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Transforming Mathematics Learning: An Android-Based Interactive Approach to Enhance Third-Grade Students' Problem-Solving Skills

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Abstract

This research is motivated by the low problem-solving ability of third grade madrasah ibtidaiyah students. To overcome this, interactive learning media based on Android was developed to improve mathematical problem-solving abilities at madrasah ibtidaiyah. The purpose of this study was to produce valid, practical, and effective learning media. The method used was the ADDIE development model with a one-group pretest-posttest design. Data were collected through validation sheets, tests, and practicality questionnaires, with 18 Islamic elementary school students as subjects. The results of the media expert validation were 90.9%, and the material expert's were 97.3%, both of which were very feasible. The student's N-Gain score of 0.5069 was in the moderate category, indicating an increase in ability. The practicality of the media was assessed by 80% of teachers and 93.1% of students, categorized as very practical. The conclusion of this study is that interactive media based on Android is declared valid, practical, and effective and has the potential to support mathematics learning in elementary schools.

Keywords: *: Interactive Learning Media, Mathematical Problem-Solving Ability, Madrasah Ibtidaiyah.*

INTRODUCTION

Mathematics as a core subject has a strategic position in the education system because it contributes directly to the development of students' intellectual capacity, especially in forming logical, critical, and systematic thought patterns (Hanifah et al., 2019; Arifuddin et al., 2022). This kind of thinking ability is not only relevant in the context of learning in schools, but also in everyday life that requires analysis and problem solving (Farhana, et.al, 2022; Azizia et al., 2023). Therefore, mathematics is not merely considered as a collection of calculation procedures, but as a means of forming reasoning and thought structures. With its abstract and deductive nature, mathematics requires a learning approach that takes into account the stages of students' cognitive development. If the mathematics learning process is not adjusted to the students'

thinking capacity, then the material presented tends to be a confusing mental burden rather than a meaningful thinking aid (Boaler, 2022). This further emphasizes that the design of mathematics learning must be contextual, applicable, and student-centered (Arifuddin, 2017).

The emerging phenomenon in the mathematical learning in elementary school shows that students' ability to understand mathematical concepts is still at a concerning level, especially in the realm of division operations (Yorulmaz & Dogan, 2022; Shih et al., 2023). Division operations are one of the basic competencies that have a fundamental role in understanding advanced materials such as fractions, decimals, and algebra (Copur-Gencturk, 2021). Students' weaknesses in understanding division from an early age will cause a domino effect in the form of difficulty in absorbing more complex materials at higher levels of education (Siregar, 2017). Understanding division is not just a mechanical skill, but concerns the mastery of concepts that can be applied in various contexts. Therefore, failure to understand this concept at an early stage of education will be a continuous conceptual obstacle, which can reduce students' motivation and self-confidence in learning mathematics as a whole (Hariyani et al., 2022; Wardani, et. al., 2021).

The problem of students' low mastery of division operations cannot be entirely attributed to the complexity of the material alone, but is also closely related to the teaching approach and methods used by teachers (Hariyani et al., 2022). Many teachers still rely on conventional methods such as lectures and giving repetitive exercises without any concrete efforts to visualize the concept. This mechanistic and minimally contextualized approach often positions students as passive objects, so that the potential for critical thinking and deep understanding is not optimally developed. As a result, students are only able to solve problems with the same pattern without understanding the meaning behind the procedure (Sachdeva & Eggen, 2021). This condition creates misconceptions that are difficult to correct at the next stage and strengthens students' resistance to mathematics lessons (Ginanjar, et.al., 2019).

In response to the weaknesses of the conventional approach, various contemporary studies underline the importance of integrating digital technology-based learning media into the mathematics learning process. Educational technology allows teachers to present materials in a more dynamic, visual, and interactive way, which ultimately increases student engagement in the learning process. The use of interactive learning media, such as animated videos and Android-based applications, can stimulate students' interest in learning and help them build mental representations of abstract

mathematical concepts (Novita et al., 2024; Umar et al., 2025). In addition, digital media allows students to learn at their own pace and explore concepts through easy-to-understand simulations and visual narratives. This strategy has proven effective in encouraging students' cognitive and affective engagement in learning (Sutarti, et.al., 2020).

