

Exploring Third-Grade Students' Understanding of Multiplication and Division Using Stone-Based Flashcards with Discovery Learning

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Abstract

Students' understanding of multiplication and division concepts often remains at a procedural level, making it difficult for them to explain these concepts meaningfully. This study aimed to explore students' conceptual understanding of multiplication and division using stone-based flashcards assisted by the Discovery Learning model. This study employed a qualitative approach with a descriptive exploratory design involving 15 third-grade students selected purposively. Data were collected through observation, interviews, and documentation and analyzed using the Miles and Huberman model, which includes data reduction, data display, and conclusion drawing. The findings showed that the use of stone-based flashcards helped students visualize abstract concepts, improve their ability to explain multiplication as repeated addition and division as a grouping process, and promote active engagement in learning. In addition, students demonstrated increased confidence and collaboration during the learning process. It can be concluded that the integration of stone-based flashcards and Discovery Learning supports meaningful learning and enhances students' conceptual understanding of multiplication and division.

Keywords: *Conceptual understanding, Multiplication and division, Stone-based flashcards, Discovery Learning, Meaningful learning.*

Abstrak

Pemahaman siswa terhadap konsep perkalian dan pembagian sering kali masih berada pada tingkat prosedural sehingga mereka kesulitan menjelaskan konsep secara bermakna. Penelitian ini bertujuan untuk mengeksplorasi pemahaman konseptual siswa tentang perkalian dan pembagian menggunakan flashcard berbasis batu dengan model Discovery Learning. Penelitian ini menggunakan pendekatan kualitatif dengan desain deskriptif eksploratif yang melibatkan 15 siswa kelas III yang dipilih secara purposif. Data dikumpulkan melalui observasi, wawancara, dan dokumentasi, kemudian dianalisis menggunakan model Miles dan Huberman meliputi reduksi data, penyajian data, dan penarikan kesimpulan. Hasil penelitian menunjukkan bahwa penggunaan flashcard berbasis batu membantu siswa memvisualisasikan konsep abstrak, meningkatkan kemampuan menjelaskan perkalian sebagai penjumlahan berulang dan pembagian sebagai proses pengelompokan, serta mendorong keterlibatan aktif dalam pembelajaran. Selain itu, siswa menunjukkan peningkatan kepercayaan diri dan kemampuan bekerja sama selama proses pembelajaran. Dapat disimpulkan bahwa penggunaan flashcard berbasis batu berbantuan Discovery Learning mendukung pembelajaran bermakna dan meningkatkan pemahaman konseptual siswa terhadap perkalian dan pembagian.

Kata kunci: *Pemahaman konseptual, Perkalian dan pembagian, Flashcard berbasis batu, Discovery Learning, Pembelajaran bermakna.*



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INTRODUCTION

Mathematics, especially the concepts of multiplication and division, is an essential foundation in the development of students' mathematical abilities (Oktafianti & Purnomo, 2025; Kristesia et al., 2025). However, based on the results of the 2018 PISA survey, Indonesian students' mathematical abilities are still lagging behind those of other countries, with an average score far below the OECD average (Belfali, 2019; Esti et al., 2023). Among the basic concepts that often present challenges for students are multiplication and division. If students do not understand these concepts well, they will struggle with more complex material in the future. This issue is not only happening globally but is also very evident in the context of education in Indonesia, where many students struggle to understand the relationships between numbers, which should form the basis for understanding other mathematical concepts (Maulidina et al., 2025; Wijaya et al., 2018).

Understanding of mathematical concepts in third-grade students, especially in multiplication and division, still faces significant challenges. Many students find it difficult to connect basic mathematical concepts with their application in daily life (Tampubolon et al., 2019; Kristesia et al., 2025). Despite being taught through various methods, many students tend to memorize formulas or procedures without understanding the deeper meaning behind the concepts (Oktafianti & Purnomo, 2025; Esti et al., 2023). This causes difficulties when they encounter more complex problems later on. Furthermore, the teaching methods implemented in many schools have not yet reached active student engagement, meaning that basic concepts like multiplication and division have not been optimally mastered (Mytra & Christi, 2024; Kristesia et al., 2025).

