

Development of Edugame-Based 'Math Quest' Learning Media to Improve Elementary School Students' Mathematical Skills in Fractional Materials through Interactive Learning

Febrinta Bima Permata Putra, Nurita Primasatya, Kharisma Eka Putri, Rian Damariswara

Universitas Nusantara PGRI Kediri, Indonesia

Email: bp081299@gmail.com, nurita.primasatya@gmail.com,
kharismaputri@unpkediri.ac.id, riandamar08@unpkediri.ac.id

ABSTRACT

Mathematics learning in elementary schools, especially concerning fractional materials, faces significant challenges, with about 70% of students showing passivity and lack of enthusiasm. This research developed an edugame-based MathQuest learning media to enhance elementary students' mathematics skills through an interactive approach. Employing the Research and Development (R&D) method with the ADDIE model (Analysis, Design, Development, Implementation, Evaluation), the study involved 30 fifth-grade students from SDN Samar 1, divided into limited (10 students) and broad (20 students) test groups. Instruments included expert validation sheets, teacher and student response questionnaires, and learning outcome tests. Results showed MathQuest met very valid criteria, with media expert validation at 92.5% and material expert validation at 91.6%. Practically, it scored 94% from teachers and 90% from students, indicating very practical use. Effectiveness tests yielded post-test scores of 87.7% (limited test) and 90% (broad test), demonstrating strong improvement in students' mathematical understanding. MathQuest creates an interactive, engaging, and enjoyable learning environment by combining educational content with game elements that motivate independent learning and critical thinking. This media offers an innovative solution to support elementary mathematics learning goals and aligns well with educational technology development.

Keywords: Learning Media, Edugame, Elementary School Mathematics

INTRODUCTION

Math learning in elementary school should be designed to be interactive and student-centered, allowing for active engagement and knowledge formation through hands-on experience. The constructivist approach enables students to discover mathematical concepts independently, with the teacher as the facilitator, while problem-based learning relates mathematical concepts to everyday life, making them more relevant. Visual and manipulative aids support students' understanding of abstract concepts such as fractions and measurements. Through creative methods that integrate technology, mathematics learning becomes more interesting and motivates students to participate more (Rusman, 2018). This approach helps build the *rasa ingin tahu* (curiosity) as well as critical thinking skills students need to explore mathematical ideas in depth.

Ideal math learning also takes into account individual differences, such as learning styles and cognitive abilities. According to Mulyani (2017), the *diferensiasi* (differentiation) approach is important to meet diverse needs, ensure students learn at the appropriate level of difficulty, and avoid frustration or boredom. A positive learning atmosphere also supports students to feel safe and encouraged to explore in solving math problems (Suryana, 2018). The contextual approach related to the real world strengthens students' understanding of the application of mathematics in everyday life. A learning environment that supports discussion

and cooperation not only improves understanding but also social skills. By combining interactive, contextual, and adaptive approaches, learning experiences become more effective and equip students with critical thinking skills relevant for life. This holistic approach makes students aware of the value of mathematics in various aspects of life, helping them to be better prepared for academic and practical challenges.

However, in practice, the application of interactive approaches still faces challenges, especially in learning mathematics on fractional materials. This topic is often considered difficult and confusing by elementary school students, as its presentation is still dominated by conventional approaches emphasizing memorizing formulas and solving problems without fostering in-depth conceptual understanding. Observations in several classes at SDN Samar 1 showed that around 70% of students seemed passive and lacked enthusiasm during fractional learning. Interviews with teachers revealed about 65% of students showed low motivation in this material, while 60% of teachers admitted difficulty designing learning activities that were engaging, interactive, and easy to understand. This condition impacts students' involvement and mastery of fraction concepts.

Documentation of learning results shows many students have difficulty understanding basic mathematical concepts, seen from consistently low average scores. This indicates that conventional approaches are insufficient for improving elementary students' mathematical understanding. Teachers face the challenge of creating more meaningful and engaging learning, necessitating new, interactive, and innovative methods.

