

The Effect of Mathematical Dakon Media on the Multiplication Operation Ability of Whole Numbers in Grade 4 Madrasah Ibtidaiyah Students

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Abstract

The low understanding of Grade 4 students at Madrasah Ibtidaiyah regarding multiplication operations with whole numbers is one of the main obstacles in mathematics learning that must be addressed promptly. This study aims to determine the effect of using dakon mathematics media on multiplication operation ability and to enhance the effectiveness of mathematics learning among Grade 4 MI students. The method used is quantitative with a quasi-experimental approach and a pretest-posttest control group design. The research sample consisted of two classes: the experimental class used dakon media, while the control class used conventional methods, with 20 students in each class. The data collection technique in this study was carried out using pretests and posttests to measure students' multiplication ability before and after treatment. The data analysis technique used was quantitative statistical analysis with a t-test to examine the difference in average multiplication ability between the experimental and control classes. The results of the study showed a significant increase in multiplication operation skills in students who used dakon media compared to those who did not use the media. The dakon media proved effective in helping students understand the concept of multiplication through a concrete and enjoyable approach.

Keywords: Mathematics dakon media, arithmetic operations, multiplication, whole numbers, grade 2 MI students.

Abstrak

Rendahnya pemahaman siswa kelas 4 Madrasah Ibtidaiyah tentang operasi perkalian dengan bilangan bulat merupakan salah satu kendala utama dalam pembelajaran matematika yang harus segera diatasi. Penelitian ini bertujuan untuk mengetahui pengaruh penggunaan media matematika dakon terhadap kemampuan operasi perkalian dan meningkatkan efektivitas pembelajaran matematika siswa MI kelas 4. Metode yang digunakan adalah kuantitatif dengan pendekatan kuasi-eksperimental dan desain kelompok kontrol pretes-postes. Sampel penelitian terdiri dari dua kelas: kelas eksperimen menggunakan media dakon, sedangkan kelas kontrol menggunakan metode konvensional, dengan masing-masing kelas berjumlah 20 siswa. Teknik pengumpulan data dalam penelitian ini dilakukan dengan menggunakan tes berupa pretes dan postes untuk mengukur kemampuan operasi perkalian siswa sebelum dan sesudah perlakuan. Teknik analisa data yang digunakan adalah analisis statistik kuantitatif dengan uji-t untuk menguji perbedaan rata-rata kemampuan operasi perkalian antara kelas eksperimen dan kelas kontrol. Hasil penelitian menunjukkan adanya peningkatan kemampuan operasi perkalian yang signifikan pada siswa yang menggunakan media dakon dibandingkan dengan yang tidak menggunakan media. Media dakon terbukti efektif membantu siswa memahami konsep perkalian melalui pendekatan yang konkret dan menyenangkan.

Kata kunci: Media dakon matematika, operasi hitung, perkalian, bilangan cacah, siswa kelas 2 MI.



INTRODUCTION

Mathematics is one of the essential subjects in elementary education that plays a crucial role in developing students' logical, systematic, and critical thinking skills (Fitriani, 2020). At the Madrasah Ibtidaiyah (MI) level, mathematics is not only taught as a subject of computation but also as a means to train problem-solving skills related to everyday life. However, in practice, many students still face difficulties in understanding basic mathematical concepts, particularly in the topic of arithmetic operations such as multiplication (Rukmini, 2021). In the context of mathematics learning at the MI level, students' success in grasping basic concepts like multiplication is highly influenced by the approach used by the teacher in delivering the material. Multiplication, as a part of arithmetic operations, requires conceptual understanding and logical thinking skills so that students can apply it appropriately in real-life situations. According to Sari (2022), mathematics learning should include visual representations, concrete manipulatives, and connections between symbols, processes, and meanings. Therefore, learning media that are visual and interactive are essential to support students in constructing a deep understanding of mathematical concepts.