Preliminary research conducted in several elementary schools in Batuwarno District showed that students' understanding of multiplication and division of whole numbers was still quite low. Based on observations and pre-tests, only about 35% of students were able to solve multiplication and division problems correctly. Most students still struggle to understand how to multiply or divide, and how to arrive at the correct results. Additionally, some students have difficulty connecting the concept of whole numbers with real-life situations, such as dividing objects in daily life. These findings indicate the need for a more engaging and effective teaching approach, such as using innovative learning media, to help improve students' understanding of multiplication and division of whole numbers.

Understanding of whole numbers and multiplication concepts should be developed through an approach that first introduces students to the basic understanding, such as whole numbers as parts of a whole and the relationship between numbers in multiplication (Hidayatullah & Zainil, 2025; Mytra & Christi, 2024). Students should be taught that whole numbers are not just numbers above and below a line, but also representations of parts that are interconnected (Lonshakova et al., 2025; Barbieri et al., 2020). In multiplication of whole numbers, students need to understand the concept of repeated parts, while in division of whole numbers, they must grasp how to divide parts into smaller pieces. Learning should be done concretely, for example, through the use of real objects, images, or manipulatives that help students visualize and understand (Jusniani & Monariska, 2025; Bartolini & Martigone, 2020). Additionally, the relationship between multiplication and division of whole numbers needs to be explained in a way that facilitates practical applications in daily life, so that students can understand these concepts more deeply and not just memorize procedures.

This study is important because a strong understanding of the concepts of multiplication and division of whole numbers is the foundation for students' mathematical abilities in the next grade. These concepts are important not only for academic success but also for practical applications in daily life, such as in financial calculations, resource division, and measurement (Hidayat et al., 2024; Agbata et al., 2024). Given the still low

understanding of these basic concepts among students, this research could contribute to finding more effective teaching methods, especially those involving active approaches and innovative media. By optimizing the use of stone flashcard media with a Discovery Learning model, it is expected that students will become more engaged in the learning process, deepen their understanding, and reduce the difficulties they face in mastering whole number operations. The results of this research may also provide valuable insights for the development of curricula and teaching methods that better meet the needs of elementary school students.

The novelty of this research lies in the use of stone flashcard media combined with the Discovery Learning model to improve students' understanding of multiplication and division of whole numbers. Although various teaching methods have been applied to teach mathematics, the combination of concrete media such as stone flashcards with the Discovery Learning approach is still rarely implemented, especially in the context of teaching multiplication and division of whole numbers at the elementary school level. Stone flashcard media offers a visual and kinesthetic experience that allows students to more easily understand the relationship between numbers and the concept of whole numbers directly. In addition, the Discovery Learning model, which encourages students to discover and solve problems independently, can enhance students' engagement and understanding more deeply. Therefore, this research presents an innovative approach that could pave the way for the development of more effective and enjoyable mathematics teaching methods for elementary school students.

This study aims to examine how the understanding of multiplication and division of whole numbers in third-grade students can be enhanced through the use of stone flashcard media with a Discovery Learning model. Furthermore, this study will also identify the challenges students face in understanding these materials and explore how this teaching approach can improve their understanding of multiplication and division of whole numbers. The main focus of this research is to determine the effectiveness of this media and learning model in overcoming students' difficulties in understanding basic mathematical concepts.

METHOD

This study employed a qualitative research design with a descriptive exploratory approach. A qualitative approach was used to gain an in-depth understanding of students' conceptual understanding of multiplication and division within the context of learning using stone-based flashcards integrated with the Discovery Learning model. Qualitative research emphasizes meaning, processes, and participants' experiences in natural settings rather than numerical measurement (Lim, 2025; Daher et al., 2017). The exploratory approach was selected because this study aims to investigate comprehensively how students' understanding is constructed throughout the learning process.

The research procedure was conducted through several stages, namely: (1) the preparation stage, which involved preliminary observations and the development of research instruments; (2) the implementation stage, in which learning activities were carried out using stone-based flashcards assisted by the Discovery Learning model; (3) the data collection stage, which included observation, in-depth interviews, and documentation; and (4) the data analysis and conclusion drawing stage. The participants of this study were 15 third-grade elementary school students. The participants were selected purposively based on their involvement in the learning process and their relevance to the research objectives. In qualitative research, participant selection focuses on the depth of information obtained rather than the size of the sample (Lim, 2025; Daher et al., 2017).

