



Interactive Learning Multimedia Based on Indonesian Realistic Mathematics Education in Mathematics Subjects

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ABSTRAK

Belum tersedianya media dan metode pembelajaran yang digunakan guru dalam pembelajaran matematika masih sederhana sehingga mengakibatkan kurangnya pemahaman siswa dalam pembelajaran dan menurunnya kualitas pembelajaran khususnya pada mata pelajaran matematika. Penelitian ini bertujuan untuk membuat multimedia pembelajaran interaktif berbasis pendidikan matematika realistik Indonesia pada mata pelajaran matematika kelas IV. Jenis penelitian ini menggunakan pengembangan dengan model ADDIE. Subjek uji terdiri dari 3 orang ahli dan 12 siswa kelas IV. Data diperoleh dengan data kuantitatif dan kualitatif. Metode yang digunakan adalah angket dan tes. Selanjutnya data dianalisis dengan teknik deskriptif kualitatif, deskriptif kuantitatif dan statistik inferensial. Kelayakan media ditentukan dari hasil penilaian ahli isi pembelajaran (91,66%), ahli desain pembelajaran (92,18%), ahli media pembelajaran (88,33%), hasil tes individu (87,38%), dan hasil tes kelompok kecil (87,73%). Sehingga disimpulkan bahwa multimedia pembelajaran interaktif berbasis pendidikan matematika realistik bahasa Indonesia layak untuk diterapkan dalam pembelajaran matematika kelas IV MI. Penelitian ini berimplikasi pada pelaksanaan kegiatan pembelajaran yang realistik dan bervariasi. Implikasi dari penelitian ini adalah semakin tersedianya perangkat pembelajaran yaitu multimedia pembelajaran interaktif sesuai kebutuhan siswa, mampu meningkatkan motivasi siswa dalam belajar matematika.

ABSTRACT

The unavailability of media and learning methods used by teachers in learning mathematics is still simple, resulting in less understanding of students in learning and a decrease in the quality of learning, especially in mathematics subjects. This study aims to create interactive learning multimedia based on Indonesian realistic mathematics education in grade IV mathematics subjects. This type of research uses development with the ADDIE model. The test subjects consisted of 3 experts and 12 fourth grade students. Data obtained with quantitative and qualitative data. The methods used were questionnaires and tests. Furthermore, the data were analyzed with descriptive qualitative techniques, descriptive quantitative and inferential statistics. Media feasibility is determined from the assessment results of learning content experts (91.66%), learning design experts (92.18%), learning media experts (88.33%), individual test results (87.38%), and small group test results (87.73%). So it is concluded that interactive learning multimedia based on Indonesian realistic mathematics education is feasible to be implemented in learning mathematics grade IV MI. This research has implications for the implementation of realistic and varied learning activities. The implication of this research is the increasing availability of learning tools, namely interactive learning multimedia according to student needs, able to increase student motivation in learning mathematics.

1. INTRODUCTION

Mathematics is one of the subjects studied in elementary schools and has an important role in improving quality human resources. Mathematics is a subject that pressures students to think logically, systematically, critically, creatively, and cooperatively so as to develop skills in solving various daily problems (Badjeber & Purwaningrum, 2018; Wedekaningsih et al., 2019). This thinking ability will support

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a person in solving a problem, especially in the field of mathematics. Science in mathematics is universal so that it will continue to develop from time to time. So that mathematics is a compulsory subject studied by students to support the ability to think logically, critically, systematically and also objectively so that students are able to solve problems related to mathematics at school. Mathematics is very important to learn to realize the importance of learning mathematics at school, in the Law of the Republic of Indonesia NO. 20 of 2003 concerning the National Education System (Sisdiknas) Article 37 emphasizes that mathematics is a compulsory subject for students at the primary and secondary education levels (Jeřková et al., 2018; Kolar & Hodnik, 2021).