The problem of understanding multiplication concepts becomes particularly prominent among fourth-grade MI students. Observations and interviews with classroom teachers revealed that many students have not yet grasped the conceptual meaning of multiplication and tend to memorize without understanding the process or the meaning behind the numbers. This leads to poor student performance in solving multiplication problems, especially when presented in story problems or real-life contexts (Prasetyo, 2020). This difficulty indicates that the current learning strategies and media are not fully effective in bridging students' understanding of multiplication. According to Hakke (2020), learning becomes more meaningful when students experience what they learn rather than merely receiving verbal information. Therefore, a concrete and enjoyable learning approach is needed so that students can more easily grasp abstract concepts such as multiplication. One such approach is using manipulative learning media that are appropriate for elementary students' cognitive development. Manipulative media may include physical teaching aids that allow students to explore concepts directly through meaningful play activities (Widodo, 2021).

One medium that can be used in teaching multiplication is the mathematics dakon. *Dakon*, also known as *congklak* in Indonesian culture, is a traditional game involving counting, strategy, and number management (Hidayah, 2023). The mathematics dakon is a modified version of the traditional dakon game, adapted for the purpose of teaching mathematics, especially arithmetic operations. In this learning context, dakon serves not only as a game but also as a medium to present mathematical concepts in a concrete, contextual, and enjoyable way (Zubaidah, 2022). Dakon, as a concrete representation of multiplication, allows students to understand multiplication as a process of repeated addition. In dakon, the seeds placed in the holes can represent number units grouped together, making the distribution of seeds into holes an analogy for multiplication (Putri, 2020). For example, if each hole represents one group and each hole is filled with the same number of seeds, students can directly observe the concept of 4×3 as "4 groups, each with 3 seeds." This provides deeper understanding than simply memorizing that $4 \times 3 = 12$ (Susanti, 2021).

Previous studies by Raharjo and Kurniawan (2023) show that using modified traditional games in mathematics learning can increase students' active participation and enhance their understanding of number concepts. In a study conducted at an elementary

school in Yogyakarta, it was found that students who learned using the dakon game showed significant improvement in arithmetic skills compared to those taught through lecture methods (Nurhadi, 2022). This indicates that the mathematics dakon has great potential in enhancing the understanding of basic arithmetic operations. From a cultural perspective, dakon is a form of local heritage with high educational value. According to Rahmawati (2024), integrating local culture into education not only enriches students' learning experiences but also fosters a sense of ownership of their culture and cultivates cultural identity from an early age. This aligns with the spirit of the *Merdeka Curriculum*, which emphasizes the importance of contextual, character-based learning that appreciates local cultural wealth in teaching and learning activities (Handayani, 2021). Furthermore, the use of dakon is also consistent with the integrative thematic learning approach of both the *Merdeka Curriculum* and the 2013 Curriculum. In this approach, the learning process does not solely focus on cognitive aspects but also develops students' affective and psychomotor domains. Through dakon, students not only learn mathematical concepts but also cooperation, social interaction, and adherence to rules. This supports Darmawan (2021) view that children learn best through play activities involving physical and social interaction.

However, despite its great potential, not many madrasahs systematically use the dakon medium in mathematics instruction. Most teachers still rely on conventional methods such as lectures and exercises without linking the material to concrete activities. This approach tends to limit students' creativity and active participation in learning. As Kurniasih (2020) stated, effective learning requires students' active involvement—both physically and mentally—in constructing knowledge through direct experiences. Therefore, an empirical study is needed to determine the effectiveness of the mathematics dakon medium in improving multiplication skills with whole numbers among fourth-grade MI students. In this study, the dakon medium serves as the independent variable applied to the experimental group, while the control group continues using conventional methods. The research uses a quantitative approach with a quasi-experimental method, applying a pretest-posttest control group design that allows comparison between learning outcomes before and after the intervention.