The data collection techniques employed in this study consisted of observation, in-depth interviews, and documentation. Observation was conducted to examine students' activities during the learning process, while interviews were used to explore students' experiences and conceptual understanding more deeply. Documentation was utilized to support the data in the form of field notes and students' work. These techniques are consistent with the characteristics of qualitative research, which emphasize naturalistic and in-depth data collection through direct interaction with participants (Chand, 2025; Daher et al., 2017). The primary research instrument was the researcher, supported by observation sheets, interview guidelines, and documentation.

The instrument grid was developed based on indicators of conceptual understanding of multiplication and division, including: (1) the ability to explain concepts, (2) the ability to relate concepts to real-life situations, (3) the ability to solve simple problems, and (4) students' responses to the use of learning media. The instrument validation was conducted through expert judgment by involving two experts in elementary mathematics education. This validation process aimed to ensure that the instruments were aligned with the research indicators and capable of accurately capturing the intended aspects. Furthermore, data credibility was strengthened through source and technique triangulation by comparing data obtained from observations, interviews, and documentation (Chand, 2025; Daher et al., 2017).

The data analysis technique in this study followed the interactive model proposed by Miles and Huberman, which consists of three main stages: data reduction, data display, and conclusion drawing. Data reduction involved selecting and focusing on relevant data, while data display was presented in the form of descriptive narratives. Conclusion drawing was carried out gradually based on the findings obtained in the field. Data analysis in qualitative research is inductive in nature and occurs continuously throughout the research process, enabling a comprehensive understanding of the phenomenon under study (Chand, 2025; Daher et al., 2017).

RESULT AND DISCUSSION

Result

1. Students' Ability to Explain Multiplication and Division Concepts

Based on the observation results from the first meeting, students were seen paying attention to the images and instructions provided on the flashcards before arranging the stones according to the given tasks. Some students were able to use the stones to count the objects displayed on the flashcards; however, they still experienced difficulties explaining why their answers were consistent with the concepts of multiplication or division. When asked to explain how they obtained their answers, several students only mentioned the final results without describing the relationship between the images on the flashcards and the arrangement of stones they had created. During the second meeting, students appeared more proficient in matching the information presented on the flashcards with their stone arrangements and began to explain multiplication as repeated addition and division as a process of grouping based on the activities they performed.

During the learning activities, students engaged in group discussions to explain multiplication and division concepts based on the representations presented on the flashcards and the stone arrangements they created. This activity provided opportunities for students to communicate their understanding verbally to both their peers and the teacher (Figure 1).



Figure 1. The Teacher Facilitating a Learning Discussion

These observational findings were supported by interviews with both the teacher and students. The third-grade teacher stated that “before using this media, most students only memorized multiplication facts but still had difficulty explaining the reasons behind their answers.” After the implementation of stone-based flashcards, the teacher observed that “students began to understand multiplication as repeated addition and division as a grouping process.” This finding was consistent with students’ responses during the interviews. One student stated that the activity made it “easier to count,” which helped them understand multiplication and division more easily. These interview findings indicate that the use of stone-based flashcards supported students’ understanding of multiplication and division concepts through more concrete learning experiences.

The results of the document analysis further supported these findings. Students’ worksheets showed that most students were able to solve multiplication and division problems using representations of stones and grouped objects. Students’ assignments also demonstrated an improvement in their ability to explain mathematical concepts compared with their performance before the learning activities were implemented. In addition, field notes indicated that students became increasingly active in using stone-based flashcards to explain their problem-solving processes.

2. Students’ Ability to Relate Multiplication and Division Concepts to Everyday Life

Based on the observation results, students’ ability to relate multiplication and division concepts to everyday life improved throughout the learning process. During the first meeting, only a few students were able to provide examples of multiplication in everyday situations, such as counting groups of fruits or candies. In contrast, most students still had difficulty providing examples of division in daily life contexts. In addition, students began to recognize that the stones used during the learning activities could represent objects commonly found in their surroundings. By the second meeting, students demonstrated a greater ability to connect multiplication and division concepts with real-life situations. They provided examples of multiplication using fruits, candies, and chairs arranged in groups, and explained division as the activity of distributing food or candies equally among friends.