Although mathematics is a subject that is difficult for students to understand, learning carried out by students must be able to make students more active and understand the material being studied and this mathematics subject is very related to the problems that are around and this really encourages students to understand and apply in everyday life. To make students better understand the learning material, especially for abstract mathematics subjects, there is a need for interactive media to make students understand the subject matter and with this interactive media facility, learning becomes more active, effective and efficient. In line with previous study that states that one of the factors that make the learning process effective is the media (Supeni et al., 2019; Yuniarti & Radia, 2021). There are benefits to the learning process that can increase new desires and interests when using learning media or interactive media.

MI - Alfalah is one of the school that get compulsory math subjects like other schools too. The results of an interview with a mathematics teacher, found that the results of students' daily test scores were still low, because there were still many students who had not met the minimum completeness of 75. This can be seen from the recap of the odd semester grades of class IV E for the 2022 - 2023 school year with a percentage of 73% of students scoring below the Minimum Criteria Completeness where 19 out of a total of 26 students still score below the average with the lowest score of 10 to 50. And students only reach that completeness by doing reassessment or remedial from the teacher, but there are also many students who still get unsatisfactory scores with scores of 60 to 70. Some of the problems that cause low student math scores are due to students' lack of understanding of the material taught by the teacher. Students at Mi Al Falah for Grade IV mathematics subjects, they still apply conventional methods or by using printed teaching material media books or pictures. The media used during classroom learning still uses simple media or utilizes benda - objects or food that students can bring to be used as learning media, for facilities at Mi Al Falah already has an LCD Projector but the number is still limited.

Based on some of these problems, it is feasible to use interactive learning media for grade IV math subjects at Mi Al Falah, for the learning media used, namely interactive learning media (Ariani, 2019; Kassem, 2018; Rachmavita, 2020). Multimedia is the use of several media to present information. This combination can contain text, graphics, animation, images, video, and sound. Coupled with using the right learning method of Mathematics learning approach, namely Indonesian Realistic Mathematics Education (PMRI). The PMRI approach is an approach to learning mathematics that begins with a realistic context for students and students are given the opportunity to develop mathematical ideas to rediscover knowledge about mathematics (Lestariningsih & Trismawati, 2020; Saleh et al., 2018). This approach is the initial source of the emergence of mathematical concepts so that students are more practical in imagining existing situations and more practical in understanding the concepts being studied (Apriyanti et al., 2020; Pratiwi & Wiarta, 2021). This approach uses problems as the first source of the emergence of mathematical concepts. To use this approach, it is not only necessary to learn formulas, but also to encourage students to understand mathematical concepts well. The tendency to memorize formulas and apply in mathematics learning is less effective for students because it will be difficult to solve problems if they forget the formula (Hanun et al., 2019; Jeheman et al., 2019). By using this approach, students can build mathematical concepts in their own way, enabling meaningful learning. PMRI can be applied to create a variety of ways to solve math problems.

As same with the research conducted by previous study that found by applying interactive learning media to social studies content on natural appearance material (Kristanti & Sujana, 2022). The results of this study indicate that interactive learning multimedia can improve student learning outcomes. Similar research was conducted by other study namely the development of interactive learning media on the volume of flat shapes in grade V elementary school (Irsalina et al., 2022). From this research, it is found that this interactive learning media can improve student learning outcomes and activeness.

Based on the description of the problems above, there has been no study of interactive multimedia based on Indonesian realistic mathematics education in mathematics lessons. The advantages of the developed media are that it contains examples such as images that make it easier for students to understand the material presented on the media. The purpose of this research is to develop interactive multimedia based on realistic Indonesian mathematics education in mathematics lessons. Through this media is expected to help students who have difficulty in learning so that it affects the learning outcomes of students who increase, especially in mathematics subjects.

