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Development of an ADDIE-Based LEGO Calculator to Support Students' Conceptual Understanding of Multiplication

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Abstract

This study aims to develop LEGO Calculator learning media based on the ADDIE model to support third-grade students' conceptual understanding of multiplication at MI Plus Ar-Ridha. The novelty of this study lies in the design of LEGO blocks as a concrete calculator that represents multiplication through vertical and horizontal block arrangements, allowing students to connect repeated addition, grouped quantities, and symbolic multiplication. Unlike general manipulative media that mainly function as counting aids, the LEGO Calculator integrates constructive play, concrete representation, collaborative learning, and Wordwall-assisted interactive questions in one learning sequence. This study employed a Research and Development method using the ADDIE model and involved 21 third-grade students of MI Plus Ar-Ridha. Data were collected through observation, interviews, expert validation sheets, teacher and student response questionnaires, and pretest-posttest instruments. The instruments were reviewed through expert judgment to ensure content suitability, language clarity, readability, and alignment with multiplication concept indicators. The data were analyzed using descriptive quantitative analysis and N-Gain calculation. The results showed that the media was highly feasible, with an average score of 4.6 from the media expert and 4.5 from the material expert. The practicality test obtained 92% from the teacher response and 90.4% from student responses. The limited trial showed an increase in the average score from 58.1 in the pretest to 89.5 in the posttest, with an N-Gain score of 0.8 in the high category. These findings indicate that the LEGO Calculator can serve as an alternative manipulative medium to support concrete, interactive, and meaningful multiplication learning in elementary mathematics.

Keywords: *LEGO Calculator; ADDIE Model; Research and Development; Manipulative Media; Multiplication Concept*

Abstrak

Penelitian ini bertujuan mengembangkan media pembelajaran Kalkulator LEGO berbasis model ADDIE untuk mendukung pemahaman konsep perkalian siswa kelas III MI Plus Ar-Ridha. Kebaruan penelitian ini terletak pada rancangan balok LEGO sebagai kalkulator konkret yang merepresentasikan perkalian melalui susunan balok secara vertikal dan horizontal, sehingga siswa dapat menghubungkan penjumlahan berulang, kelompok bilangan, dan simbol perkalian. Berbeda dari media manipulatif umum yang lebih banyak berfungsi sebagai alat bantu hitung, Kalkulator LEGO memadukan permainan konstruktif, representasi konkret, pembelajaran kolaboratif, dan soal interaktif berbasis

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Wordwall dalam satu rangkaian pembelajaran. Penelitian ini menggunakan metode Research and Development dengan model ADDIE dan melibatkan 21 siswa kelas III MI Plus Ar-Ridha. Teknik pengumpulan data dilakukan melalui observasi, wawancara, lembar validasi ahli, angket respons guru dan siswa, serta instrumen pretest-posttest. Instrumen penelitian ditelaah melalui expert judgment untuk memastikan kesesuaian isi, kejelasan bahasa, keterbacaan, dan keterkaitan dengan indikator pemahaman konsep perkalian. Data dianalisis menggunakan analisis deskriptif kuantitatif dan perhitungan N-Gain. Hasil penelitian menunjukkan bahwa media berada pada kategori sangat layak dengan skor rata-rata 4,6 dari ahli media dan 4,5 dari ahli materi. Uji kepraktisan memperoleh persentase 92% dari respons guru dan 90,4% dari respons siswa. Uji coba terbatas menunjukkan peningkatan nilai rata-rata dari 58,1 pada pretest menjadi 89,5 pada posttest, dengan nilai N-Gain 0,8 kategori tinggi. Temuan ini menunjukkan bahwa Kalkulator LEGO dapat menjadi alternatif media manipulatif untuk mendukung pembelajaran perkalian yang konkret, interaktif, dan bermakna pada pembelajaran matematika dasar.