One of the significant advantages of using technology-based interactive learning media is its ability to foster high-level thinking skills, such as problem-solving skills (Pratama, 2025; Rino et al., 2023). Interactive media not only presents information, but also encourages active student participation through exploratory and reflective activities. Thus, students are not only recipients of information, but also active actors in the learning process. Harahap et al. (2021) emphasized that this kind of media facilitates the development of reasoning and the ability to conclude information independently, because students are involved in a thinking process that requires observation, inference, and evaluation of the information presented. Concepts learned through visualization and interactive activities will be easier to understand and remember, because they involve a more holistic learning experience (Harahap, et.al., 2021).

Despite research highlighting the efficacy of interactive media in mathematics education, a gap persists in its practical implementation within elementary schools, particularly in regions with limited technological infrastructure. Observations indicate that teachers often rely on traditional methods for abstract concepts like division, neglecting students' visual learning needs. This underscores the necessity for developing technology-based learning media tailored to local conditions and student characteristics, aiming to boost learning effectiveness and mitigate the digital divide. This research focuses on creating Android-based interactive animated videos that teach division through a sequential story problem approach. This approach aims to deliver division concepts visually, narratively, and interactively, capitalizing on elementary students' preference for story-based and contextual learning. The integration of narrative, animation, and interactive elements within an Android platform is designed to create enjoyable and cognitively stimulating learning experiences, enhancing students' understanding of division and their logical problem-solving abilities.

METHODS

This research is included in the type of research and development or Research and Development (R&D) which has a high urgency to be implemented, especially in the context of low mathematical problem-solving abilities in elementary school students, especially in the material of division operations. The development model used in this

study is the ADDIE model which consists of five systematic stages, namely Analysis, Design, Development, Implementation, and Evaluation. This model was developed by Dick and Carey and has been widely used in the development of learning products because it is considered effective in designing structured learning solutions that can be implemented efficiently (Hamzah, 2020).

The Analysis stage is carried out to identify the needs of students and teachers and to examine the characteristics of the learning context, including obstacles in understanding the concept of division. Furthermore, at the Design stage, planning is carried out for the media to be developed, including the preparation of storyboards, sequential story problem scenarios, and the structure of the Android application interface. The Development stage includes the media production process, including animation creation, narrative integration, and interactive feature development. After the media is developed, the Implementation stage is carried out by testing the media on grade III students of MI Islamiyah Negla to obtain initial data on the effectiveness of its use. Finally, at the Evaluation stage, an assessment is made of the quality of the media in terms of the appropriateness of the content, visual appearance, interactivity, and its impact on students' problem-solving abilities.

The population in this study included all 18 students of grade III of MI Islamiyah Negla, West Java. The entire population was sampled because the number was relatively small and allowed for comprehensive intervention in the implementation process of learning media. This full sampling was carried out to obtain a comprehensive picture of the effectiveness of Android-based interactive video media on improving mathematical problem-solving skills in division material. This approach also provides an opportunity to observe the impact of media directly on all students in a homogeneous environment. The research was carried out for two months, namely from April to May 2025, taking place at MI Islamiyah Negla which is located in Negla Village, Losari District, Brebes Regency, Central Java. This location was chosen based on the results of initial observations which showed the limited use of technology-based learning media in mathematics teaching and learning activities, especially in division operations. This situation provides a relevant opportunity for conducting research on the development of learning media as an intervention to improve the quality of the process and student learning outcomes.

For validity analysis, an instrument was used in the form of a Likert scale questionnaire with a score range of 1 (very poor) to 5 (very good). Validation was carried out by media experts and material experts. Validity assessment was analyzed

using the formula:

$$P = \frac{\sum x}{\sum X} \text{ x } 100\%$$

Information:

P = percentage (%)

Σx = total score from validator

ΣX = ideal score amount

Table 1. Validity Criteria

Presentation (%)	**Validity Criteria**
85 < average ≤100	Very Valid
70 < average ≤85	Valid
50< average ≤70	Less Valid
01< average ≤50	Not Valid

Source: Wati, 2022.

For the practicality analysis, a questionnaire was distributed to students and teachers. The analysis was carried out using the following formula (Zulfiana, 2023) :

$$\text{P} = \frac{Total\ Score}{Maximum\ Score\ Amount} \times 100\%$$

.