2. METHOD

This research is a development research with several stages in it that lead to the ADDIE development model which consists of 5 stages, namely the stages of analysis (analysis), design (design), development (development), implementation (Implementation), evaluation (evaluation) (Puspasari & Suryaningsih, 2019). The ADDIE model is a model that is often used for instructional development, this model can also be used for various forms of product development such as models, learning strategies, learning methods, media and teaching materials. This model is often used as a reference in the development of learning in various educational institutions, such as schools, universities, or training institutions. This research was conducted at Mi - AlFalah South Jakarta. The subjects of this study were for the expert review stage consisting of 1 learning content expert, 1 learning design expert, and 1 learning media expert while for subjects, namely individual student trials consisting of 3 Mi - AlFalah fifth grade students consisting of 1 high achieving student, 1 medium achieving student, and 1 low achieving student. The techniques used to collect data are questionnaires and tests. The questionnaire is used to determine the feasibility of the product developed and the product is tested for feasibility by experts. After being declared feasible, the product was tested on students to find out the response of students to this development product. The lattice of research instruments is presented in Table 1, Table 2, Table 3, and Table 4.

Table 1. Learning Content Instrument Grid

No.	Aspects	Indicator	Item No.	Number of Items
1.	Curriculum	a. Multimedia Suitability	1,2	4
		b. Indicator Suitability	3	
		c. Appropriateness of Learning Objectives	4	
2.	Methods	a. Clarity and completeness of presentation of material, examples, images and animations	5,6,7,8,9,10	6
3.	Language	a. Appropriateness of using clear and precise language and sentences in accordance with learner communication	11,12	2
4.	Evaluation	a. The level of difficulty of the questions, the suitability of the questions with the learning objectives, and the questions given are easy to understand.	13,14,15	3
Total				15

Table 2. Learning Design Instrument Grid

No.	Aspects	Indicator	Item No.	Number of Items
1.	Objectives/ Competencies	a. Clarity and suitability of the formulation of indicators, methods, steps, techniques, assessment instruments, and facilitate learning	1,2,4,5,6,7,8	7
Total				7

Table 3. Learning Media Instrument Grid

No.	Aspects	Indicator	Item No.	Number of Items
1.	Text	a. Text clarity (text read ability, text presentation, text size and type)	1,2,3,4	4
2.	Image	a. Image layout, quality, color balance and attractiveness of images	5,6,7,8,9	5
3.	Animation	a. The quality, attractiveness, and suitability of the animation to the material presented	10,11,12	3
4.	Audio	a. Clarity and appropriateness of the use of sound and narrator voice	13,14,15,16	4
5.	Accessibility	a. Ease of access or use of multimedia learning and the flexibility of interactive links	17,18,19,20	4
Total				20

Table 4. Instrument Lattice for Individual and Small Group Trials

No.	Aspects	Indicator	Item No.	Number of Items
1.	Objectives/ Competencies	a. Ease of use	1,2	3
		b. Attractiveness and accuracy of text presentation, images, animation, language, and sound	3,4,5,6,7,8,9,10	8
		c. Convenience and attractiveness	11,12,13,14,15,16	6
		d. Evaluation	17,18	2
Total				18

The data analysis method used in this research of Interactive Learning Multimedia Development in Mathematics Subjects is descriptive qualitative method and descriptive quantitative analysis method. Descriptive analysis method is a method of analyzing processing data by systematically compiling in the form of words or sentences, categories of objects so as to get general conclusions. This method is used to process data in the form of input, criticism, suggestions, in the questionnaire used in revising interactive learning multimedia products from the results of trials of learning content experts, learning design experts, learning media experts, and small group and individual trials. As for the quantitative descriptive data analysis method, namely the method of processing data in the form of numbers and percentages systematically on the object under study, so that general conclusions are obtained. The validity test by experts is then converted into a 4-scale achievement level conversion table, as presented in Table 5.

