support both teachers and students in implementing the media effectively. Once the prototype is completed, expert validation is conducted by subject-matter experts and media. Subsequently, a limited trial is carried out with fourth-grade students to evaluate the practicality and attractiveness of the MDC Game. Data collection consisted of student and teacher feedback questionnaires focusing on the attractiveness of the media and its ease of use.

3.2. Participant

The research participant consisted of elementary school students and expert validatiors involved in the development and evaluation of the MDC Game learning media. The student participants were Phase B (Grade III) elementary school students who served as the target

users of the MDC Game, with a total of 16 students participating in the limited trial. The selection of student participants was based on relevant characteristics, including their basic mathematics abilities, learning interest, and prior experience in mathematics learning. In addition to students, two classroom teachers was involved as a user respondents who implemented the MDC Game during the learning process and provided feedback on the practicality, clarity of instructions, and ease of use of the media through observation and questionnaire instruments.

Furthermore, the study involved expert validators to ensure the quality and feasibility of the developed learning media. The validators consisted of material experts and a media expert. The material experts included an elementary school supervisor and a lecturer in mathematics education with expertise in multiplication concepts, while the media expert was a lecturer specializing in instructional media design. The research was conducted at SDN Panyingkiran III, Sumedang, a public elementary school selected based on the availability of research participants and the official permission granted to conduct the study. The characteristics of the research participants are presented in Table 1.

Table 1. Characteristics of Research Participants

Participant Category	Number (n)	Gender	Age Range	Occupation/ Role	Education	Main Function in Research
Students	16	Male: 10 (62,5%) Female: 6 (37,5%)	8-9 years	Elementary school (Phase B/ Grade III)	Elementary education level	Target users of the MDC Game in the limited trial
Teacher Users	2	Male: 1 Female: 1	25-30 years	Classroom teachers	Bachelor of Education (Elementary Shool Teacher Education and Mathematics Education)	Implementing the MDC Game and providing user response feedback
Material Experts	2	Female	30-40 years	Elementary School Supervisor and University Lecturer	Master in Primary Education and Doctorate in Mathematics Education	Validating content accuracy, curriculum aligment, and conceptual suitability
Media Expert	1	Male	40-50 years	University Lecturer	Doctorate in Educational Technology	Validating visual design, layout, and usability of the learning media

The composition of research participants presented in Table 1 reflects the involvement of relevant users and experts to support the development and evaluation of the MDC Game. The inclusion of students, teacher users, and expert validators ensured that the media was reviewed from practical, instructional, and professional perspectives, providing sufficient data to assess its feasibility and suitability for use in elementary mathematics learning.

3.3. Data Collection

Data in this research were collected using several instruments, including validation sheets, questionnaires, observation sheets, and a test. The validation sheets consisted of material validation and media validation instruments. The material validation sheets were used by material experts to assess curriculum aligment, conceptual accuracy, and content completeness of the MDC Game. Meanwhile, the media validation sheets were used by

media experts to evaluate visual quality, design consistency, ease of use, and the overall attractiveness of the learning media.

In addition, teacher and student response questionnaires were used to evaluate the practicality and usability of the MDC Game during the limited trial. The teacher response questionnaire focused on aspects such as ease of use, clarity of instructions, and the perceived support of the media in facilitating students' conceptual understanding of multiplication. The student questionnaire examined engagement, attractiveness, and ease of use of the MDC Game. Observation sheets were also used to record students' participation and interaction during the learning activities.

Furthermore, a test was administered during the limited trial to measure students' conceptual understanding of multiplication. The test was given in the form of a pretest before the implementation and a posttest after the use of the MDC Game. The collected data were used to provide initial insights into students' learning improvement after using the MDC Game, without aiming to measure effectiveness comprehensively.

3.4. Data Analysis

Data in this research were collected using several instruments, including validation sheets, questionnaires, observation sheets, and a test. The validation sheets consisted of material and media validation instruments completed by experts to assess curriculum alignment, conceptual accuracy, content completeness, visual quality, design concistency, and ease of use of the MDC Game. In addition, teacher and student response questionnaires were used to evaluate the practicality and usability of the MDC Game during the limited trial. Observation sheets were also employed to record students' engagement and participation during learning activities. Furthermore, a test was administered during the limited trial in the form of a pretest before implementation and a posttest after using the MDC Game to measure students' conceptual understanding of multiplication. (Riduwan, 2015; Widiyanti & Anugraheni, 2022).

The collected data were analyzed descriptive quantitative and qualitative techniques. Quantitative data from validation sheets, questionnaires, and test results were analyzed by calculating mean scores. The difference between pretest and posttest mean scores was used to identify students' learning improvement, supported by percentage increase calculations. The quantitative data analysis was assisted using Microsoft Excel and SPSS version 30 to ensure accuracy in data processing. Meanwhile, qualitative data obtained from expert suggestions, teacher observations, and student comments were grouped into themes to support product refinement. The results were descriptively to proved initial insights into learning improvement without conductiong inferential satiscal analysis (Riduwan, 2014). The combination of quantitative and qualitative analysis enabled a comprehensive evaluation of the MDC Game, ensuring that both measurable outcomes and experiential feedback guided the iterative development process.