Based on preliminary trials and data collection, it was found that students who learned using the dakon medium showed improvement in understanding multiplication concepts and were more enthusiastic during learning. The dakon medium helped students grasp multiplication as a grouping process repeated multiple times, visualized through dakon holes and seeds (Pratiwi, 2023). This helped students perceive multiplication not merely as a numerical result but as a meaningful repetitive process. In addition, the playful nature of the game boosted students' motivation and interest in learning. Thus, the research problem can be formulated as follows: *Does the use of the mathematics dakon medium affect the improvement of multiplication skills with whole numbers in fourth-grade Madrasah Ibtidaiyah students?* Based on this, the objective of the research is to examine the influence of using the mathematics dakon medium on multiplication performance and to assess its effectiveness in mathematics teaching in Grade IV MI. This study is expected to contribute to the development of mathematics learning strategies at the elementary/madrasah level, particularly in the use of culturally-based learning media. Moreover, the results of this study can serve as a reference for MI teachers in designing more enjoyable and meaningful lessons for students and in

promoting the innovative use of concrete teaching aids in mathematics instruction (Safitri, 2021). Based on the description above, this study aims to determine the effectiveness of using mathematics *dakon* media in improving the understanding of multiplication concepts in fourth-grade students of Islamic Elementary Schools. Specifically, this study was designed to identify how the use of mathematics *dakon* can help students understand multiplication concepts concretely and contextually, thereby enabling them to overcome difficulties in multiplication operations.

METHOD

This study employed a quantitative approach using a quasi-experimental method. The design used was a *pretest-posttest control group design*, in which there were two sample groups: the experimental group and the control group. Both groups were given different treatments but were tested using the same instrument before and after the treatment (Khasanah, 2022). The population in this study consisted of all fourth-grade students at an Islamic elementary school (Madrasah Ibtidaiyah) in Sukoharjo Regency. The sample was selected using purposive sampling, taking into account the equivalence of initial abilities and relatively homogeneous class conditions. The sample consisted of two classes: the experimental class, consisting of 20 students, received instruction using the *dakon* mathematics media, while the control class, also consisting of 20 students, received instruction through conventional methods (lectures and practice questions). The primary data source in this study was quantitative data obtained from the results of multiplication tests involving whole numbers administered to students before and after the treatment. The data collection technique used was a written test consisting of multiplication problems with whole numbers that had been validated by experts. The test was administered twice, namely during the pretest (before the treatment) and the posttest (after the treatment). The test was designed to assess students' understanding of concepts and skills in performing multiplication with whole numbers. The *dakon* media used in the experimental class was a modified traditional game tool designed to present multiplication problems in a concrete and contextual manner, allowing students to grasp concepts through direct experience (Wahyuni, 2024). The pretest and posttest data were analyzed quantitatively using the *independent sample t-test* statistical technique to determine the difference in improvement between the experimental and control groups. Prior to the *t-test*, normality testing (using the Kolmogorov-Smirnov test) and homogeneity testing (using Levene's Test) were conducted to ensure that the data met the assumptions of normal distribution and homogeneous variance. The Normality Test uses the Kolmogorov-Smirnov test, which is a statistical test used to assess whether the data is normally distributed. Data normality is important to ensure that the use of parametric tests such as the *t-test* can be applied appropriately. The Homogeneity of Variance Test uses the Levene test. This test is used to check whether the variances of the two groups being compared are homogeneous or equal. Homogeneity of variance is one of the important assumptions in the independent *t-test* so that the comparison results are not biased. If both assumptions are met, then the independent *t-test* can be used to test the hypothesis whether there is a significant difference between the average pre-test and post-test scores of the experimental and control groups. However, if the data does not meet the assumptions of normality or homogeneity, then non-parametric methods such as the Mann-Whitney test can be used as an alternative. The difference between pretest and posttest scores was used to calculate the gain score, which was

then compared between the two groups to assess the significance of the effect of using *dakon* media on students' multiplication ability. Data processing was carried out using SPSS version 26. With this approach and design, the study is expected to provide empirical evidence on the effectiveness of using *dakon* mathematics media to improve the multiplication skills of fourth-grade students at Madrasah Ibtidaiyah

RESULTS AND DISCUSSION

A. Research Results

This study aimed to determine the effect of using the *Dakon Mathematics* media on the multiplication operation ability of whole numbers among fourth-grade students at Madrasah Ibtidaiyah. The research was conducted using a quantitative approach and a quasi-experimental method with a **pretest-posttest control group design**.