Kata Kunci: Kalkulator LEGO; Model ADDIE; Research and Development; Media Manipulatif; Konsep Perkalian

PENDAHULUAN

Mathematics learning in Madrasah Ibtidaiyah plays an important role in developing students' logical, systematic, critical, and creative thinking skills from an early age. One of the fundamental abilities that students need to master is conceptual understanding of arithmetic operations, as this concept serves as a foundation for learning mathematics at higher levels. When students' basic understanding of arithmetic operations is not well established, they may experience difficulties in learning more complex mathematical topics. Therefore, mathematics learning at the elementary level should not merely focus on obtaining final answers, but should also emphasize thinking processes, representation, and meaningful conceptual understanding (Siregar, 2019; Wandini et al., 2023).

Conceptual understanding in mathematics learning helps students understand the meaning of an operation, rather than merely memorizing formulas or problem-solving procedures. In multiplication, for example, students need to understand that multiplication represents repeated addition, grouped quantities, and concrete representations of numbers. However, in classroom practice, students are often directed to memorize multiplication facts without understanding how the results are formed. This condition makes mathematics learning mechanical and provides limited opportunities for students to construct conceptual understanding independently (Lubis & Rahmadhani, 2023).

Conceptually, mathematics learning for elementary school students needs to be aligned with their cognitive development characteristics, which still require the support of concrete objects. Abstract mathematical concepts need to be visualized through learning media that can be seen, touched, arranged, and directly manipulated. In this context, manipulative media serve as a bridge between concrete experiences, visual

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representations, and mathematical symbols. Through activities involving arranging and counting concrete objects, students can connect the concept of multiplication with repeated addition, grouped quantities, and operation results in a more meaningful way. The use of learning media is also in line with the demands of 21st-century learning, which emphasizes student engagement, creativity, collaboration, and active participation in the learning process (Albina et al., 2022; Anas & Hartono, 2024).

From the perspective of Islamic education, the delivery of knowledge should also be carried out wisely, clearly, and in accordance with students' needs. This principle is consistent with the value of learning that emphasizes the importance of using appropriate strategies and tools so that educational messages can be well received by students. In this context, the use of learning media can be understood as a pedagogical effort to create a learning process that is easier to understand, enjoyable, and suitable for students' conditions. Thus, learning media do not only function as technical aids, but also serve as a means of creating more effective, humanistic, and meaningful learning (Mardianto et al., 2022; Nasution, 2017).

The factual condition in grade III at MI Plus Ar-Ridha shows that some students still experience difficulties in understanding arithmetic concepts, particularly multiplication. Based on preliminary observations, students tended to memorize multiplication results without understanding the relationship between numbers, the number of groups, and the total result. In addition, learning was still largely conducted through teacher explanations and practice questions, so students were less actively involved in constructing conceptual understanding. This condition was reinforced by the pretest result, with an average score of 58.1, indicating that students' initial understanding of multiplication concepts still needed to be strengthened through more concrete, visual, and interactive learning. This situation shows a gap between the need for manipulative and concrete mathematics learning and classroom practices that still tend to be conventional (Rambe, 2023).

Several previous studies have shown that the use of innovative learning models and media can help increase students' engagement and mathematics learning outcomes. Digital media, certain learning models, and various learning strategies have been proven to make students more active and interested in the learning process (Dermawan & Ramadhan, 2024; Rukono et al., 2025). However, some studies still focus on digital media, learning models, or general manipulative media that mainly function as counting aids. The development of concrete media based on constructive play that is specifically designed to visualize multiplication concepts through rows, columns, and grouped quantities remains relatively limited, particularly in the context of mathematics learning in Madrasah Ibtidaiyah. In fact, elementary school students more easily understand abstract concepts when learning involves concrete objects and directly observable manipulative activities (Daniyati et al., 2025; Maysarah, 2017).

The LEGO Calculator was developed as an alternative manipulative medium that does not merely function as a counting aid, but also as a medium for representing multiplication concepts. This medium uses LEGO blocks to represent numbers through

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vertical and horizontal arrangements, allowing students to see the relationship between repeated addition, grouped quantities, and multiplication symbols. Unlike common manipulative media that generally only help students obtain calculation results, the LEGO Calculator integrates constructive play, block-arranging activities, concept visualization, collaborative learning, and Wordwall-based interactive questions. In this way, students are not only directed to find multiplication results, but also to understand the process through which those results are formed through concrete and visual experiences (Risqi & Siregar, 2023).