Based on these findings, there is a need to develop interactive learning methods that increase students' interest in mathematics and deepen conceptual understanding. This study proposes the development of edugame-based learning media called *MathQuest*. Edugame is a form of learning media combining educational elements with game features, enabling students to learn through fun, interactive experiences. As a digital learning medium, edugames aim to increase motivation and enhance material comprehension (Setiawan & Widi, 2019). *MathQuest* is designed as an interactive game where students face various math problems to solve in order to progress through stages, making learning challenging and interesting. The app offers attractive graphics, engaging storylines, and interactive features that facilitate learning through play. Development stages include design, trials to receive input from students and teachers on design and effectiveness, classroom implementation, and evaluation with improvements to optimize learning outcomes.

MathQuest has several key advantages. First, it increases student interest in learning by making math engaging and fun, motivating active learning. Research shows game-based learning can boost engagement and motivation (Setiawan & Widi, 2019). Second, *MathQuest* enhances understanding of mathematical concepts through interactive exercises suited to students' cognitive levels. These games build problem-solving skills by presenting scenarios requiring critical thinking, analysis, and strategies, aligning with findings that educational games effectively develop these skills (Pramudito, 2018). Third, *MathQuest* provides real-time feedback after each challenge, helping students recognize mistakes and learn from them. Prompt feedback is essential for correcting errors and improving understanding (Rohman & Harahap, 2020). Fourth, this edugame is flexible and accessible on computers or tablets, usable both in classrooms and at home for additional practice. Finally, *MathQuest* encourages independent learning, allowing students to proceed at their own pace without feeling pressured

by hands-on assessments. Overall, *MathQuest* is expected to be an effective interactive learning medium for improving elementary students' mathematical skills, facilitating active learning, and making mathematics more interesting and accessible.

Previous studies confirm that technology use in learning, including edugames, positively impacts student outcomes. Wulandari et al. (2019) found edugames help students understand concepts faster and improve problem-solving skills. Similarly, Kurniawan and Prasetyo (2020) showed edugames improve achievement while making learning enjoyable. Suryaningtyas and Indriyanto (2019) emphasized game-based educational media enhance mathematics learning interactively and attract student attention.

Based on the above background, this study aims to develop edugame-based *MathQuest* learning media to improve the mathematics skills of elementary school students through an interactive and fun approach. It is hoped the media will create more effective, efficient, and technologically relevant mathematics learning.

This research aims to develop interactive and engaging *MathQuest*-based learning media to improve elementary students' mathematics skills, especially in fractional topics. Through a fun approach, it hopes to address low motivation and participation, helping students understand fractions deeply. The study also evaluates the validity, practicality, and effectiveness of *MathQuest* in supporting learning.

The benefits are multifaceted. For students, *MathQuest* offers an enjoyable, interactive experience that boosts motivation and outcomes. For teachers, it provides a practical, effective tool to present fractional materials more interestingly. For education, it contributes to innovative, technology-based learning media development aligned with current demands and offers a reference for future similar research.

METHOD

The research method used in this study is the R&D method or development research. The research and development method is a research method where research is carried out to analyze a problem and develop a product, and based on the results of the needs analysis carried out, the feasibility of the product as an alternative to solving problems can be verified. The development model used in this study is the ADDIE model. The ADDIE model has 5 stages, namely *Analyze*, *Design*, *Development*, *Implementation*, *Evaluation* (Umami, Rusdi & Kamid, 2021). The following is a picture of the stages of the ADDIE model:

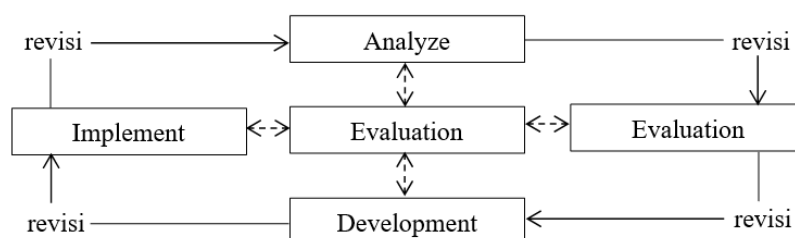


Figure 1. ADDIE Model Stages

Source: Hidayat, 2021

This research and development will be carried out in accordance with the stages of the ADDIE model, which begins with analyzing needs, designing the product to be developed,

developing an initial prototype, and validating the product through experts in their fields. The process continues with trials to evaluate the practicality and effectiveness of the product, ending with a final evaluation of the product that has been developed. This research will be carried out at SD Negeri Samar 1 by involving all 5th grade students, consisting of 30 students. The research subjects will be divided into two groups, i.e. a limited test group that includes 10 randomly selected students. Meanwhile, another 20 students will be involved in large-scale trials.