1. Description of Pretest and Posttest Data

To gain an initial and final overview of students' abilities, a pretest and posttest were administered to both groups. The tests consisted of validated multiplication problems involving whole numbers.

Table 1. Pretest and Posttest Data

Group	N	Pretest Mean	Posttest Mean	Max Score	Min Score
Experimental	20	57.25	83.90	100	70
Control	20	55.65	71.75	90	60

From the table above, it is evident that there was an increase in the average score in both the experimental and control groups. However, the increase in the experimental group (26.65 points) was higher than that in the control group (16.10 points). This indicates a potential influence of the use of *Dakon* media on student learning outcomes.

2. Normality Test

A normality test was conducted to determine whether the pretest and posttest data were normally distributed. The Kolmogorov-Smirnov test was used with a significance level (α) = 0.05.

Table 2. Normality Test Results

Group	Stage	Sig. (Kolmogorov-Smirnov)
Experimental	Pretest	0.200
Experimental	Posttest	0.172
Control	Pretest	0.193
Control	Posttest	0.135

Based on the results, the significance values for all groups were greater than 0.05, indicating that the data are normally distributed and meet the assumptions for parametric testing.

3. Homogeneity Test

A homogeneity test was conducted to determine the equality of variances between the two groups using the **Levene's Test**, with the following result:

Table 3. Homogeneity Test

Variable	Levene Statistic	Sig.
Gain Score	1.213	0.278

The significance value of $0.278 > 0.05$ shows that the variances of both groups are homogeneous.

4. t-Test (Independent Sample t-test)

Hypothesis testing was conducted using an independent sample t-test on the gain score (difference between posttest and pretest) to examine the significant effect of different treatments.

Table 4. Independent Sample t-test

Group	Mean Gain	Std. Dev	t-value	df	Sig. (2-tailed)
Experimental	26.65	4.87	4.581	38	0.000
Control	16.10	5.21			

A significance value of $0.000 < 0.05$ indicates a significant difference between the experimental and control groups. Thus, the null hypothesis (H_0) is rejected and the alternative hypothesis (H_1) is accepted, namely that the use of *Dakon Mathematics* media significantly affects the multiplication skills of fourth-grade students at Madrasah Ibtidaiyah.

B. Discussion

1. Improvement of Student Ability through *Dakon* Media

The study results show that students taught using *Dakon* media experienced a significantly higher posttest score increase than those taught using conventional methods. This indicates that *Dakon* media positively contributes to facilitating mathematics learning, particularly in whole number multiplication. *Dakon Mathematics* operates on the principle of concretizing mathematical concepts. The modified *dakon* game allows students to visualize multiplication patterns through *dakon* seeds, physically count outcomes (concretely), engage in motor and social interaction activities that can enhance learning interest (Arifin M, 2025). This study shows that the use of *Dakon* media in mathematics learning significantly improves students' abilities, especially in understanding the concept of multiplication of integers. The results of a higher increase in posttest scores compared to conventional methods confirm the effectiveness of this media as a learning aid. *Dakon* media not only facilitates learning in a concrete way but also integrates important visual and social aspects in the student learning process. Mathematical concepts taught through the *Dakon* game become easier to understand because students can directly manipulate *Dakon* seeds, physically count, and interact with peers, thereby increasing their engagement and interest in learning.

Asriyanti (2021) states that effective mathematics learning should involve three stages of representation: enactive (direct experience), iconic (imagery), and symbolic (abstract). The *Dakon* media effectively addresses all three stages, starting with real object manipulation (enactive), followed by visual recording (iconic), and finally enabling students to solve symbolic mathematical problems. *Dakon* media provides an enactive experience by allowing students to interact directly with real objects, which is then reinforced through iconic representations as students recall the patterns formed from these manipulations. Finally, the symbolic stage is reached when students can connect these concrete experiences with abstract mathematical notation. Thus, *Dakon* media not only enhances conceptual understanding but also builds a strong cognitive foundation through a multisensorial approach, which supports constructivist theory in mathematics learning. This approach encourages students to learn actively and meaningfully, contributing to improved overall learning outcomes.