Based on the explanation above, this study aims to develop LEGO Calculator learning media based on the ADDIE model and examine its feasibility, practicality, and support for third-grade students' conceptual understanding of multiplication at MI Plus Ar-Ridha within a limited trial context. This study employed a Research and Development (R&D) method using the ADDIE model, which includes the stages of analysis, design, development, implementation, and evaluation. The novelty of this study lies in the development of the LEGO Calculator as a manipulative medium that connects concrete activities, visual representation, group interaction, interactive questions, and mathematical symbols in one learning sequence. This study is expected to contribute to the development of mathematics learning media in Madrasah Ibtidaiyah and serve as an alternative for teachers in providing multiplication learning that is more concrete, interactive, collaborative, and meaningful.

METHOD

Research Design and Participants

This study used the Research and Development (R&D) method, which aims to develop LEGO Calculator learning media and examine its feasibility, practicality, and support for students' conceptual understanding of multiplication within a limited trial context. The development method was chosen because this study did not only focus on theory testing, but also on the process of designing, developing, validating, revising, implementing, and evaluating an educational product that can be directly applied in learning activities (Sugiyono, 2017).

The development model used in this study was the ADDIE model, which consists of five stages: analysis, design, development, implementation, and evaluation. The ADDIE model was selected because it provides systematic and structured stages that help researchers design, develop, implement, and evaluate learning media gradually and continuously (Branch, 2009). The stages of the ADDIE development model in this study are presented in Figure 1.

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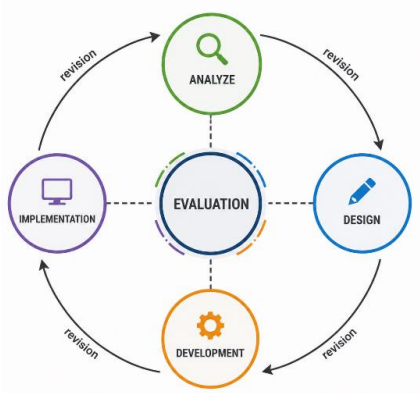

Figure 1. Stages of the ADDIE Development Model

The study was conducted at MI Plus Ar-Ridha, Medan Marelan, North Sumatra. The research subjects were all 21 third-grade students. The sampling technique used was total sampling because the entire class population was involved as the product trial subjects. In addition to the students, this study also involved a classroom teacher and two expert validators. The expert validators consisted of a material expert with competence in elementary mathematics learning and a media expert with competence in learning media development. The involvement of validators aimed to assess content feasibility, language, appearance, function, and media suitability before the media was used in learning. The classroom teacher was involved in providing responses regarding the practicality of the media after product implementation (Molenda, 2015).

Instruments and Data Collection Procedures

The instruments used in this study included observation sheets, interview guidelines, expert validation sheets, teacher and student response questionnaires, and conceptual understanding tests in the form of pretest and posttest. Observation sheets were used to obtain initial data regarding the mathematics learning process and students' difficulties in understanding multiplication operations. Interview guidelines were used to gather information from the teacher regarding the need for learning media that suited students' characteristics. Expert validation sheets were used to obtain feasibility assessments of the media in terms of content, language, appearance, function, and alignment with learning objectives. Teacher and student response questionnaires were used to determine the practicality of the media after it was used in learning. The pretest and posttest were used to examine changes in students' conceptual understanding of multiplication before and after using the LEGO Calculator media (Arikunto, 2022; Murdiyanto, 2020).

Before being used in the study, the instruments were first reviewed through expert judgment. This process was carried out to ensure that the instrument items were aligned with the research objectives, indicators of conceptual understanding of

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multiplication, the characteristics of third-grade students, and the needs of learning media assessment. The validation sheets, response questionnaires, and pretest-posttest items were reviewed in terms of content suitability, language clarity, readability, and indicator alignment. Feedback from the validators was used to revise the wording of instrument items, clarify instructions, and adjust the test items to the students' ability level. Thus, the validity of the instruments in this study emphasized content validity through expert review before the instruments were used at the implementation stage.