The instruments to be used include observation guides, validation sheets from experts, response questionnaires from teachers, and student learning outcome tests. The collected data will be analyzed to evaluate the feasibility level of *the developed MathQuest* learning media, including aspects of validity, practicality, and effectiveness. As for the distribution of data, the type of instrument used and the respondents to be used in this study can be clearly seen in Table 1 below:

Table 1. Data, Types of Instruments and Respondents in the Study

No.	Data Type	Data Collection Instruments	Response
1.	Data need assessment/ needs analysis	1. Observation guidelines 2. Interview Guidelines 3. Evaluation tests/questions	1. Teacher + Student 2. Teacher 3. Student
2.	The validity of EDUGAME-based 'MathQuest' learning media	1. Media expert validation sheet 2. Subject matter expert validation sheet	1. Media Expert Lecturer 2. Lecturer Material Expert
3.	Practicality of EDUGAME-based 'MathQuest' learning media	Teacher response questionnaire and student response questionnaire	Teachers and students
4.	The effectiveness of EDUGAME-based 'MathQuest' learning media	Learning Outcome Test/Questions	Student

Source: Researcher's original work

Data collection was carried out at SDN Samar 1 with all 5th grade students as a sample consisting of 30 students. Based on Table 1 about data, instruments, and respondents in research and development, the types of data, data collection instruments, and respondents in the research and development carried out can be described. The first data is data on need analysis to collect data on needs analysis using observation guidelines. The next data related to the validity of the instrument products used is an expert validation sheet with respondents, media experts, and material experts. The next data is product practicality data obtained through a practicality questionnaire instrument with teacher respondents and product effectiveness data obtained through learning outcome tests with student respondents.

A. Kevalidan

The validity of this learning media will be assessed based on the percentage of validation results using the appropriate formula:

$$\text{Validity (\%)} = X \ 100\% \frac{\text{Score attained}}{\text{Maximum score}}$$

The results of the validity analysis will be compared with the criteria in Table 2:

Table 2. Product Validity Criteria

Product Validity Criteria (%)	Product
0-20	Very Unworthy
21-40	Not Eligible
41-60	Quite Decent
61-80	Proper
81-100	Highly Worth It

Source: Adapted from Daryanto (2018)

B. Practicality

To measure the practicality of MatQuest, the following practical assessment score percentages are used:

$$\text{Practicality (\%)} = X 100\% \frac{\text{Skor yang diperoleh}}{\text{Skor Penilaian Maksimal}}$$

The results of the practicality analysis will be described in Table 3:

Table 3. Product Practicality Criteria

Product Practicality Criteria (%)	Product
0-20	Very Ineligible
21-40	Not Eligible
41-60	Quite Eligible
61-80	Eligible
81-100	Highly Eligible

Source: Researcher-developed scale based on Islahudin & Rini (2019) assessment framework

C. Keefektifan

The assessment of the effectiveness of learning media is seen from the results of the evaluation score. The calculation is carried out by calculating the average score of students on the results of the evaluation questions. The results of the evaluation conducted by the students determine the effectiveness of the developed media. Here are the steps to collect data on media effectiveness.

- 1) Calculate the results of each student's evaluation with the following formula.

$$\text{Learning Evaluation Result} = \frac{\sum \text{correct answers}}{\sum \text{maximum questions}} \times 100$$

(Napitupulu, 2021:127)

- 2) Calculate the average results of student evaluations in one class with the following formula.

$$\text{Learning Evaluation Result} = \frac{\sum \text{learning result score}}{\sum \text{student total}} \times 100$$

- 3) Calculating the percentage of classical learning completeness (KBK) of all students. Calculate classical learning completeness with the following formula.

$$P = \frac{\text{students with score} \geq 70}{\text{students attending}} \times 100$$

According to (Islahudin & Rini, 2019:68) classical learning completeness is said to be successful if 85% of students who take the test get a score of ≥ 70 . Furthermore, the scale of assessment and interpretation is used as follows.