These observational findings were supported by interviews with both the teacher and students. The third-grade teacher explained that before the implementation of stone-based flashcards, students often experienced difficulties when solving word problems related to everyday situations. According to the teacher, students were generally able to perform calculations but were unable to explain the relationship between multiplication and division operations and the activities they encountered in daily life. After participating in the learning activities using stone-based flashcards, the teacher observed that students were better able to provide examples of multiplication and division in everyday contexts, such as counting candies, sharing food with friends, and grouping objects into equal sets. This finding was consistent with students’ responses, which indicated that the stones

and flashcards helped them visualize the situations presented in the problems, making it easier to understand multiplication and division in real-life contexts.

The results of the document analysis further supported these findings. Students' worksheets showed that most students were able to use examples drawn from everyday life to explain multiplication and division situations. Individual assignments also revealed that students increasingly related problem solutions to daily activities, such as counting objects arranged in groups and distributing objects equally among friends.

3. Students' Ability to Solve Simple Multiplication and Division Problems

Based on the observation results, students' ability to solve simple multiplication and division problems improved throughout the learning process. During the first meeting, several students appeared hesitant when determining solution steps for the problems presented on the flashcards. Some students waited for guidance from the teacher or followed the strategies used by their peers before attempting to solve the tasks. When working on division problems, several students tried different approaches before arriving at the correct answer. By the second meeting, students demonstrated greater independence in completing the assigned tasks. Most students were able to determine appropriate solution steps, check their answers, and complete the problems with minimal assistance from the teacher.

Students were actively involved in group discussions to solve multiplication and division problems. Through collaborative activities, students discussed solution steps and worked together to complete the assigned tasks (Figure 2).



Figure 2. Students Solving Multiplication and Division Problems Through Group Discussion Activities

These findings were supported by interviews with both the teacher and students. The third-grade teacher explained that before the use of stone-based flashcards, students tended to focus on obtaining the final answer without paying attention to the problem-solving process. After the implementation of the learning activities, the teacher observed that students became more capable of determining solution steps systematically and were less likely to give up when encountering difficulties. This finding was consistent with students' responses, which indicated that they found it easier to solve problems because they could try different strategies before deciding on an answer. Students also reported feeling more confident in their answers after reviewing the solution steps they had taken. One student stated that the stones and flashcards made it "easier to count one by one," while another student explained that the stones helped because "I can see the quantities." The student further mentioned that when facing difficult problems, he or she still relied on "imagining the stones" to support the problem-solving process.

The results of the document analysis showed that most students were able to correctly solve multiplication and division problems on the worksheets provided. Students' individual assignments also demonstrated improvements in answer accuracy and in their ability to determine appropriate solution procedures compared to their performance before the learning activities were implemented.

4. Students' Responses to the Use of Stone-Based Flashcards in Discovery Learning

Based on the observation results, students demonstrated positive responses toward the use of stone-based flashcards during the learning process. During the first meeting, most students appeared interested and enthusiastic about using a learning medium that differed from their usual classroom activities. Students actively participated in learning tasks, engaged in group discussions, and showed interest in the media used. However, only a few students were willing to ask questions or express their opinions. By the second meeting, students' positive responses became more evident. They actively participated in all stages of the learning process, demonstrated greater confidence in asking questions, engaged more actively in group discussions, and confidently explained their answers in front of the class. In addition, students appeared more focused throughout the lesson and showed a high level of interest in the use of stone-based flashcards.

During the learning activities, students actively participated in small-group discussions while receiving guidance from the teacher. The interaction between the teacher and students encouraged students to ask questions, express their ideas, and remain engaged throughout the learning process (Figure 3).



Figure 3. Teacher Facilitating Students During Small-Group Learning Activities

These observational findings were supported by interviews with both the teacher and students. The third-grade teacher stated that "students appeared more active than in previous lessons" and became more engaged in classroom activities. The teacher also observed an increase in students' confidence in asking questions and expressing their opinions during discussions. These findings were consistent with students' interview responses, in which they described learning with stones and flashcards as "fun and easier to understand" and "exciting and not boring." Students also reported enjoying group learning activities and feeling more confident when answering questions while using the learning media.