The research procedure followed the five stages of the ADDIE model. First, the analysis stage was carried out through classroom observation and interviews with the teacher to identify learning needs, students' characteristics, and students' difficulties in understanding multiplication concepts. Second, the design stage was conducted by formulating learning objectives, designing the structure of the LEGO Calculator media, preparing the media-use scenario, and developing research instruments consisting of validation sheets, response questionnaires, and pretest-posttest items. Third, the development stage was conducted by creating a media prototype based on the design. The developed product was then validated by the material expert and the media expert. Product revision was carried out based on validator feedback, particularly on the aspects of media appearance, clarity of usage instructions, suitability of questions, media function, and the connection between the media and multiplication concepts. Fourth, the implementation stage was conducted through a limited trial involving 21 third-grade students at MI Plus Ar-Ridha to obtain teacher and student responses and examine changes in students' conceptual understanding after using the media. Fifth, the evaluation stage was conducted formatively and summatively. Formative evaluation was carried out through validator feedback during the development stage, while summative evaluation was conducted through the analysis of validation results, response questionnaires, pretest, and posttest.

Data Analysis Techniques and Ethical Considerations

Data analysis in this study was conducted to assess three main aspects of the LEGO Calculator learning media: feasibility, practicality, and its support for students' conceptual understanding of multiplication. Each aspect was analyzed using descriptive quantitative techniques with formulas and interpretations adjusted to the standards of educational development research (Okpatrioka, 2023). In addition, qualitative data from observations and interviews were analyzed descriptively through the stages of data reduction, data presentation, and conclusion drawing to strengthen the interpretation of quantitative results.

Media feasibility analysis was conducted based on the validation results from the material expert and the media expert. Each assessment item used a 1–5 Likert scale, and the results were calculated using the following mean formula:

$$\bar{X} = \frac{\sum X_i}{n}$$

Description:

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$\bar{X}$ = overall mean score
X_i = score from each validator
n = number of assessment items

The mean score was then converted into feasibility categories as shown in Table 1.

Table 1. Media Feasibility Categories

Mean Score Interval	Feasibility Category
4,20 - 5,00	Highly Feasible
3,40 - 4,19	Feasible
2,60 - 3,39	Moderately Feasible
1,80 - 2,59	Less Feasible
1,00 - 1,79	Not Feasible

This interpretation was adapted from guidelines for educational media validation analysis. Media practicality analysis was conducted based on the teacher and student response questionnaires after the media was used. The score obtained from each statement item was calculated using the following percentage formula:

$$P = \frac{\sum X}{X_{max}} \times 100\%$$

Description:
P = practicality percentage
X = total score obtained
X_{max} = maximum score

Kriteria interpretasi kepraktisan media ditunjukkan pada Tabel 2.

Table 2. Media Practicality Categories

Percentage	Practicality Category
85%–100%	Highly Practical
70%–84%	Practical
55%–69%	Moderately Practical
40%–54%	Less Practical
< 40%	Not Practical

The analysis of students' conceptual understanding was conducted by comparing the pretest and posttest results using the Normalized Gain (N-Gain) formula. The formula used is as follows:

$$g = \frac{(S_{Post} - S_{pre})}{(S_{max} - S_{pre})}$$

Description:
g = *N-Gain score*
S_{post} = average posttest score
S_{pre} = average pretest score
S_{max} = maximum score

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The interpretation of N-Gain scores is presented in Table 3.

Table 3. N-Gain Improvement Categories

N-Gain Score	Improvement Category
(g \geq 0,70)	High
(0,30 \leq g < 0,70)	Moderate
(g < 0,30)	Low

The N-Gain score was used to examine indications of improvement in students' conceptual understanding after using the LEGO Calculator media within a limited trial context. This analysis provides a quantitative description of changes in students' conceptual ability before and after learning with the LEGO Calculator media. Since this study did not use a comparison group, the N-Gain results were not interpreted as broadly applicable causal evidence, but rather as an indication that the LEGO Calculator media has the potential to support students' conceptual understanding of multiplication.

This study also considered ethical aspects in its implementation. Data collection was conducted after obtaining permission from the school. Students' identities were kept confidential, and the data obtained were used only for research purposes. All students had the same opportunity to use the LEGO Calculator media during the learning process, and the research activities were conducted without causing harm to the participants.