3.5. Validity and Reliability

The validity of the test instrument was examined to ensure that it accurately measured students' conceptual understanding of multiplication. Based on the results presented in Table 2, all test items met the validity criteria, as indicated by the Pearson correlation coefficients and significance values below 0.05 (Arifin, 2019). These results (Table 2) confirm that all items were valid and appropriate for use in this study.

Table 2. Item Validity Test Results

Item	Pearson Correlation	Interpretation	Sig. (2-tailed)	Conclusion
1	0.66	Moderate	< 0,001	Valid
2a	0.62	Moderate	< 0,001	Valid
2b	0.53	Moderate	0,002	Valid
3a	0.81	High	< 0,001	Valid
3b	0.81	High	< 0,001	Valid

Item	Pearson Correlation	Interpretation	Sig. (2-tailed)	Conclusion
4a	0.88	High	< 0,001	Valid
4b	0.76	High	< 0,001	Valid
5a	0.88	High	< 0,001	Valid
5b	0.88	High	< 0,001	Valid
6a	0.61	Moderate	< 0,001	Valid
6b	0.52	Moderate	0,03	Valid
6c	0.71	High	< 0,001	Valid

The reliability of the test instrument was analyzed using Cronbach's Alpha with the assistance of SPSS version 30. The results showed a Cronbach's Alpha coefficient of 0.906, which falls into the very high reliability category (Riduwan, 2015). This indicates that the instrument has strong internal consistency and is reliable for use in the limited trial. In this study, the test was used to obtain preliminary data on students' conceptual understanding of multiplication, and the results were analyzed descriptively to provide initial insights rather were analyzed descriptively to provide initial insights rather than to measure effectiveness comprehensively.

4. Findings

The findings of this study are presented in line with the established research objectives, highlighting both the development process and the evaluation outcomes of the MDC Game.

4.1. Development of the MDC Game

4.1.1. Needs Analysis

The needs analysis was conducted through classroom observations, teacher interviews, and pretest results obtained during GASING training in several regions, including Banyuwangi, Central Buton, West Muna, and Tebo, involving 64 elementary students in each region. The pretest results show consistently low performance on a 0-100 scale, with average scores of 30 in Banyuwangi, 20 in Central Buton, 20 in West Muna, and 35 in Tebo, indicating that students achieved only a small proportion of the expected competency level. These findings show that many students have difficulties in understanding multiplication concepts, particularly in connecting numerical operations to meaningful representations, and tend to rely on rote memorization. Observations and interviews also revealed that learning still relies on conventional methods with limited use of engaging media, resulting on conventional methods with limited use of engaging media, resulting in low student motivation. Meanwhile, students showed a preference for interactive and game-based learning activites. Therefore, there is a need for a concrete, structured, and engaging learning medium, and the development of the MDC Game is considered relevant to support students' conceptual understanding.

4.1.2. Product Design

The initial design of the Multiplication and Division Card (MDC) Game was developed based on the principles of the GASING method, which emphasize simplicity, conceptual clarity, and enjoyable learning. The MDC Game was designed as a card-based learning medium to facilitate students's understanding of arithmetic concepts through interactive and structured activities. Although the game conceptually accommodates both multiplication learning based on the results of the needs analysis. Therefore, the card content, game rules, and learning objectives were tailored to multiplication material ranging from 1 to 100. The design integrates visual elements and gameplay to support students' engagement and conceptual understanding, while maintaining the potential for future expansion to division learning.

4.1.3 Product Development

The product development stage resulted in a physical prototype of the Multiplication and Division Card (MDC) Game, which was specifically developed and tested to support multiplication learning for Phase B (Grade III) elementary students. However, the design of the MDC Game is not limited to a single grade level. Conceptually, the game is structured to be

flexible and adaptable, allowing it to be used by learners of various age groups who wish to practice and strengthen their multiplication skills.

The MDC game board was designed with three card placement areas. One central area, referred to as the result box, is used to place one red card containing the result of a multiplication operation ranging from 1 to 100, which is controlled and presented by teacher during the game. In addition, the board provides two placement areas for blue cards, which represent the multiplication factors held by the students. During gameplay, students place their blue cards in response to the multiplication result shown on the red card, allowing the to identify factor pairs and recognize multiplication patterns in a concrete and structured manner. The overall design of the game board is illustrated in Figure 1.

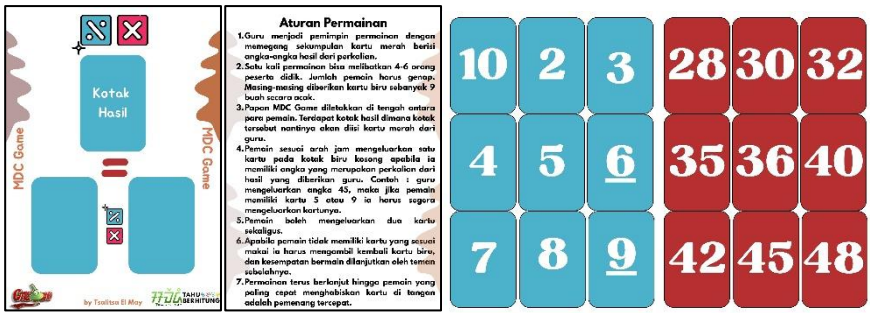


Figure 1. Prototype MDC Game Board and Card Components

The card components of the MDC Game include red cards displaying multiplication results and blue cards displaying multiplication numbers. These cards were designed with clear numerical representation and contrasting colors to support visual clarity and ease of use for elementary students. The physical prototype was produced using thick cardboard material to ensure durability, and all components were manually laminated to enhance strength and extend usability during repeated classroom implementation. the overall design emphasizes simplicity, practicality, and hands-on interaction, which are consistent with the principles of the GASING method. Detailed procedures and rules of gameplay are presented separately in a Table 3 to provide a clear and systematic explanation of how the MDC Game is implemented in classroom learning.