Table 2. Product Practicality Criteria

No.	**Practicality Criteria**	**Level of Practicality**
1	81% - 100%	Very Practical
2	61% - 80%	Practical
3	41% - 60 %	Quite Practical
4	21% - 40%	Not Practical
5	0% - 20%	Very Not Practical

Source: Zulfiana (2023)

Effectiveness data were obtained through pre-test and post-test. The instrument was in the form of story questions containing five indicators of problem-solving ability: understanding the problem, making a plan, implementing the plan, and checking the results. The questions had been validated and tested first on 22 students outside the main sample to determine validity, reliability, level of difficulty, and discriminatory power using SPSS 26.

The validity of the questions is determined using the product moment

correlation. The questions are said to be valid if the calculated r value is > r table (0.423). All questions are declared valid. The reliability of the questions was tested using Cronbach's Alpha, and the result was 0.725, which means it is in the high category (Fadli, et.al., 2023). The level of difficulty of the questions is calculated using the formula (Zulfiana, 2023) :

$$\text{TK} = \frac{Mean}{Max\ score}$$

The results show that all three questions are in the “easy” category (Zulfiana, 2023). The discriminatory power of the questions was analyzed through the Corrected Item-Total Correlation value, and all three were in the "good" category. To find out the difference in pretest and posttest results, a normality test (Shapiro-Wilk) is used, and a hypothesis test using the paired sample t-test if the data is normal and Wilcoxon if the data is not normal. The level of effectiveness is calculated using N-Gain with the formula:

$$\text{N-Gain} = \frac{posttest\ score - pretest\ score}{maximum\ score - pretest\ score}$$

Table 3. N-Gain Criterion

N-Gain	Improvement Criteria
G < 0,3	Low increase
0,3 ≤ G ≤ 0,7	Moderate improvement
G > 0,7	Height increase

Source: Hake in Asti, 2023.

With this method approach, researchers can comprehensively measure the validity, practicality, and effectiveness of the media developed, while also providing concrete contributions to the development of learning media that are appropriate to student characteristics and current learning needs.

RESULTS AND DISCUSSION

This study aims to develop interactive learning media based on Android in order to improve mathematical problem-solving skills in grade III students of Madrasah Ibtidaiyah. The study was conducted with a research and development (R&D) approach using the ADDIE development model consisting of five stages, namely analysis, design, development, implementation, and evaluation. The subjects of this study were 18 grade III students of Madrasah Ibtidaiyah. The instruments used included expert validation sheets, teacher and student practicality questionnaires, and pre-test and post-test

questions.

1. Analysis Stage

In February 2025, researchers conducted a series of interviews with grade III teachers at Madrasah Ibtidaiyah to explore the problems faced by students in learning mathematics, especially in problem-solving skills in division material. Teachers revealed that learning methods that were less varied and lacked innovation caused students to get bored quickly, which resulted in their low ability to solve problems. In addition, teachers also rarely used learning media and only relied on textbooks, which made the learning process less interesting and non-contextual. This statement in line with research result of Yorulmaz & Dogan (2022) and Shih et al. (2023) show that students still have difficulty in solving problems related to fractions. This is because fraction material is quite complex material (Copur-Gencturk, 2021).

2. Design Stage

In the design stage, researchers designed questions based on indicators of problem-solving abilities, such as understanding problems, designing solutions, carrying out calculations, and evaluating results. One of the questions developed was in the form of a contextual story about dividing a cake, followed by five multiple-choice questions and short answers according to the established indicators. After receiving approval from the supervising lecturer, researchers began developing interactive media using the Canva application.

The media design process includes the selection of visual elements such as backgrounds, characters, types of writing, and audio elements in the form of voice recordings and background music. All of these elements are arranged to suit the characteristics and needs of grade III students so that they can support their involvement and understanding. This stage produces an initial design as a foundation for the development of more interactive and interesting learning media.