2. Effectiveness of *Dakon* Media Based on Gain Score

The gain score in this study was used to measure the effectiveness of the treatment. The results of the study on the effectiveness of *Dakon* media as a learning aid showed a significant difference between the experimental group and the control group

based on the gain scores obtained. Based on the average gain score calculations the average gain score for the experimental group reached 26.65, 10.55 points higher than the control group which was only 16.10. This indicates that the improvement in learning outcomes in the group using Dakon media was greater than that of the group using the conventional lecture method. A more in-depth analysis using the normalized gain value (g) also strengthened these findings, where the experimental group had a g value of 0.62 which falls into the medium to high category according to (Hake, 2020) interpretation. Meanwhile, the control group had a g value of 0.36 which is only in the medium to low category. Thus, it can be concluded that Dakon media has a positive impact and is more effective in improving student understanding compared to traditional learning methods, as reflected in the significant differences in gain scores and the category of strengthening learning outcomes. This study emphasizes the importance of using interactive media such as Dakon in the learning process to increase student motivation and learning outcomes more optimally. Thus, the experimental group's gain falls into the medium to high category, while the control group is in the medium to low category. This indicates that the use of Dakon media is more effective than the conventional lecture method.

3. Result Visualization

The data presented illustrates a comparison of the average pretest and posttest scores between the experimental and control groups, providing a clear picture of the effectiveness of using Dakon Mathematics media in the multiplication learning process (Ariyandi, 2025). Specifically, the experimental group demonstrated a significant increase in average scores, from 57.25 in the pretest to 83.90 in the posttest. Meanwhile, the control group also experienced an increase in scores, but to a lesser extent, from 55.65 to 71.75. This indicates that while conventional learning can improve student abilities, interactive media such as Dakon Mathematics has a much stronger influence on improving students' understanding of multiplication concepts. Analysis of the research findings demonstrates consistency with previous studies emphasizing the role of innovative learning media in improving learning outcomes. For example, research by Rahmawati (2022) found that visual and kinesthetic media-based learning methods significantly improve elementary school students' mathematics comprehension. Similar results were also reported by Sari and Nugroho (2023), who confirmed that traditional game-based learning media, such as Dakon, can facilitate more enjoyable learning activities while also honing mathematical thinking skills.

This comparison confirms that the experimental group's success is not a single phenomenon, but rather part of consistent empirical evidence that the use of interactive learning media can strengthen the internalization of mathematical concepts. Thus, these findings strengthen the argument for the need to incorporate innovative media into the mathematics curriculum to improve student competency achievement, particularly in abstract arithmetic operations such as integer multiplication. Overall, the data and analysis indicate that the integration of Dakon Mathematics media not only improves student evaluation scores but also has the potential to transform the learning dynamics, making them more active, engaging, and effective compared to more passive conventional methods. This opens up broader opportunities for the development of teaching methods that adapt to the needs and learning characteristics of today's students.

4. Alignment with Theoretical Studies

This study comprehensively reinforces previous findings regarding the effectiveness of using concrete learning media in improving understanding of mathematical concepts at the elementary school level. First, it is clearly consistent with the findings of Suyatno (2021), who demonstrated that the use of traditional game-based learning media can increase students' motivation to learn and their understanding of basic mathematical concepts. This demonstrates that an approach involving game elements not only makes the learning process more enjoyable but is also more effective

in instilling abstract concepts in a more digestible way. Furthermore, this study supports the findings of Rahmawati et al. (2022), who asserted that elementary school students more easily understand arithmetic operations when taught using concrete and familiar teaching aids. These teaching aids allow students to interact directly with real objects, making initially abstract mathematical concepts more concrete and understandable. This demonstrates the importance of selecting media that are appropriate to the context and students' everyday experiences for a more effective learning process.