Table 3. Guidelines fo Using the MDC Game

Step	Activity	Teacher's Role	Student's Role
1	Game preparation	Acts as the game leader and holds a set of red cards containing multiplication results	Preprare to participate in the game
2	Group formation and card distribution	Organizes the game for 4-6 students per round with an even number of players	Receive 9 blue cards randomly
3	Game board placement	Places the MDC Game board at the center and prepares the result box	Sit around the game board
4	Presenting multiplication results	Places one red card (multiplication result) in the result box	Observe the displayed multiplication result
5	Identifying multiplication factors	Guides the flow of the game	According to turn order, place one blue card showing a factor of the given result (e.g., for 45. Cards 5 or 9)
6	Playing multiple cards	Allows students to place two blue cards simultaneously if applicable	Place two factor cards at once if possible

Step	Activity	Teacher's Role	Student's Role
7	No matching card condition	Instructs the continuation of turns	If no matching card is available, take back a blue card and pass the turn
8	Ending the game	Monitors gameplay until completion	The first player tu use all blue cards becomes the winner

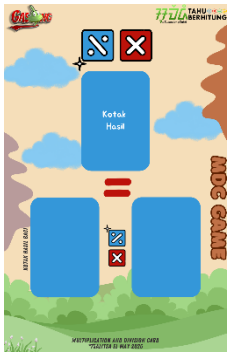
The guidelines presented in Table 3 emphasize that the MDC Game is implemented through structured yet flexible gameplay that encourages actives student participation and rapid reasoning. By positioning the teacher as the game leader and allowing students to interact directly with the card components, the game creates an engaging learning environment that supports conceptual understanding of multiplication. The turn-based mechanism and competitive elements also enable teachers to observe students' thinking processes in real time, making the MDC Game not only a learning tool but also an informal means of formative assessment during mathematics instruction.

Product revision was conducted based on feedback obtained from material experts and the media expert during the validation stafe. The revisions focused on improving visual quality, instructional clarity, durability, and safety, while maintaining the original game mechanics and learning objectives of the MDC Game. All visual components were revised, including the game board, game instructions, red cards (multiplication results), and blue cards (multiplication factors).

The game board was redesigned using thick acrylic material to enhance durability and stability during repeated classroom use. To improve practicality and ease of reference, clear and simplified game instructions were placed on the back of the board, allowing teachers and students to access guidance directly during gameplay. Visual adjustments, such as improved color contrast and layout organization, were also applied to ensure better readability for elementary school students.

Revisions were also applied to the card components. The red and blue cards were reproduced using art paper material, which provides a smooth surface, cear print quality, and sufficient rigidity while remaining lightweight and safe for student use. The font size, numerical clarity, and color contrast on both card types were refined to enhance visibility and reduce the risk of misinterpretation during gameplay. These revisions resulted in a more durable, visually clear, and student-friendly MDC Game prototype that is suitable for implementation in the limited trial stage. The final design are presented in Table 4.

Table 4. Final Design and Physical Form of the MDC Game

Component	Final Design	Physical Form
Game Board		

Instructional Design		
Red Cards (Multiplication Results)		
Blue Cards (Multiplication Factors)		

The information presented in Table 4 confirms that the final design and physical form of the MDC Game emphasize clarity, functionality, and ease of classroom implementation. the arrangement of components and visual layout were designed to support smooth gameplay and facilitate students' understanding of multiplication concepts. Overall, the finalized design ensures that the MDC Game can be used effectively as a practical learning medium that encourages actives engagement and meaningful interaction during mathematics learning activities.

4.1.4. Implementation

The implementation stage was conducted through a limited trial involving Phase B (Grade III) elementary school students using the revised MDC Game prototype. The implementation aimed to examine the practicality of the media and to observe students' engagement during multiplication learning activities. The MDC Game was implemented in small groups under the guidance of the classroom teacher, who acted as the game leader by presenting multiplication result cards and facilitating the flow of the game. During the implementation, students actively participated by identifying multiplication factors and placing the appropriate cards according to the game rules. The classroom implementation of the MDC Game during the limited trial is illustrated in Figure 2.

Figure 2. Classroom Implementation of the MDC Game During the Limited Trial

Classroom observations during the implementation indicated that students were able to follow the gameplay procedures and showed high levels of enthusiasm and involvement. The game-based format encouraged students to think quickly, interact with peers, and apply multiplication concepts in a concrete manner. The implementation stage also provided opportunities for teachers to monitor students' understanding and identify learning difficulties in real time. Overall, the MDC Game was implemented smoothly within the classroom setting and functioned as intended as a multiplication learning medium.