The following is the initial design of Android-based interactive media created by the researcher:

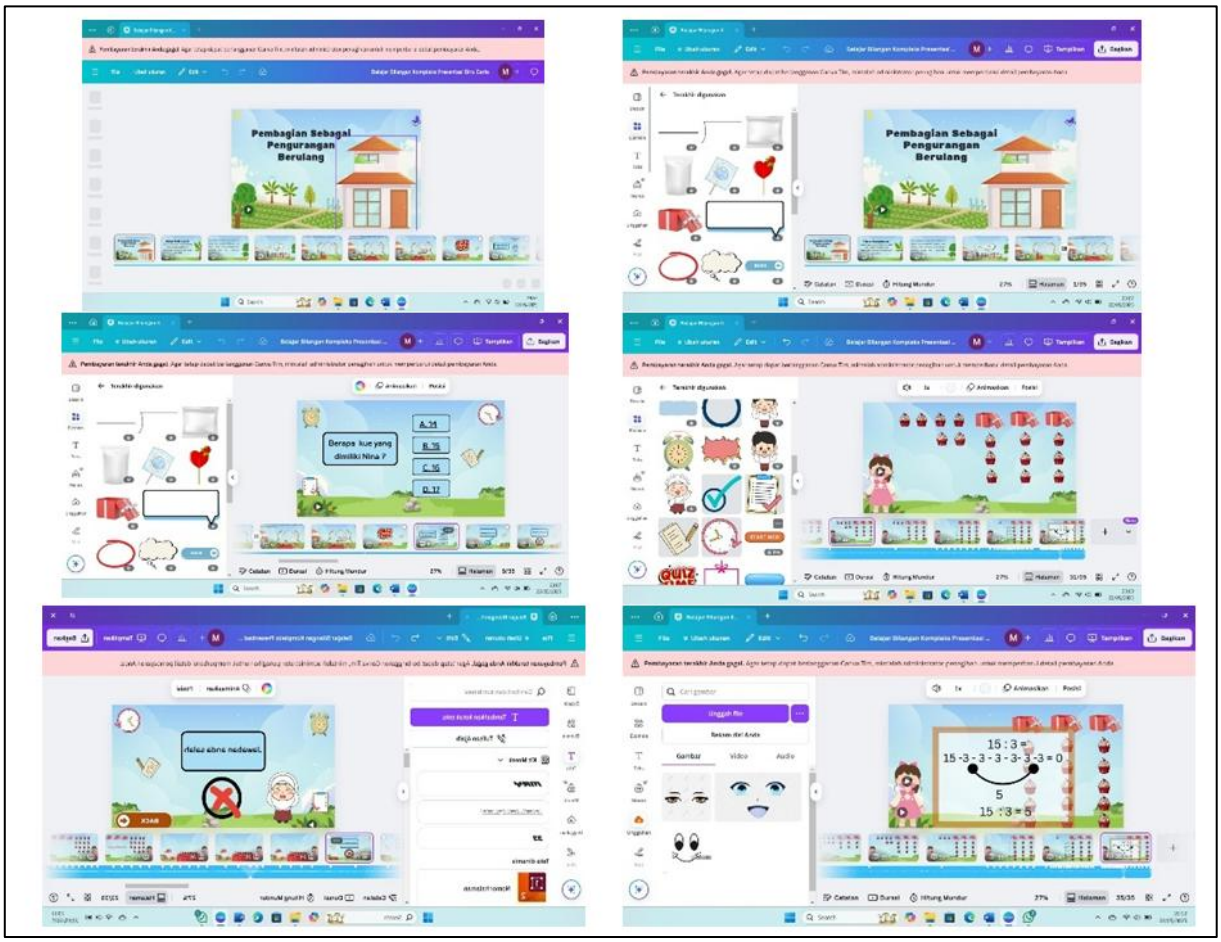


Figure 1. Android Based Interactive Media Design

3. Development Stage

In the development stage, researchers began to realize learning media based on the design results that had been prepared in the previous stage. This media was developed with the aim of supporting a more interesting, interactive learning process, and in accordance with the characteristics of students. The design process is guided by the principles of instructional design that have been established, in order to ensure integration between the content of the material and the presentation of the media.

The media creation process was carried out using the Canva application, a flexible and easy-to-use digital graphic design platform. This application is used to design visual characters, arrange the composition of graphic elements, and arrange page layouts that support understanding of the material. In addition, Canva also allows the addition of sound effects and background music to increase the interactivity and attractiveness of the resulting media.

The integration of sound and background music is one strategy to create a pleasant learning atmosphere and stimulate students' attention. The selection of audio elements is done selectively so as not to interfere with understanding, but instead strengthens the learning message conveyed through the media. Aesthetic and functional aspects are used as references in the final editing process before the media is tested.