RESULTS AND DISCUSSION

Result

This study produced LEGO Calculator learning media developed through the ADDIE model, namely analysis, design, development, implementation, and evaluation. The ADDIE model was used because it provides systematic stages in developing learning products, starting from needs identification, product design, media development, limited trials, and evaluation of feasibility, practicality, and media support for students' conceptual understanding. The LEGO Calculator media was developed to help third-grade students at MI Plus Ar-Ridha understand multiplication operations through concrete activities involving the arrangement and counting of LEGO blocks.

At the analysis stage, the results of observation and interviews showed that some students still experienced difficulties in understanding multiplication concepts conceptually. Students tended to memorize multiplication results without understanding the process through which the results were formed. Learning was also still dominated by teacher explanations and practice questions, so students were less active in constructing conceptual understanding. This condition was reinforced by the students' average pretest score of 58.1, indicating that their initial understanding of multiplication concepts still needed to be strengthened through more concrete, visual, and manipulative learning. These findings indicate the need for learning media that are appropriate to the characteristics of elementary school students, especially because

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abstract mathematical concepts are easier to understand through real objects and manipulative activities (Daniyati et al., 2025; Lubis & Rahmadhani, 2023).

At the design stage, the media was designed in the form of a game board combined with LEGO blocks, a storage box, and the Wordwall application as a support for interactive learning. Each LEGO block was assigned a value of one, regardless of its color or size. Students arranged the blocks vertically to represent the first number and horizontally to represent the second number. After the blocks formed a certain arrangement pattern, students counted the total number of blocks to obtain the multiplication result. This design was created so that students could understand multiplication as repeated addition and grouped quantities directly.

At the development stage, the media design was realized into a tangible product consisting of a LEGO Calculator game board, LEGO blocks, a storage box, and Wordwall-based learning support tools. The media was made using a large LEGO board mounted on a frame to make it stronger and easier to use. LEGO blocks in several colors were used as visual aids, but all blocks still had the same value, namely one. The initial product was then validated by media and material experts to assess aspects of appearance, media function, material suitability, clarity of usage instructions, and the connection between the media and multiplication learning objectives. The developed LEGO Calculator media can be seen in Figure 2, Figure 3, Figure 4, and Figure 5.

Figure 2. Storage Box for the LEGO Calculator Media

The storage box was used to store all media components so that they were neater, safer, and easier to move when used in learning.

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Figure 3. Game Board of the LEGO Calculator Media

The game board functioned as a base for arranging LEGO blocks to form multiplication operation patterns according to the given questions.

Figure 4. LEGO Blocks with a Value of One

Each LEGO block had a value of one, regardless of color or size, making it easier for students to understand the concept of quantity in multiplication operations.

Figure 5. Example of Multiplication Results Using the LEGO Calculator Media

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Figure 5 shows an example of using the media in a multiplication operation. Blocks arranged vertically represent the first number, while blocks arranged horizontally represent the second number. The total number of blocks shows the multiplication result.

At the implementation stage, the media was tested in a limited trial involving 21 third-grade students at MI Plus Ar-Ridha. Students were divided into three groups, each consisting of seven students. Each group used one set of LEGO Calculator media to solve multiplication questions displayed through the Wordwall application. During the learning process, students arranged blocks according to the numbers in the questions, counted the number of blocks, compared the block arrangements, and discussed their answers with group members. This activity showed that the media was not only used as a counting aid, but also as a means to encourage students' engagement in understanding the process through which multiplication results are formed.

Teacher and student responses during the trial showed that the LEGO Calculator media was easy to use and attractive in learning. The teacher stated that this media helped explain multiplication concepts more concretely because students could see the relationship between numbers, groups, and the total number of blocks. Students also appeared more enthusiastic because learning was carried out through block-arranging activities and interactive questions through Wordwall. Thus, the use of the LEGO Calculator media indicated that this medium has the potential to be applied in multiplication learning that requires concrete, visual, and collaborative learning experiences.