4.1.5. Evaluation

The evaluation stage was conducted to examine the feasibility, practicality, and instructional relevance of the MDC Game based on the results of the limited trial. Evaluation data were obtained from student and teacher response questionnaires, classroom observations, and teacher interviews. Overall, the results indicate that the MDC Game functioned effectively as a multiplication learning medium and was well received by both teachers and students during classroom implementation.

The triangulation of observation, questionnaire, and interview data shows consistent findings. Observations revealed active student participation, positive peer iteraction, and effective use of instructional time. These findings were supported by student questionnaire results, which indicated high levels of enjoyment, engagement, and perceived benefits in understanding multiplication concepts. Teacher responses and interviews further confirmed that the MDC Game was practical to implement, aligned with learning objectives, and capable of fostering student motivation.

Based on the evaluation results, the MDC Game is considered feasible for classroom use with minor recommendations, including the provision of clearer gameplay instructions and an increased number of game sets to support simultaneous group activities. These findings suggest that the MDC Game has strong potential for broader implementation in elementary multiplication learning and may be further developed in future studies to cover additional mathematical concepts.

4.2. Feasibility and Practicality of the MDC Game

4.2.1. Expert Validation Results

Expert validation was conducted to evaluate the feasibility and quality of the MDC Game prototype prior to its use in the limited trial stage. The validation involved material experts, an elementary school supervisor, and a media expert, focusing on aspects of content suitability, conceptual accuracy, language clarity, instructional usefulness, visual design, and ease of use. Overall, the validation results indicate that the MDC Game is feasible to be implemented in elementary multiplication learning, with minor revisions suggested to enhance clarity and visual quality.

The results of material validation conducted by a material expert (Table 5) showed a mean score of 4.57 out of 5 (91%), which falss into the "Very Feasible" category. The elementary school supervisor validation yielded a mean score of 5.00 (100%), also categorized as "Very Feasible". Both validators agreed that multiplication content was accurate, aligned with elementart mathematics learning objectives, and appropriate for the developmental level of Phase B (Grade III) students. The main suggestion provided by the validators was related to improving the clarity of usage instructions so that students could more easily understand the game procedures.

Table 5. Summary of Material Expert Validation Results

Aspect	Mean Score	Percentage (%)	Category
Content Feasibility	4.75	95	Very Feasible
Concept Accuracy	4.75	95	Very Feasible
Languange Clarity	5.00	100	Very Feasible
Instructional Usefulness	4.63	92.6	Very Feasible
Overall Mean Score	4.78	95.5	Very Feasible

The media expert validation (Table 6) focused on visual design, material quality, readability, user-friendliness, attractiveness, and alignment with instructional design principles. The validation results showed an overall mean score of 4.38 (88%), categorized as "Feasible". The media expert noted that the overall design was appropriate and engaging for elementary students. However, several improvements were recommended, including increasing color contrast for better visibility, enhancing the attractiveness of usage instructions, and considering the use of more durable and student-safe materials.

Table 6. Media Expert Validation Results

Aspect	Mean Score	Percentage (%)	Category
Visual Design & Layout	4.50	90	Feasible
Material Quality	4.33	86.6	Feasible
Readability & Clarity	5.00	100	Very Feasible
Ease of Use	4.00	80	Feasible
Attractiveness	4.50	90	Feasible
Instructional Design Suitability	4.20	84	Feasible
Overall Mean Score	4.38	88	Feasible

Based on the expert validation results, the MDC Game prototype was considered suitable for limited trials with revisions made in accordance with expert feedback to improve instructional clarity, visual appeal, and material durability.

4.2.2. User Responses (Teachers and Students)

Teachers' responses were collected from two teachers to evaluate the practicality, clarity, and instructional benefits of the MDC Game during the limited trial. Based on the questionnaire results, the MDC Game obtained an overall mean score of 4.66 out of 5 (93%), which falls into the "Very Good" category. The teachers perceived the media as suitable for elementary multiplication learning, easy to implement in classroom settings, and effective in encouraging active student participation. The media was also considered helpful in supporting students' conceptual understanding and problem-solving skills in multiplication.

Qualitative feedback from teachers further indicated several suggestions for improvement. Teachers recommended increasing the number of MDC Game sets to allow all student groups to play simultaneously, especially in larger classes. They also emphasized the importance of providing more detailed and clearly structured game instructions so that students could fully understand the rules without repeated clarification. In addition, teachers suggested the use of supporting multiplication cards as reference tools to assist students who were still developing multiplication fluency during gameplay. Overall, teachers viewed the MDC Game as a practical and engaging learning medium with strong potential for broader classroom application. Teacher responses to the MDC Game are summarized in Table 7.

Table 7. Summary of Teacher Responses to the MDC Game

Aspect Evaluated	Mean Score	Percentage (%)	Category
Content Suitability	4.75	95	Very Good
Media Clarity	4.50	90	Very Good
Student Engagement	5.00	100	Very Good

Ease of Use	4.50	90	Very Good
Learning Benefits	4.50	90	Very Good
Visual Appearance	4.75	95	Very Good
Overall Mean	4.66	93	Very Good

Student responses were obtained from 16 Phase B (Grade III) students using a response questionnaire consisting of seven indicators related to language clarity, instruction clarity, learning enjoyment, engagement, conceptual understanding, problem-solving support, and visual attractiveness. The result showed a total score 523, with most indicators achieving percentage scores above 90%, indicating a "Very Good" level of student response. Students reported that the MDC Game made mathematics learning more enjoyable, reduced boredom during lessons, and helped them better understand multiplication concepts.