Before the media is applied in the context of classroom learning, a validation test is carried out to ensure the quality and feasibility of the product. This validation involves two competent parties, namely media experts and material experts. Media experts are tasked with assessing aspects of visual design, navigation, and interactivity, while material experts evaluate the accuracy of the content, suitability to the curriculum, and clarity of information delivery.

Feedback from the validation process is used as a basis for revising and improving the media that has been developed. Input provided by experts becomes a reference for correcting weaknesses, increasing the effectiveness of presentation, and adjusting the media to learning needs in the field. After going through this stage, the learning media is declared ready to be implemented in the learning process in the classroom.

a. Media Expert Validation

The learning media developed in this study is an interactive Android-based video containing material on the concept of division. The material presented includes an introduction to the concept of division as repeated subtraction, division of whole numbers without remainder, and solving contextual problems that are relevant to everyday life. The purpose of developing this media is to help students understand the concept of division more concretely through attractive visualization and interaction that is easily accessible via Android devices.

Before being used in the learning process, the initial media design was consulted with experts in the field of graphic design to obtain input related to aspects of aesthetics, navigation, and effectiveness of visual presentation. In this context, validation was carried out by Mr. Onwardono Rit Riyanto, M.Pd., who acted as a media expert. The validation process used an instrument in the form of an assessment sheet that covered five main aspects, namely visual appearance, clarity of message, interactivity, design consistency, and suitability of the media to learning objectives.

Based on the validation results carried out by media experts, this Android-based interactive media obtained a feasibility score of 90.9%, which is included in the "very feasible" category with recommendations for minor improvements. The researcher then revised the media based on suggestions and input provided by the validator, such as adjusting the background color to improve text readability and improving animations to be more responsive. These improvements aim to improve the quality and effectiveness of the media before being applied in classroom learning activities.


















Dikurangi 3


Dikurangi 3 lagi

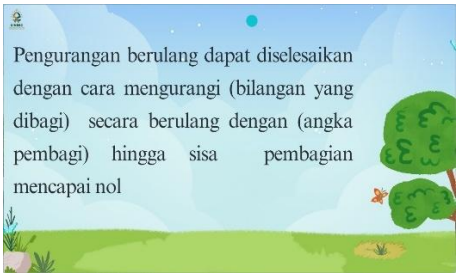

Dan dikurangi 3 lagi


Hingga tak tersisa


Ternyata kita mengurangi angka 9 dengan angka 3 secara berulang.


Itulah yang dinamakan pengurangan berulang.


Nah, setelah ini kita akan belajar tentang pengurangan berulang sebagai pembagian. Kalian siap?


Pengurangan berulang dapat diselesaikan dengan cara mengurangi (bilangan yang dibagi) secara berulang dengan (angka pembagi) hingga sisa pembagian mencapai nol


Ibu Dewi
Teman-teman
Nina


Nina dan Ibu Dewi sedang mempersiapkan pesta ulang tahun
HAPPY BIRTHDAY


Nina mempunyai 15 potong kue yang akan dibagikan kedalam 3 kotak dengan jumlah yang sama


menurut Nina, setiap kotak akan berisi 6 potong kue


QUIZ TIME
START NOW

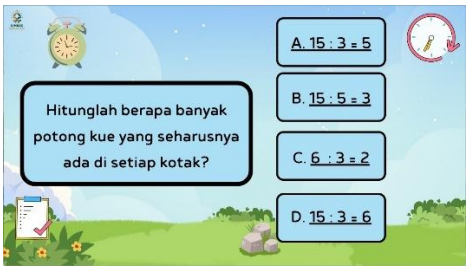

Berapa kue yang dimiliki Nina ?
A. 14
B. 15
C. 16
D. 17


Jawaban anda benar
NEXT

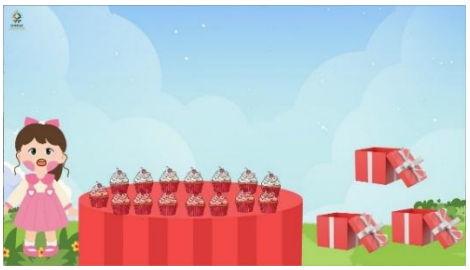

Jawaban anda salah
BACK


Ada berapa kotak yang akan di isi kue?
A. 6
B. 5
C. 4
D. 3


Menurutmu, bagaimana cara Nina menghitung jumlah kue di setiap kotak?
a. Penjumlahan
Pengurangan
Pembagian
Perkalian