At the evaluation stage, assessment was conducted through formative and summative evaluation. Formative evaluation was carried out based on feedback from media and material experts to improve the appearance, function, usage instructions, and content suitability of the media before it was used in learning. Summative evaluation was conducted through feasibility testing, practicality testing, and analysis of changes in students' conceptual understanding after using the media. The pretest and posttest results showed an increase in students' scores after learning with the LEGO Calculator. However, because this study was conducted in one group without a comparison group, the increase was not interpreted as broadly applicable causal evidence, but rather as an indication that the LEGO Calculator media has the potential to support students' conceptual understanding of multiplication in a limited trial context. The validation results are presented in Table 4.

Tabel 4. Hasil Validasi Kelayakan Media

No	Validator	Total Score	Mean Score	Category
1	Media Expert	98	4,6	Highly Feasible
2	Material Expert	95	4,5	Highly Feasible
	Overall Mean	193	4,55	Highly Feasible

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Based on the validation results, the strengths of the LEGO Calculator media lie in its suitability for third-grade students' characteristics, its ease in visualizing multiplication concepts, and the function of LEGO blocks as concrete representations of repeated addition and grouped quantities. From the media aspect, the appearance of the game board and the use of LEGO blocks were considered attractive and supportive of student engagement in learning. From the material aspect, the media was considered aligned with the learning objectives of multiplication operations because it helped students understand the relationship between numbers, groups, and multiplication results. The aspects that still needed improvement based on validator feedback included the clarity of usage instructions, neater arrangement of media components, and adjustment of questions to suit the ability level of third-grade students. This feedback was used as the basis for revision before the media was implemented in the limited trial.

Media practicality was measured through teacher and student response questionnaires after the media was used. The results of the practicality test are presented in Table 5.

Table 5. Media Practicality Results Based on Teacher and Student Responses

No	Respondent	Score Obtained	Maximum Score	Percentage	Category
1	Teacher	69	75	92%	Highly Practical
2	Student	950	1050	90,4%	Highly Practical
	Overall Mean	1019	1125	91,2%	Highly Practical

Based on Table 5, the LEGO Calculator media obtained a practicality percentage of 92% from the teacher response and 90.4% from student responses. The overall mean reached 91.2%, placing the media in the highly practical category. These results indicate that the media was easy to use, attractive to students, and able to help the teacher explain multiplication concepts more concretely.

Media effectiveness was measured by comparing pretest and posttest scores. Learning improvement was analyzed using N-Gain, with the high category indicated by (g \geq 0.70) (Hake, 1998). The results of the effectiveness test are presented in Table 6.

Table 6. Students' Pretest, Posttest, and N-Gain Results

No	Number of Students	Mean Pretest Score	Mean Posttest Score	Mean N-Gain	Category
1	21 Student	58,1	89,5	0,8	High

Based on Table 6, the students' mean pretest score of 58.1 increased to 89.5 in the posttest. The mean N-Gain score of 0.8 was in the high category. These results indicate an improvement in students' conceptual understanding of multiplication operations after using the LEGO Calculator media in a limited trial context. Overall, the

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developed media fulfilled the three main criteria of development research: highly feasible, highly practical, and potentially supportive of students' conceptual understanding of multiplication.

Discussion

The results of this study show that the LEGO Calculator media has good quality in terms of feasibility, practicality, and its support for students' conceptual understanding of multiplication. This finding does not only indicate that the developed media can be used in learning, but also highlights the importance of designing manipulative media that can connect concrete activities, visual representations, social interaction, and mathematical symbols. In elementary mathematics learning, students' difficulties in understanding multiplication cannot be sufficiently addressed only through practice questions and memorization of multiplication facts. Instead, students need learning experiences that allow them to see how multiplication results are formed. Therefore, the LEGO Calculator is important because it presents multiplication as an activity that can be observed, touched, arranged, and counted directly (Anas & Hartono, 2024).

The highly feasible category obtained by the media indicates that the LEGO Calculator has met pedagogical, visual, technical, and material suitability needs. However, the meaning of feasibility in this study does not only lie in the validation score, but also in the suitability between the media design and the characteristics of the concept being taught. Multiplication is a concept that requires an understanding of repetition, grouping, and the relationship between numbers. The design of the LEGO Calculator enables students to transform this concept into vertical and horizontal block arrangements. Thus, this media does not merely function as a counting aid, but also as a representational tool that helps students connect multiplication operations with concrete quantity structures (Mardianto et al., 2022).