Furthermore, the results of this study align with Piaget's theory of cognitive development, which states that elementary school-aged children are in the concrete operational stage (Andiyani, 2019). At this stage, children are better able to learn and understand concepts through concrete experiences and direct manipulation of real objects, rather than through the abstract symbols often found in conventional learning. Therefore, a learning approach that emphasizes real-world teaching aids is highly relevant and necessary to optimize elementary school students' understanding of mathematical concepts. On the other hand, this study confirms the weaknesses of conventional learning methods, which predominantly use lectures and worksheets, which are passive and tend to be symbolic. These methods often make it difficult for students to grasp the concept of multiplication, which is actually a matter of repeated addition or grouping. Therefore, this study clarifies that innovative learning media that integrate concrete teaching aids and traditional games can be an effective solution to overcome obstacles to understanding mathematical concepts in elementary school children (Purnasari, 2023). Analytically, the conclusions from these various studies complement and reinforce each other, illustrating the need for a more active, concrete, and contextual learning approach for elementary school students. The combination of these findings confirms that learning media that prioritize direct interaction with real objects and environments familiar to children are key to increasing motivation and understanding of mathematics, while minimizing the difficulties that arise from symbolic and passive learning.

5. Implications of the Study

The use of Dakon Mathematics media The use of Dakon Mathematics media in learning has been proven not only to improve student test scores but also to create a more meaningful and contextual learning experience. Based on research findings, teachers can utilize this traditional game as an effective educational medium to significantly increase student participation and motivation (Risnawati, 2019). The use of Dakon provides a fun learning environment while also facilitating students' understanding of mathematical concepts through real-life experiences and local culture, in line with the principles of the Merdeka Belajar movement, which encourages experiential and contextual learning. Analysis of various studies shows that Dakon media accommodates the needs of more active and interactive learning, thereby increasing student engagement cognitively and affectively. However, several limitations of this study should be noted, such as the relatively short implementation period and the limited scope of the study in a single madrasah (Islamic school). Therefore, the conclusions require further verification with a wider population. Furthermore, the long-term effects of using Dakon media in mathematics learning have not been thoroughly evaluated, so further research is needed to determine its ongoing impact.

As a future prospect, the development of Dakon media can be directed towards expanding other mathematical topics such as division, greatest common factor (GCF), and least common multiple (LCM). Integrating Dakon media with digital technology, for example through virtual simulation games, can enrich the learning experience and broaden its reach. Furthermore, using Dakon in project-based or collaborative learning models will enhance learning, strengthen students' collaboration skills, and enhance their understanding of mathematical concepts. Therefore, although Dakon media has demonstrated positive results in mathematics learning, further research with longer

implementation durations, broader coverage, and testing of long-term effects is needed to establish it as a more established and effective learning medium for various mathematical concepts. This learning approach, which combines local culture, technology, and collaborative methods, aligns with educational innovation efforts that support independent and participatory learning in the modern era.

CONCLUSION

The study entitled "The Effect of Dakon Mathematics Media on the Multiplication Operation Ability of Whole Numbers among Fourth Grade Students of Madrasah Ibtidaiyah" aimed to Mathematics is an important subject in elementary education, particularly in Islamic elementary schools (MI), which plays a role in developing students' logical, systematic, and critical thinking skills. However, many fourth-grade MI students struggle to grasp the basic concept of multiplication due to rote memorization without conceptual understanding. Visual and interactive learning media, such as dakon mathematics a modified traditional game can be an effective solution to help students understand multiplication concepts in a concrete and enjoyable way. This approach not only improves mathematical comprehension but also enriches learning with local cultural values. It is recommended that MI teachers use manipulative learning media such as dakon mathematics in teaching multiplication operations to facilitate conceptual understanding and increase student engagement. Integrating local culture into learning is also encouraged to increase students' sense of ownership and connection with the material being taught, while also supporting thematic and character-based learning approaches in accordance with the Merdeka Curriculum and the 2013 Curriculum. This presentation aligns with the objectives of mathematics learning to equip students with problem-solving skills and in-depth conceptual understanding, which are expected to be achieved through a concrete and contextual learning approach..

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