In particular, students expressed strong agreement that the game-based format increased their motivation to learn and supported active participation during classroom activites. The visual design, use of colors, and card-based interaction were perceived as attractive and easy to follow. These finsings suggest that the MDC Game was well received by students and successfully created a positive and engaging learning experience during the limited trial implementation. Table 8 summarizes students' responses to the MDC Game.

Table 8. Summary of Student Responses to the MDC Game

Indicator	Mean Score	Percentage (%)	Category
Language Clarity	4.25	85	Good
Instruction Clarity	4.69	94	Very Good
Learning Enjoyment	5.00	100	Very Good
Reduced Learning Boredom	4.81	96	Very Good
Conceptual Understanding	4.69	94	Very Good
Problem-Solving Support	4.69	94	Very Good
Visual Attractiveness	4.56	91	Very Good
Overall Mean	4.67	93.4	Very Good

4.2.3. Observation and Interview Results

Observation was conducted during the limited trial to examine students' engagement, understanding of instructions, interaction, and the practicality of using the MDC Game in classroom learning. The observation was carried out over three implementation sessions, focusing on seven indicators related to student participation, instructional clarity, collaboration, enthusiasm, response to tasks, teacher guidance, and time efficiency.

The observation results indicate that students showed a positive and consistent level of engagement throughout the implementation. students actively participated in the game activities, demonstrated the ability to follow game rules, and interacted well with peers during gameplay. Indicators related to student participation, cooperation, and enthusiasm showed higher scores on the third day, suggesting that students became more familiar and confident with the game mechanics over time. This pattern indicates that repeated exposure to the MDC Game supported smoother gameplay and increased student involvement.

In terms of instructional clarity, students were generally able to understand and follow the game rules correctly across all sessions. The relatively stable scores on this indicator reflect that the revised instructions were sufficiently clear to guide students during the learning process. Additionally, students were able to respond to multiplication tasks presented on the cards with minimal assistance, indicating that the media supported independent thinking and conceptual application. The role of the teacher as a facilitator was consistently observed to be effective, as reflected by the highest scores across all sessions.

Overall, the observation results yielded an average total score of 4.33 out of 5 (87%), which falls into the "Good" category. These findings suggest that the MDC Game can be implemented effectively within the available classroom time and supports active, collaborative, and engaging multiplication learning. The observation data further strengthen

the results obtained from user response questionnaires by providing direct evidence of classroom interaction and student behavior during the implementation of the MDC Game.

Interviews were conducted with the classroom teacher after the limited trial to obtain in-depth feedback regarding the implementation of the MDC Game. The interview results indicate that the MDC Game is appropriate and relevant to the learning objectives of the elementary mathematics, particularly multiplication. The teacher confirmed that the content presented in the MDC Game aligned well with the learning indicators and supported the instructional goals targeted during classroom implementation.

In terms of media appearance, the teacher stated that the MDC Game was visually attractive and able to capture students' attention. The use of game-based elements encouraged students to participate actively and created a positive learning atmosphere. Regarding ease of use, the teacher noted that the game instructions were generally easy to understand; however, for Grade III students, additional verbal explanation from the teacher was still necessary. This was particularly important because some students were still developing basic reading skills, indicating that teacher guidance remains essential during implementation.

The interview findings also revealed that students showed high enthusiasm while using the MDC Game. According to the teacher, students appeared more motivated and engaged during multiplication learning activites compared to conventional lessons. The teacher emphasized that the media helped students better understand multiplication concepts, especially when supported by additional multiplication cards that reinforced the idea of repeated addition and factor recognition. This combination was perceived as beneficial for students who had yet fully mastered multiplication facts.

Finally, regarding implementation readiness, the teacher stated that the MDC Game was feasible for classroom use. The main constraint identified was the limited number of game sets, which sometimes caused students to wait or disrupt other groups during gameplay. To address this issue, the teacher suggested increasing the number of MDC Game sets or organizing the class using structured group management strategies so that all students could participate simultaneously. Overall, the interview findings support the observation and questionnaire results, indicating that the MDC Game is practical, engaging, and suitable for use in elementary multiplication learning with minor implementation adjustments.

4.2.4 Results of Limited Trial (Pretest-Posttest)

The limited trial was conducted involving 16 elementary school students to observe the implementation of the MDC Game in multiplication learning. The activity consisted of three main stages: pretest, learning implementation using the MDC Game, and posttest. The pretest results indicate that student's initial understanding of multiplication concepts was still relatively low and varied. The average pretest score was 46.31, with a minimum score of 12.82 and a maximum score of 87.18. These results suggest that students entered the learning process with differing levels of prior knowledge. After the implementation of the MDC Game, the posttest results show a notable improvement in students' scores. The average score increased to 97.43, with a minimum score of 51.28 and a maximum score of 100. This shift indicates that most students demonstrated higher achievement after participating in the learning activities. A summary of the pretest and posttest results is presented in Table 9.