The results of the document analysis further supported these findings. Field notes indicated that students actively participated throughout the learning process. They appeared enthusiastic when using the stone-based flashcards, discussing ideas with group members, and attempting to complete the assigned tasks independently. In addition, students' worksheets and assignments showed that most students actively participated in the learning activities provided.

Discussion

These findings are in line with previous studies stating that the use of concrete media can help students understand mathematical concepts more effectively (Wathoni, 2024; Bahtiar & Santoso, 2024). Concrete media provide real learning experiences so that students can connect abstract concepts with more easily understood situations (Shoimah et al., 2021; Islamiah et al., 2025). Through the use of real objects, students not only memorize procedures but also understand the meaning of the concepts being learned. This makes the learning process more meaningful and in-depth for students.

Thus, concrete media play an important role in improving the quality of students' conceptual understanding of mathematics (Wathoni, 2024; Shoimah et al., 2021).

The improvement in students' ability to explain multiplication and division concepts can also be understood from a constructivist perspective. From a constructivist perspective, students' understanding is formed through active interaction with the learning environment (Ardi et al., 2025; Dina et al., 2025). The use of stone-based flashcards allows students to be directly involved in the learning process through manipulative activities (Arnas et al., 2025; Febrian et al., 2025). This interaction helps students build knowledge independently based on their own experiences. In addition, active student involvement also encourages the development of deeper understanding rather than mere memorization (Ochtaulia & Safitri, 2025; Ulumiyah & Pratama, 2025). Therefore, experience-based learning is very important in supporting the development of students' conceptual understanding.

In addition to improving conceptual understanding, the findings also showed that students were increasingly able to relate multiplication and division concepts to situations encountered in everyday life. Previous research states that the Discovery Learning model can increase student activeness and engagement in learning (Prasetyo & Abduh, 2021; Luthfi et al., 2021). This model provides opportunities for students to learn through the process of discovery, so they do not only receive information passively but are also involved in constructing knowledge. Through exploration activities, students are encouraged to search, discover, and understand concepts independently (Khoiriyah & Fatonah, 2024; Syafila & A'yun, 2024). This process makes learning more meaningful because students are directly involved in learning experiences. Thus, Discovery Learning plays an important role in improving the quality of student interaction in learning (Nurjihan & Bunawan, 2025; Sausan et al., 2023).

The ability to connect mathematical concepts with real-life situations further supported students in solving multiplication and division problems. In addition to the application of learning models, the use of interactive media is also an important factor influencing students' learning experiences. The use of interactive media can increase students' learning motivation because it provides an engaging and non-monotonous learning experience (Kusnadi & Azzahra, 2024; Ayuningtyas & Zulfah, 2021). Media such as stone-based flashcards allow students to learn through visual and kinesthetic activities (Febrian et al., 2025; Abrar & Listrianti, 2025). This helps students become more focused and interested in participating in the learning process. When students are interested, they tend to be more active and have higher motivation to understand the material. Therefore, interactive learning media play an important role in creating an enjoyable learning atmosphere (Yusnaldi et al., 2025; Ali et al., 2025).

The positive impact on students' conceptual understanding and problem-solving abilities was also reflected in their responses toward the learning process. The combination of the Discovery Learning model and the use of concrete media such as stone-based flashcards provides a significant impact on students' learning experiences (Shintya et al., 2026; Ananta & Isdaryanti, 2025). These two components complement each other in creating effective and meaningful learning. The learning model encourages active thinking processes, while the media help visualize abstract concepts (Sophian et al., 2025; Harahap et al., 2025). The integration of both enables students to understand the material more deeply through direct experience. Thus, the implementation of appropriate learning strategies can improve the quality of the learning process and outcomes overall.

Although the findings generally indicated positive outcomes, several challenges were still encountered during the implementation of the learning activities. The difficulties experienced by students were further analyzed by referring to previous research findings. Previous studies indicate that the use of new learning media requires an adaptation

process for students (Hasibuan et al., 2024; Putri & Sutriyani, 2025). In the early stages, students tend to experience confusion in understanding how to use unfamiliar media. This is natural because students are accustomed to conventional learning methods that are more passive. Therefore, the adaptation process becomes an important part of the successful implementation of learning media. Over time, students begin to understand and adjust to the use of the media.