The suitability of the LEGO Calculator media with the characteristics of elementary school students can be explained through cognitive development theory. Students at the Madrasah Ibtidaiyah level generally still need concrete objects to understand abstract mathematical concepts. When students arrange LEGO blocks to represent the first and second numbers, they do not immediately deal with mathematical symbols, but first experience the process of concept formation through real objects. This is in line with Piaget's view that elementary school-age children are in the concrete operational stage, a stage in which understanding is more easily built through real objects and direct experience (Piaget, 1972). This finding also strengthens previous research showing that the use of LEGO in mathematics learning can help students understand concepts through concrete experiences that are appropriate to children's cognitive development (Amreta, 2022).

From the perspective of representation theory, the main contribution of the LEGO Calculator lies in its ability to facilitate the transition from enactive experience to iconic and symbolic representation. The enactive stage appears when students hold,

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arrange, and count the blocks directly. The iconic stage appears when students see the block arrangement as a visual pattern of multiplication. The symbolic stage occurs when students connect the pattern with mathematical operations, such as $7 \times 6 = 42$. This gradual process is important because students do not only know the final answer, but also understand the relationship between concrete actions, visual arrangements, and mathematical symbols. Thus, the LEGO Calculator provides a conceptual contribution to multiplication learning because it helps students construct the meaning of operations gradually, rather than merely memorizing multiplication results (Bruner, 1966).

In terms of practicality, positive responses from teachers and students show that the LEGO Calculator media is easy to use and suitable for classroom learning situations. However, practicality in this study should be understood more broadly than merely ease of use. Practical media are media that can help teachers explain concepts more simply, encourage students' active involvement, and create learning activities that can be carried out collaboratively. The activity of arranging and counting blocks enables students not only to receive information, but also to become active participants in the learning process. This strengthens the view that game-based media can increase students' motivation, attention, and involvement in mathematics learning (Jadidah & Baalwi, 2025; Rejeki, 2017).

The practicality of the media is also related to the social dimension of learning. When students work in groups, they discuss with one another, compare block arrangements, count the results, and present their answers. This interaction provides opportunities for students to build understanding through peer assistance and teacher guidance. From the perspective of social constructivism, learning does not only occur individually, but also through social interaction that functions as scaffolding. Therefore, the use of the LEGO Calculator does not only support conceptual understanding cognitively, but also strengthens students' communication skills, cooperation, and confidence in presenting their learning outcomes (Vygotsky, 1978).

The increase in the mean pretest score from 58.1 to 89.5 in the posttest, with an N-Gain score of 0.8, indicates an improvement in conceptual understanding after using the LEGO Calculator media. However, this finding should be interpreted carefully because the study was conducted in a limited trial and did not involve a control group. This means that the increase indicates that the LEGO Calculator has the potential to support conceptual understanding of multiplication in the class studied, but it cannot be used as a basis for concluding that the improvement was entirely caused by the media. Therefore, the N-Gain result in this study is more appropriately understood as initial evidence that the media has positive pedagogical potential in helping students understand multiplication concepts concretely.

The LEGO Calculator media is also relevant to the Realistic Mathematics Education approach because it presents mathematics learning through real experiences that are close to children's world. LEGO, as an object associated with play, makes it easier for students to enter the learning situation because the media feels familiar to them. Through block arrangement, students can understand that mathematics is not

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merely about numbers and symbols in textbooks, but can also be found through real activities. In this context, the LEGO Calculator helps bridge play experiences and formal learning, making mathematics more contextual, enjoyable, and meaningful (Freudenthal, 2002; Risqi & Siregar, 2023).

The findings of this study strengthen several previous studies showing that learning media innovation can support students' engagement and mathematics learning outcomes. Digital media and innovative learning models have been proven to increase student engagement, but concrete media still play an important role because they align with the needs of lower-grade students who still require manipulative activities (Dermawan & Ramadhan, 2024; Rukono et al., 2025). In this context, the LEGO Calculator has uniqueness because it combines manipulative media based on constructive play with Wordwall as a trigger for interactive questions. This combination creates two layers of learning experience: concrete experience through block arrangement and interactive experience through digital questions.