Table 9. Summary of the Pretest and Posttest Results

Indicator	Pretest	Posttest
Mean Score	46.31	87.34
Minimum Score	12.82	51.28
Maximum Score	87.18	100

As shown in Table 9, it can be observed that students experienced learning progression during the limited trial. The increase in minimum scores also indicates that students with initially low performance showed improvement after engaging in the learning activities. During the implementation, students were actively involved in the use of the MDC Game, which supported a more interactive learning atmosphere.

5. Discussion

The findings of this study indicate that the MDC Game facilitates students' learning progression in multiplication through the transformation of abstract numerical relationships into concrete and interactive learning experiences. The implementation results show that students were able to engage in identifying factor relationships and matching multiplication results through card manipulation, which supports the development of conceptual understanding. In addition, observational data revealed high levels of student participation and involvement during the learning process. These findings are consistent with previous studies and theoretical perspectives emphasizing the importance of concrete and structured learning experiences in early mathematics education. Multiplication concepts are often challenging for elementary students when presented solely through symbolic representations. In this context, the MDC Game aligns with research indicating that non-digital games, when systematically designed, can enhance students' engagement and conceptual comprehension (Szilágyi et al., 2025). Furthermore, the integration of GASING principles strengthens this alignment, as GASING emphasizes conceptual sequencing by findings that structured conceptual scaffolding and the use of concrete representations significantly improve students' understanding while reducing cognitive load (Fyfe et al., 2014).

The consistency between this study and prior research can be explained by the combination of conceptual scaffolding and game mechanics embedded in the MDC Game. Elements such as turn-taking, competition, collaboration, and immediate feedback contribute to a more engaging and low-anxiety learning environtment. Previous research also indicates that well-designed educational game can increase intrinsic motivation, sustain attention, and promote deeper learning in mathematics classrooms (Plass et al., 2020; Tokac et al., 2019). The results of this study reflect similar patterns, as students demonstrated enthusiasm and active participation during the implementation. However, it is important to note that this study differs from large-scale or experimental research designs, as it was conducted as a limited trial. Therefore, the findings should be interpreted as indicative of implementation outcomes rather than casual relationships. The implications of this study suggest that the MDC Game can serve as an alternative instructional medium that supports interactive and student-centered learning in elementary mathematics. It highlights the potential of integrating local pedagogical approach, such as GASING, with game-based learning strategies to create meaningful and contextually relevant learning experiences. In practice, this approach may assist teachers in facilitating more engaging classroom environments while supporting students' conceptual understanding of multiplication.

From a theoretical perspective, this study contributes to the development of instructional design by demonstrating how GASING principles can be operationalized within a game-based learning framework. It provides an example of how concrete, structured, and interactive learning media can bridge abstract mathematical concepts with students' cognitive development processes. This integration enriches the literature on mathematics education, particularly in combining local instructional approaches with established game-based learning theories. Despite these contributions, several limitations must be acknowledged. This study involved a limited number of participants (16 students), which restricts the generalizability of the findings. The implementation was also conducted over a short duration, limiting the observation of long-term learning progression. In addition, the analysis was primarily descriptive and did not include inferential statistical testing. As noted in methodological literature, pilot studies are intended for exploratory evaluation and refinement rather than hypothesis testing (Leon et al., 2011). Therefore, further revision and refinement are necessary befoe large-scale implementation. Feedback from teachers and observational findings highlight the impotance of clear instructional guidance, adequate availability of game materials, and effective classroom management strategies. Such iterative refinement is essential in educational design research to ensure the development of high-quality and context-sensitive learning media (McKenney & Reeves, 2018). Overall, the MDC Game demonstrates strong potential as a GASING-based, game-oriented learning medium for elementary multiplication instruction and warrants further investigation in broader contexts.

6. Conclusion

This research developed the Multiplication and Division Card (MDC) Game based on GASING principles as a game-oriented learning medium for elementary multiplication instruction. The results of expert validation and user evaluation indicate that the MDC Game is feasible, practical, and positively received, particularly in promoting student engagement and interaction. Findings from the limited trial involving 16 students show clear learning progression, with the mean score increasing from 46.31 (pretest) to 87.34 (posttest), alongside improvements in minimum and maximum scores. The integration of GASING principles with card-based mechanics enables multiplication concepts to be presented in a concrete, structured, and interactive manner, supporting active participation and reducing learning boredom. Although limited to a pilot context and not intended to establish casual relationships or long-term impact, these findings provide strong preliminary support for the instructional potential of the MDC Game, which, with minor revisions, shows promise for broader implementation and further investigation in larger-scale studies.

Limitation

This research is subject to several limitations. Although broader field testing has been conducted, this article focuses on the limited trial involving 16 students; thus, the findings represent initial implementation outcomes rather than large-scale results. While pretest and posttest data indicate learning progression, the absence of a control group limits causal interpretation. The short implementation duration also restricts into long-term learning retention. In addition, the research was limited to multiplication content, despite the MDC Game designed for both multiplication and division. Data collection relied primarily on descriptive and perceptual measures, which may introduce bias. Therefore, further research with larger samples, extended implementation, and more rigorous designs is needed to strengthen the evidence and broaden applicability.