In addition to the adaptation process to learning media, differences in students' individual characteristics also influence the learning process. Not all students can immediately understand how to use the media optimally. Differences in the ability to receive information cause each student to have a different learning pace. Some students are able to adapt quickly, while others require more time. This condition indicates that learning needs to be designed flexibly to accommodate individual differences among students. Thus, an adaptive learning approach becomes very important in supporting the successful use of media (Inriani et al., 2025; Fuad & Ar-Rohman, 2025).

Differences in students' cognitive abilities also influence the learning process (Winanda & Yana, 2021; Magdalena et al., 2021). Students with higher cognitive abilities tend to understand concepts more quickly, while those with lower abilities require additional guidance (Aprilia, 2024; Purwulan, 2024). This shows that learning cannot be standardized for all students. Teachers need to understand the characteristics and needs of each student to provide appropriate support. Thus, learning can take place more effectively and inclusively.

Therefore, the role of the teacher is very important in providing guidance during the learning process. Teachers not only act as providers of material but also as facilitators who assist students in understanding concepts. The guidance provided can take the form of directions, guiding questions, and assistance during learning activities. In addition, teachers need to create a supportive learning environment so that students feel comfortable exploring knowledge. With the optimal role of the teacher, the learning process can run more effectively and help all students achieve the expected understanding (Tambunan et al., 2024; Aida, 2024).

Students' positive responses toward the use of stone-based flashcards were reflected in their increased enthusiasm, active participation, and confidence throughout the learning process. The findings revealed that students enjoyed learning with stones and flashcards because the media made mathematical concepts easier to understand and the learning activities more engaging. In addition, students demonstrated greater confidence in answering questions and participating in group discussions, as the concrete objects served as tools to support their thinking processes. These findings are consistent with previous studies suggesting that engaging and interactive learning media can enhance students' learning motivation, self-confidence, and active participation in classroom activities (Monigir & Wakari, 2024; Rahman et al., 2024). When students feel interested and comfortable during the learning process, they are more likely to participate actively and develop positive attitudes toward mathematics learning (Dwiguningtyas et al., 2025).

Furthermore, the positive responses demonstrated by students were closely associated with the improvements in conceptual understanding and problem-solving abilities they experienced throughout the learning process. Students who developed a better understanding of multiplication and division concepts tended to feel more confident when completing assigned tasks (Hasibuan et al., 2024). In this study, students not only expressed enthusiasm toward the use of the learning media but also reported that learning multiplication and division became easier and more enjoyable. These findings suggest that cognitive and affective aspects of learning are closely interconnected. As students acquire conceptual understanding through meaningful learning experiences, their motivation and engagement in learning also increase (Arsi, 2025). Therefore, the

integration of stone-based flashcards with the Discovery Learning model not only supports the development of students' mathematical conceptual understanding but also creates a more positive and meaningful learning experience (Wibowo et al., 2025).

CONCLUSION

This study concludes that the use of stone-based flashcards assisted by Discovery Learning supports the development of students' conceptual understanding of multiplication and division. Learning that integrates concrete media with discovery-based approaches encourages active engagement, meaningful learning experiences, and deeper conceptual construction. Students are not only able to interact directly with learning materials but also develop confidence and collaboration skills during the learning process. However, the effectiveness of this approach depends on adequate guidance and students' readiness to adapt to new learning methods. Therefore, teachers play a crucial role in facilitating learning and ensuring that all students can participate effectively. Overall, this approach has the potential to enhance the quality of mathematics learning by promoting meaningful understanding and student-centered learning.

Furthermore, teachers are encouraged to utilize concrete learning media, such as stone-based flashcards, to support students' understanding of mathematical concepts. Future studies may involve a larger number of participants and different grade levels to obtain broader insights regarding the effectiveness of this approach. In addition, further research is recommended to examine the long-term impact of integrating stone-based flashcards with Discovery Learning on students' mathematical achievement, problem-solving skills, and learning motivation.

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