Table 4. Conversion of Learning Outcome Percentage Values

Percentage of Quantitative Score	Category
81,00 % - 100,00 %	Excellent
61,00 % - 80,00 %	Good
41,00 % - 60,00 %	Enough
21,00 % - 40,00 %	Less
0,00 % - 20,00 %	Very Less

Source: Adapted from Daryanto (2018)

RESULT AND DISCUSSION

This study uses the ADDIE development model, which includes five main steps: *Analysis*, *Design*, *Development*, *Implementation*, and *Evaluation*. The explanation of each stage is as follows:

1. *Analysis*

The first stage in the ADDIE model is analysis, which involves two main approaches, namely performance analysis and needs analysis. In performance analysis, observations, interviews, and document reviews are carried out to identify problems in the learning process. Based on the results of the analysis, it is known that the learning methods and media used are less attractive, so they are not able to increase students' enthusiasm for learning.

In addition, a needs analysis is carried out to understand the needs of students and teachers in Indonesian learning. The findings from interviews and observations show that learning methods that rely only on textbooks create a monotonous learning atmosphere. As a result, students' motivation to learn becomes low, and their average scores on sentence structure materials do not meet the Minimum Completeness Criteria (KKM).

Research supports the importance of innovative learning media, attractively designed and accessible media also plays a role in increasing student learning motivation by creating an inclusive learning environment and encouraging active participation. Therefore, it is necessary to develop more innovative and interactive learning media to improve student learning outcomes.

2. *Design*

The next step is to design learning media that suits the needs that have been identified. At this stage, MATHQUEST's interactive multimedia is designed with aesthetics, functionality, and ease of use in mind. The main elements designed in this medium include:



Figure 2. Cover Page Display
Source: Original design by research team (2023)

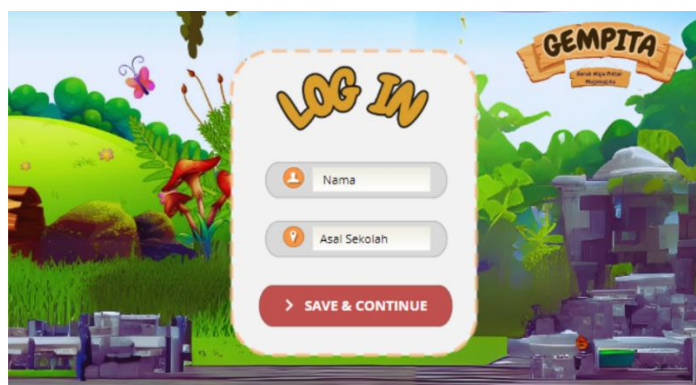


Figure 3. Login Page View
Source: Original design by research team (2023)



Figure 4. Main Menu Page View
Source: Original design by research team (2023)

3. Development

At this stage, the final version of interactive multimedia will be made which will be used as a learning medium. After the development process, this multimedia is validated by material experts and media experts to get very useful suggestions, comments, and inputs as a basis for the analysis and improvement of the media that has been developed. Editing is done to avoid various errors, such as errors in the content of the material, the use of language, and the visual presentation.

The validity of the product is assessed based on the results of validation

conducted by media and material experts, which are used to assess whether the media meets the set standards. The following are the results of the media validation that has been carried out:

Table 5. Media Expert Validation Results

No	Aspects	Question Item	Score Obtained	Maximum Score	Percentage
1	Media Display	2	10	10	100%
2	Keefektifan	2	9	10	90%
3	Efficiency	2	8	10	80%
4	Media Practicality	2	10	10	100%
Sum		8	37	40	92,5%
Criterion					Highly Worth It

Source: Primary data collected through expert validation sheets

Based on the results of the validation of media experts, the Media Display component obtained a score of 100%, Effectiveness 90%, Efficiency 80%, and Media Practicality 100%. The total score obtained was 92.5%, which is in the category of very feasible. This shows that the interactive multimedia learning media developed has an excellent media appearance, effectiveness, efficiency and practicality of media to support learning. In addition to assessing media validation, the validity of the product is also evaluated through validation of learning materials. The results of the material validation are presented in the following table:

Table 6. Material Expert Validation Results

No	Aspects	Question Item	Score Obtained	Maximum Score	Percentage
1	Material Completeness Components	4	17	20	85%
2	Truth of the Concept	3	15	15	100%
3	Material Presentation Components	3	13	15	86,6%
4	Components of Conformity with Basic Competencies	2	10	10	100%
Sum		12	55	60	91,6%
Criterion					Highly Valid

Source: Primary data collected

Based on the results of the validation of material experts, the material completeness component obtained a score of 85%, 100% concept correctness, 86.6% material presentation, and 100% suitability with basic competencies. The total score obtained was 91.6%, which belongs to the very valid category. These results show that the material in interactive multimedia meets the standards of completeness, correctness, presentation, and conformity to the basic competencies required in learning. Based on the description above, it can be concluded that the results of the assessment from the

material expert show a validation score of 91.6%, which is included in the very valid category and this media is declared ready to be used without the need for revision.

4. Implementation

In the *ADDIE* model, the implementation stage is when users, such as students and teachers, start using interactive media that has been developed in the learning environment. At this stage, *MATQUEST* interactive media is applied in the classroom to evaluate student responses and how they help learning. This stage is carried out to see the practicality and effectiveness of the developed media.

a. Practicality

The practicality test was carried out using a response questionnaire, which was filled out by teachers and students. The results of the questionnaire given to teachers can be seen in the following table:

Table 7. Results of the Teacher Response Questionnaire

No	Aspects	Question Item	Score Obtained	Maximum Score	Percentage
1	Media Usability Components	4	17	20	85%
2	Components of Material Suitability with Learning	3	15	15	100%
3	Components of Eligibility for Use	3	15	15	100%
Sum		10	47	50	94%
Criterion					Highly Valid

Source: Field data collected

Based on the description above, it can be concluded that the response results from the teacher showed a score of 94%, which indicates that *MATQUEST interactive multimedia* is considered very practical to use in learning. In addition to the teacher's response questionnaire, the practicality of interactive multimedia is also measured through the response questionnaire given to students. The results of the student response questionnaire can be seen in the following table:

Table 8. Student Response Survey Results

No	Question	Information				
		1	2	3	4	5
1	Do you find multimedia learning interesting?					V
2	Does this multimedia learning feel new to you?					V
3	Are multimedia learning materials presented in a systematic and easy-to-understand manner?				V	
4	Do you feel happy when learning using multimedia?				V	
5	Is the material about sentence structure easy to					V

	understand after using multimedia?				
6	After using multimedia, can you work on the questions given?	V			
7	Can you give an example of sentence structure?	V			
8	Is the language used in multimedia easy to understand?			V	
9	What are the images and colors used in interactive multimedia that catch your attention?	V			
10	Do you feel more motivated to participate in learning activities when using multimedia?			V	
Total score		-	-	-	20 25
Total score		45			
Presentase		90%			
Criterion		Very Practical			

Source: Field data collected

Based on the description above, it can be concluded that the results of the students' responses to the limited trial showed a score of 90%, which indicates that this interactive multimedia falls into the category of very practical to use.

b. Keefektifan

In addition to assessing the practicality of the product, to measure the effectiveness of interactive multimedia, test instruments are also needed that function to evaluate student learning outcomes. The results of the effectiveness test from the limited test can be seen in the following data:

Table 9. Results of Post Test Limited and Extensive Test

Test Results	Total Quantity	Percentage
Limited Test Results	790	87,7%
Extensive Test Results	2.520	90%

Source: Primary assessment data

Based on the data from the results of *the MATQUEST interactive multimedia effectiveness test* through evaluation questions (Post Test), the cumulative results of all subjects showed that the limited trial obtained a score of 87.7%, which means that this media is considered very effective and has achieved completion in the material taught. Furthermore, the results of the effectiveness test from the extensive trial can be seen in the following data:

Based on the data from the results of *the MATQUEST interactive multimedia effectiveness test* through evaluation questions (Post Test), the cumulative results of all subjects showed that the extensive trial obtained a score of 90%, which shows that this media is very effective and has achieved completeness in Indonesian learning materials, especially on the topic of sentence structure.

5. Evaluation

The final stage in the development process is evaluation, which serves as an assessment of the learning products that have been developed. After the media has gone through validation tests by material experts and media experts, the next step is to analyze whether there are still shortcomings in the product. If deficiencies are found,

revisions will be made based on input from validators, so that the learning media can meet validity standards and be ready to be used in the learning process.