Recommendation

Future research should extend this research through large-scale field implementation employing rigorous experimental or quasi-experimental designs with control groups to generate stronger empirical evidence on learning outcomes. Longitudinal studies are also necessary to examine learning retention and the sustainability of the MDC Game in authentic classroom settings. Further development should expand the MDC Game to cover division and other mathematical topics, accompanied by the refinement of instructional guidelines, standardization of game procedures, and optimization of classroom management strategies to ensure scalability across diverse contexts. In addition, integrating the MDC Game within structured instructional models is recommended to maximize its pedagogical value. These effoerts are expected to strengthen both the empirical foundation and practical applicability of the MDC Game in elementary mathematics learning.

Acknowledgments

The author gratefully acknowledges SDN Panyingkiran III for facilitating this study and all participants involved. Appreciation is also extended to Universitas Pendidikan Indonesia and the academic supervisors for their guidance and support.

Conflict of Interest Statement

The author(s) declare(s) that there is no conflict of interest.

Declaration of Generative AI and AI-assisted Technologies

This manuscript was prepared with the assistance of Generative AI ChatGPT. The AI was used to assist in language refinement. All intellectual contributions, critical analyses, and final revisions were conducted by the authors. The authors take full responsibility for the accuracy, originality, and integrity of the content presented in this work.

References

Adistira, L. G. A. K. D., & Jiwandono, I. S. (2022). Analisis Kesulitan Belajar Matematika Materi Perkalian. *Journal of Classroom Action Research*, *4*(4), 123–130. https://doi.org/https://doi.org/10.29303/jcar.v4i4.2398

Alali, R. M., & Al-Barakat, A. A. (2024). Assessing the Effectiveness of Environmental Approach-Based Learning in Developing Science Process Skills and Cognitive Achievement in Young Children. *Education Sciences*, *14*(11), 1–18. https://doi.org/https://doi.org/10.3390/educsci14111269

Arifin, Z. (2019). *Evaluasi Pembelajaran*. Remaja Rosdakarya.

Aryfien, W. N., Ragil, I., & Atmojo, W. (2025). *Interactive Learning Media for Better Learning Outcomes in Elementary School : A Systematic Literature Review*. *12*(1), 132–147. https://doi.org/10.53400/mimbar-sd.v12i1.82323

Astriani, L., & Khairani, N. A. (2022). Development of a Multiplication Learning Media for Primary School Mathematics using Multiple Math Card. *Jurnal Pendidikan MIPA*, *23*(2), 712–722. https://doi.org/https://doi.org/10.23960/jpmipa/v23i2.pp712-722

Badan Standar Kurikulum dan Asesmen Pendidikan. (2025). Capaian Pembelajaran Pada Pendidikan Anak Usia Dini, Jenjang Pendidikan Dasar, dan Jenjang Pendidikan Menengah. In *Kementrian Pendidikan Dasar dan Menengah*. KEMENDIKDASMEN.

Dasopang, M. D. (2020). Pengembangan buku cerita bergambar berbasis augmented reality untuk mengakomodasi generasi Z. *Jurnal Pendidikan: Teori, Penelitian, & Pengembangan*, *5*(6), 780–791. https://doi.org/https://doi.org/10.17977/jptpp.v5i6.13613

Diah, R., & Siregar, N. (2023). Pengaruh Model Pembelajaran TGT (Teams Games Tournament) Modifikasi Metode Gasing Terhadap Hasil Belajar Matematika Siswa. *EDUKASIA: Jurnal Pendidikan Dan Pembelajaran*, *4*(2), 1033–1042. https://doi.org/10.62775/edukasia.v4i2.386

Fyfe, E. R., McNeil, N. M., Son, J. Y., & Goldstone, R. L. (2014). Concreteness Fading in Mathematics and Science Instruction: a Systematic Review. *Educational Psychology Review*, *26*(1), 9–25. https://doi.org/10.1007/s10648-014-9249-3

Hwang, G. J., Wu, P. H., & Chang, C. C. (2012). An online game approach for improving students' learning performance in web-based problem-solving activities. *Computers & Education*, *59*(4), 1246–1256. https://doi.org/https://doi.org/10.1016/j.compedu.2012.05.009

Killpatrick, J., Swafford, J., & Findell, B. (2001). Adding It Up: Helping Children Learn Mathematics. In *October* (Issue October). National Academy Press.

Kusuma, I. A., & Retnowati, E. (2021). Designs of faded-example to increase problem solving skills and procedural fluency in algebraic division. *Journal of Physics: Conference Series*, *1806*(1), 12109. https://doi.org/10.1088/1742-6596/1806/1/012109

Leon, A. C., Davis, L. L., & Kraemer, H. C. (2011). The role and interpretation of pilot studies in clinical research. *Journal of Psychiatric Research*, *45*(5), 626–629. https://doi.org/10.1016/j.jpsychires.2010.10.008

Listriani, & Nasution, A. S. (2022). Desain Pembelajaran Perkalian dengan Permainan Kartu Bilangan di Kelas II SD. *Indonesian Research Journal On Education, Universitas Pahlawan*

Tuanku Tambusai, *2*(2), 170–181. https://doi.org/https://doi.org/10.31004/irje.v2i2.308

McKenney, S., & Reeves, T. (2018). *Conducting educational design research*. Routledge.