Hitunglah berapa banyak potong kue yang seharusnya ada di setiap kotak?
A. 15 : 3 = 5
B. 15 : 5 = 3
C. 6 : 3 = 2
D. 15 : 3 = 6


Berdasarkan hasil perhitungan, apakah perhitungan Nina benar ?
Benar
Salah




15 kue dan 3 kotak

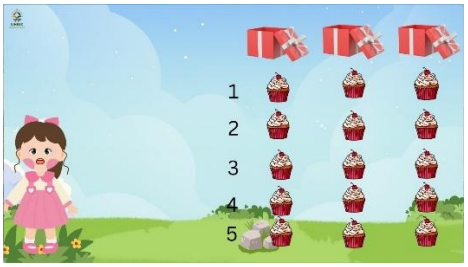




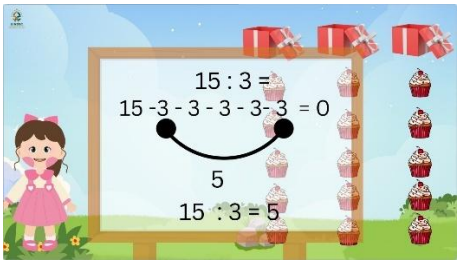


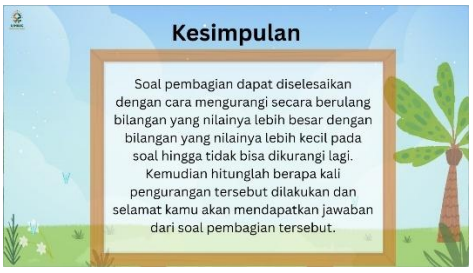





1
2
3
4
5


15


15 : 3 =
15 -3 - 3 - 3 - 3 - 3 = 0
5
15 : 3 = 5


Kesimpulan
Soal pembagian dapat diselesaikan dengan cara mengurangi secara berulang bilangan yang nilainya lebih besar dengan bilangan yang nilainya lebih kecil pada soal hingga tidak bisa dikurangi lagi. Kemudian hitunglah berapa kali pengurangan tersebut dilakukan dan selamat kamu akan mendapatkan jawaban dari soal pembagian tersebut.


Jadi bagaimana, apakah Kamu sudah paham dengan materi pembagian ini?
Sudah Paham Semua
Baru Paham Sebagian
Belum Paham Semua



Figure 2. Android-Based Interactive Video Learning Media Results

b. Research Validation by Material Experts

The design of Android-based interactive media containing repeated subtraction material, division of whole numbers without remainder, and contextual questions related to division for grade III students of Madrasah Ibtidaiyah has been reviewed by material experts. The validator in this process is Mrs. Dedeh Suhaedah, S.Ag., who assesses the feasibility of the material content by filling out a validation sheet based on five main assessment criteria. This validation is carried out to ensure the suitability of the material with the learning objectives before the media is applied in class. The results of the material expert's assessment of the Android-based interactive media were 97.3%, which was categorized as very feasible with no improvements.

At the validation stage by material experts, the criteria were obtained as very feasible. This means that the material explained in the interactive media is feasible to be delivered to students and is in accordance with the objectives to be achieved. Furthermore, the validation of media experts obtained the criteria very feasible. This means that the graphics designed in interactive media are feasible to be used in class III because of the suitability of the background, the elements used, the sound or music backson used, and the design that is appropriate for the lower grade level of elementary schools, which must integrate all their senses in learning.

Based on the assessment results from the validators, the developed product was declared very valid and feasible to use. This validity was obtained because the interactive media designed was equipped with interesting elements or illustrations so that it could increase students' attention. In addition, the elements in this interactive media greatly support the process of delivering question material to students effectively. This is based on the advantages of interactive media products, namely: presenting learning materials in an interesting and easy-

to-understand manner, increasing student involvement and motivation, allowing independent and individual-paced learning, and providing flexible access to learning materials anytime and anywhere (Susaksi, et.al., 2022; Daryanes, 2023). Interactive learning media has been widely developed, but not many teachers use it in their classes. Developing interactive learning media using special software for interactive media and e-learning, namely Lectora. This software is an authoring tool that can be easily used by every general teacher and lecturer to create interactive learning media content (Malik, et.al., 2012).