The development of edugame-based "*MathQuest*" learning media aims to improve the mathematics skills of elementary school students through an interactive learning approach. The use of edugames as a learning medium has been proven to be effective in stimulating students' mathematical thinking skills. Siswati (2019) in his research stated that Android-based puzzle games can stimulate students' logical and creative thinking skills in solving mathematical problems. In addition, Candra and Rahayu (2021) found that interactive game-based learning media can improve students' mathematical problem-solving skills in elementary school, which is very important in mastering mathematical concepts.

Ferlina and Fratiwi (2024) revealed that the use of edugame media such as Wordwall can attract students' interest in learning and make them more active in the mathematics learning process. Thus, the development of "*MathQuest*" as an edugame-based learning medium is expected to provide a fun and effective learning experience, which in turn can increase the interest and mathematics skills of elementary school students through more interactive and fun learning methods. The use of media like this allows students to learn independently and in a more enjoyable atmosphere, so they can better understand mathematical concepts in a more interesting way.

In this study, an interactive multimedia "*MathQuest*" based on edugame was developed to overcome problems in mathematics learning in grade 5 elementary school. The development of this media uses the ADDIE model which includes five stages, namely needs analysis, design, development, implementation, and evaluation. Each stage is designed with the aim of ensuring that the learning media produced meets three main criteria, namely validity, practicality, and effectiveness. The needs analysis stage is carried out to understand the problems and challenges faced by students in mathematics learning, while the design stage focuses on creating an interesting and educational edugame concept. Furthermore, in the development stage, the media is created according to the planned design, and the implementation stage is used to test the media in the classroom. Finally, evaluations are conducted to assess the extent to which this medium can improve students' mathematical abilities, as well as to make improvements if necessary.

The validation results show that *MATQUEST* has an excellent level of validity. From the results of the validation of media experts, this media obtained a score of 92.5%, while the validation results of material experts reached 85%. This puts *MATQUEST* multimedia in the category of being very valid and ready to use without major revisions. This high validation shows that *MATQUEST multimedia* has been designed systematically and in accordance with the characteristics of grade 5 elementary school students.

The practicality of *MATQUEST's multimedia* was tested through response questionnaires from teachers and students. The results showed that teachers gave a practicality score of 87.5%, while students gave a score of 90%. With an average score of 88.75%, this multimedia is considered very practical. These results show that the interactive features, visual design, and easy-to-use navigation in *MATQUEST* multimedia are helpful in creating a comfortable learning experience for students and teachers.

The effectiveness of *MATQUEST* multimedia was tested through Post Test results in two phases of trials; limited trials and large trials. In the limited trial, which involved 9 students, the average score reached 87.7%, while in the large trial with 28 students, the average score increased to 90%. With an overall average of 88.85%, this multimedia is categorized as very effective in improving students' understanding of sentence structure material. These results show that this learning media is very effective in improving students' understanding of sentence structure material. As explained by Salsabila and Puspitasari (2020), interactive media can increase students' motivation to learn, which ultimately contributes to improving learning outcomes. This corroborates that *MATQUEST* multimedia is not only valid and practical, but also effective in improving student learning outcomes.

CONCLUSION

This research developed the edugame-based *MathQuest* learning media using the ADDIE model to enhance elementary students' mathematics skills, particularly in fractional materials. The results demonstrated excellent validity—media validity at 92.5% and material validity at 91.6%—and high practicality, with teacher and student evaluations averaging 94% and 90%, respectively. Effectiveness tests from limited and extensive trials showed strong improvements in math comprehension, with scores of 87.7% and 90%. *MathQuest* effectively combines educational content and game features to create an interactive, engaging, and motivating learning experience that fosters independent and critical thinking. It serves as an innovative tool to support elementary mathematics education, aligning well with advancements in educational technology. Recommendations include encouraging educators to integrate *MathQuest* alongside other methods, urging institutions to provide necessary technological infrastructure and teacher training, and advising developers to continually update content to stay relevant. For future research, it is suggested to expand sample size and mathematical topics for broader effectiveness testing and to explore adaptive features that personalize difficulty based on individual student abilities, thereby enhancing the learning experience further.

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