Mujahadah, I., Alman, A., & Triono, M. (2021). Pengembangan Media Pembelajaran Komik untuk Meningkatkan Hasil dan Minat Belajar Matematika Peserta Didik Kelas III SD Muhammadiyah Malawili. *Jurnal Papeda: Jurnal Publikasi Pendidikan Dasar*, *3*(1), 8–15. https://doi.org/https://doi.org/10.36232/jurnalpendidikandasar.v3i1.758

OECD. (2023). *PISA 2022 Results (Volume I and II) - Country Notes : Indonesia*.

Oktafiyani, A., Istiningsih, S., & Jiwandono, I. S. (2022). Pengaruh Penggunaan Media Pembelajaran Kartu Angka Perkalian Terhadap Minat Belajar Matematika. *Journal of Classroom Action Research*, *4*, 67–75.

Paling, S., & Suparyono, E. I. (2024). MENINGKATKAN KEMAMPUAN PERKALIAN PADA SISWA KELAS 3 SD KOINONIA WAMENA MELALUI PENGGUNAAN METODE GASING DALAM PEMBELAJARAN MATEMATIKA. *Pedagog Jurnal Ilmiah*, *2*(1), 17–25. https://doi.org/https://doi.org/10.71387/pji.v2i1.59

Plass, J. L., Homer, B. D., & Kinzer, C. K. (2020). Foundations of game-based learning. *Educational Psychologist*, *50*(4), 258–283. https://doi.org/10.1080/00461520.2015.1122533

Plomp, T. (2013). *Educational design research: An introduction. In T. Plomp & N. Nieveen (Eds.)*. SLO.

Posicelskaya, M. A., Rudchenko, T. A., & Semenov, A. L. (2023). Mathematical Elements of Elementary Education. *Doklady Mathematics*, *107*, S10–S41. https://doi.org/10.1134/S1064562423700576

Richey, R. C., & Klein, J. D. (2007). *Design and development research: Methods, strategies, and issues*. Lawrence Erlbaum Associates.

Riduwan. (2014). *Metode dan Teknik Menyusun Tesis*. Alfabeta.

Riduwan. (2015). *Skala Pengukuran variabel-variabel Penelitian*. Alfabeta.

Safitri, M., Iriawan, S. B., Mufliva, R., & Indonesia, U. P. (2025). The Effectiveness of the GASING Method in Improving Mathematical Procedural Understanding Ability in Multiplication Among Phase B Elementary School Students. *Jurnal Studi Keislaman Dan Ilmu Pendidikan*, *13*(November 2025), 238–248. https://doi.org/https://doi.org/10.36088/palapa.v13i2.5908

Suherman, E., Turmudi, Suryadi, D., Suherman, T., Suhendra, Sufyani, P., Nurjanah, & Rohayati, A. (2003). *Strategi Pembelajaran Matematika Kontemporer*. Universitas Pendidikan Indonesia.

Sunarti, S. (2021). Peningkatan Hasil Belajar Siswa pada Mata Pelajaran Matematika dengan Menggunakan Metode Pembelajaran Matematika Gasing di Sekolah Dasar. *TANGGAP: Jurnal Riset Dan Inovasi Pendidikan Dasar*, *2*(1), 29–38. https://doi.org/https://doi.org/10.55933/tjripd.v2i1.263

Surya, Y. (2024). *Matematika GASING SD Bagian 1*. Kandel.

Szilágyi, S., Körei, A., & Vaičiulytė, I. (2025). The role of non-digital and digital UNO-type card games as learning media in different levels of mathematics education: A systematic review. *Education Sciences*, *15*(8), 1030. https://doi.org/10.3390/educsci15081030

Tokac, U., Novak, E., & Thompson, C. G. (2019). Effects of game-based learning on students' mathematics achievement: A meta-analysis. *Journal of Computer Assisted Learning*, *35*(3), 407–420. https://doi.org/10.1111/jcal.12347

Vita-Barrull, N., Estrada-Plana, V., March-Llanes, J., Guzmán, N., Fernández-Muñoz, C., Ayesa, R., & Moya-Higueras, J. (2023). Board game-based intervention to improve executive functions and academic skills in rural schools: A randomized controlled trial. *Trends in Neuroscience and Education*, *33*, 100216. https://doi.org/10.1016/j.tine.2023.100216

Wibowo, A. W., Suryaningrum, G. D., Ristianti, N. A., Agustin, P., & Prasetyaningtyas, P. (2022). Meta-analisis pengaruh metode gasing pada pembelajaran matematika SD dalam meningkatkan hasil belajar siswa. *Mahaguru: Jurnal Pendidikan Guru Sekolah Dasar*, *3*(1), 142–148. https://doi.org/https://doi.org/10.33487/mgr.v3i1.3686

Widiyanti, M., & Anugraheni, I. (2022). Pengembangan Media Pembelajaran Berbasis Android" Opera Juragan" pada Materi Operasi Hitung di Sekolah Dasar. *Edukatif: Jurnal Ilmu Pendidikan*, *4*(5480–5491). https://doi.org/https://doi.org/10.31004/edukatif.v4i4.3243

Zaranis, N., & Alexandraki, F. (2021). *Game-Based Learning for Teaching Multiplication and Division to Kindergarten Students BT - Smart Pedagogy of Game-based Learning* (L. Daniela (ed.); pp. 85–101). Springer International Publishing. https://doi.org/10.1007/978-3-030-76986-4_6