In line with the research conducted by Abidin and Rohati (2014) it was stated that the development of interactive Android-based mathematics learning instruments can increase the learning motivation of dyslexic students. The results of the study showed that the media developed was able to help dyslexic students recognize letters and numbers and increase their enthusiasm during the learning process. Thus, the learning success of dyslexic students has increased through the use of interactive media.

4. Implementation Stage

After the Android-based interactive media was declared feasible by experts, the researchers continued with a field trial on grade III students of Madrasah Ibtidaiyah. This stage began with the preparation of a Learning Implementation Plan (RPP) that refers to core competencies and basic competencies, namely KD 3.1 on the nature of whole number arithmetic operations and KD 4.1 on solving problems related to the concept. Learning objectives include understanding division as repeated subtraction, determining quotients without remainder, and solving contextual division problems.

The trial was conducted on May 22–24, 2025. The learning process began with opening activities in the form of greetings, joint prayers, attendance, and delivering motivation to students. After that, the researcher introduced the material, conducted apperception, and conveyed the learning objectives. In the core activities, the problem-based learning model was applied through three interactive media that presented problems related to division. The researcher guided students to understand the media displays, gave them the opportunity to ask questions, and encouraged them to think critically in developing problem-solving strategies. Learning was closed with a joint reflection activity to conclude the material that had been studied.

5. Evaluation Stage

Evaluation is the final stage in the ADDIE development model, which aims to assess the quality of the Android-based interactive video media that has been created. This assessment includes aspects of validity, effectiveness, and practicality to ensure that the media is truly worthy of use in the learning process. The evaluation was carried out through validation by experts, direct trials in class III of Madrasah Ibtidaiyah, and analysis of teacher and student responses collected through questionnaires as an indicator of the practicality of using the media.

a. Validity of Android-Based Interactive Media

Android-based interactive learning media has been validated by two experts, and the results show that the media is in the category of very feasible to use. The assessment from media experts obtained a score of 90.9%, while from material experts it reached 97.3%. This shows that the content of the material and the appearance of the media have met the eligibility standards to support the teaching and learning process.

b. Practicality of Android-Based Interactive Media

a) Teacher Response

Based on the results of the questionnaire filled out by the third-grade teachers of Madrasah Ibtidaiyah, this learning media obtained a practicality value of 80%, which is included in the practical category. This means that this media is easy to use, in accordance with learning needs, and can be integrated with the teacher's teaching method.

b) Student Response

The results of the questionnaire from 18 students showed that the interactive media used were very much liked and easy to understand. The practicality value obtained was 93.1%, which is classified as very practical. This indicates that students feel helped in understanding the division material and are more motivated during the learning process.

Based on the results of the teacher and student response questionnaire, the interactive media products developed meet the criteria of being very practical. This is

because the appearance of different materials, such as in textbooks or other LKS, is a pleasure for students (Umar et al., 2025). This interactive media can make it easier for students to improve their problem-solving skills in division so that there is a high curiosity in students in interactive media (Pratama, 2025; hanifah et al., 2019; Arifuddin et al., 2022).

In line with the research conducted by Arisetya Research, it shows that the development of interactive learning media based on Macromedia Flash provides similar results, namely effectively improving students' mastery of the material (Arisetya, 2016). Testing shows that the media helps students understand and analyze the material through practice questions. Its effectiveness is measured through the increase in pretest and posttest results with N-Gain analysis, which shows moderate to high results in improving concept mastery (Zairana, et.al., 2020).

CONCLUSION

A study developed an Android-based interactive video learning medium that demonstrated validity, practicality, and effectiveness in enhancing mathematical problem-solving skills for third-grade students at Madrasah Ibtidaiyah. Media experts and material experts assessed the medium as very feasible, meeting criteria for content, visual design, and student suitability. Teacher and student feedback indicated the medium's practicality, ease of use, engaging nature, and facilitation of both independent and group learning. Effectiveness was confirmed by improvements in student problem-solving abilities, evidenced by pretest/posttest score differences and moderate N-Gain values. This interactive medium serves as a valuable alternative for mathematics learning at the elementary level, particularly for abstract concepts like division, by actively engaging students in thinking and problem-solving

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