This finding also supports the importance of manipulative media in elementary mathematics learning. The use of manipulative media has been shown to help students understand abstract mathematical concepts through concrete, visual, and direct activities, including in understanding number operations (Al Ayyubi et al., 2025; Carbonneau et al., 2013). In addition, the use of Wordwall as interactive supporting media is also relevant to the need for more engaging and less monotonous mathematics learning. Wordwall can increase learning motivation, active participation, and help strengthen conceptual understanding of mathematics through quiz activities and educational games (Dewi et al., 2025; Fitriani & Irawati, 2025). Thus, the integration of LEGO and Wordwall in this study can be understood as a simple hybrid media development that combines concrete manipulation and digital interaction in elementary mathematics learning.

Theoretically, this study contributes to the development of the idea that students' conceptual understanding of multiplication in elementary school can be built through three main pathways: concrete object manipulation, visualization of number structures, and social interaction in learning. The LEGO Calculator shows that manipulative media become more meaningful when they are not only used for counting, but are also designed to show the structure of mathematical concepts. In this study, vertical and horizontal block arrangements serve as a bridge between repeated addition, number grouping, and multiplication symbols. Thus, this study strengthens the idea that mathematics learning for elementary school students needs to involve concrete, visual, collaborative, and contextual activities so that students do not only master procedures, but also understand the meaning of concepts (Wandini et al., 2023).

Practically, the LEGO Calculator media can serve as an alternative for Madrasah Ibtidaiyah teachers in teaching multiplication in a more active and enjoyable way. This media is relatively easy to use because its components are simple, reusable, and can be developed according to learning needs. Teachers can use this media to guide students in understanding multiplication as repeated addition, arranging number groups, and

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connecting block arrangements with mathematical operation symbols. In addition, integration with Wordwall provides variation in question presentation, so learning is not only teacher-centered but also gives students opportunities to practice, discuss, and solve problems collaboratively.

Nevertheless, this study has several limitations that need to be considered. First, the media trial was only conducted in one class with 21 students, so the results cannot be widely generalized to all Madrasah Ibtidaiyah contexts. Second, this study did not use a control group, so the increase in pretest and posttest scores cannot be fully claimed as a direct result of the use of the LEGO Calculator media. Third, the material tested was limited to multiplication operations, so the media's support for other topics, such as division, column addition, or column subtraction, cannot yet be confirmed. Fourth, the use of the media in group activities still requires time management and teacher guidance so that all students can be involved equally.

These limitations have important implications for future research. Future studies need to test the LEGO Calculator media with a larger number of subjects, in different schools, and using research designs that involve comparison groups so that the effect of the media can be analyzed more strongly. In addition, the development of this media can be expanded to other arithmetic operation topics to determine its flexibility in elementary mathematics learning. Further research also needs to develop more detailed guidelines for using the media so that teachers can apply the LEGO Calculator more effectively and consistently in the classroom.

CONCLUSION

The development of the LEGO Calculator learning media for multiplication operations among third-grade students at MI Plus Ar-Ridha produced media that were highly feasible, highly practical, and showed potential in supporting students' conceptual understanding of multiplication within a limited trial context. This media was developed through the ADDIE stages, namely analysis, design, development, implementation, and evaluation. The validation results showed that the media obtained an average score of 4.6 from the media expert and 4.5 from the material expert, both of which were categorized as highly feasible. The practicality test obtained 92% from the teacher response and 90.4% from student responses, indicating that the media was categorized as highly practical. The pretest and posttest results showed an improvement in students' conceptual understanding, with the average pretest score increasing from 58.1 to 89.5 in the posttest and an N-Gain score of 0.8 in the high category. These findings indicate that the LEGO Calculator media can support concrete, interactive, and enjoyable multiplication learning through activities involving arranging and counting LEGO blocks. However, these results should be understood within the scope of a limited trial conducted in one class without a comparison group, so they cannot yet be widely generalized. Future research is recommended to test this media with a larger number of subjects, in different schools, and using research designs involving comparison groups, as well as to develop its use for other arithmetic operation topics.

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