Table 5. Scale 4 Achievement Level Conversion

Achievement Rate (%)	Qualification	Description
76 - 100	Strongly Agree	Feasible (no revision needed)
56 - 75	Agree	Feasible (No need for revision)
40 - 55	Disagree Strongly	Less Feasible (Revision)
0 - 39	Disagree	Not Feasible (Revision)

3. RESULT AND DISCUSSION

Results

This research produces a product, namely interactive learning multimedia based on Indonesian realistic mathematics education in mathematics subjects for the material of the circumference and area of flat buildings in grade IV MI. This product is in accordance with the ADDIE model development procedure which is carried out in five stages, namely the analysis stage, design stage, development stage, implementation stage and evaluation stage. The results of the analysis stage are obtained in the learning process the teacher still uses printed teaching materials and the methods used are still lectures, printed media books used masish a lot of writing and still not able to provide a clear and complete picture of the circumference and area of flat shapes. The shortcomings of the media and learning methods used by teachers have not been addressed with any development efforts due to teacher limitations. These conditions make students less enthusiastic about learning, get bored quickly, have difficulty learning, and easily lose concentration. This is complicated by the fact that teachers have not used digital media in learning which limits students from being able to understand math subject matter. Students cannot learn and understand mathematics material in a real and meaningful way, which results in students learning more by memorizing rather than understanding the content of the subject matter. The results of the analysis of learning facilities obtained by the school have adequate facilities for learning by applying interactive learning multimedia with the availability of a good internet connection and a computer for students to learn. Then from the results of material analysis in grade IV mathematics subjects, the material that has problems will be developed interactive learning multimedia is the material of the perimeter and area of flat shapes.

The second stage of product design begins with the creation of a storyboard and product flowchart as an initial description of the product to be developed, followed by making lesson plans, preparing instruments, assessing products, and determining Articulate Storyline 3 as software to create products. The results of the design stage are then used as material in the development process which starts the process from the preparation of material in the media, making sounds for buttons, selecting images that are in accordance with the material of the perimeter and area of flat shapes, forming learning multimedia. The results of product development are presented in Figure 1.



Figure 1. Multimedia Developed

After that, continuing to test the products developed to test the feasibility of learning multimedia products. This feasibility test is carried out according to the trial design starting from the content, design, and learning media expert tests. After revising the multimedia based on comments from experts and declared feasible, then the multimedia was tested on grade IV MI students consisting of 12 people in individual tests involving 3 students and small group tests involving nine students each consisting of students with high, medium, and low math learning outcomes. The results of interactive learning multimedia product trials that have been developed are presented in Table 6.

Table 6. Product Validity Test Results

No.	Product Trial Subjects	Validity Result (%)	Description
1	Subject content expert test	91.66	Very good
2	Learning design expert test	92.18	Very good
3	Learning media expert test	88.33	Very good
4	Individual trial	87.73	Very good
5	Small group trial	87.38	Very good

Table 6 show assessment by subject content experts shows that the percentage results are 91.66% with very good qualifications, learning design expert assessment shows a percentage of 92.18% with very good qualifications, learning media expert assessment shows a percentage of 88.33% with very good qualifications, and individual trials with a percentage of 87.73% with very good qualifications and finally small group trials with a percentage of 87.38 with very good qualifications. Based on the acquisition of product validity test results, it can be concluded that PMRI-based interactive learning multimedia is very well qualified and feasible to use in learning mathematics in grade IV. Although the product has qualified very well, there are some inputs related to the improvement of the developed media. The input from the experts is presented in Table 7.

Table 7. Product Improvement by Experts

No.	Suggestions, Feedback, Comments	Revised
1	Correct the writing of triangles in the circumference material section	The writing of the segments in the material section of the circumference has been corrected and is clearly visible.
2	Learning objectives are detailed one by one. One learning objective uses 1 operational verb	The learning objectives have been changed to one-to-one and operational verbs.

No.	Suggestions, Feedback, Comments	Revised
3	Problems related to the perimeter and area of flat buildings are not appropriate, replaced by exercise questions related to the perimeter and area of flat buildings.	The sentence has been replaced with "practice questions related to the perimeter and area of flat shapes".
4	Use numbers don't use stripes	Already replaced by using the number
5	Formula column, the text should be clearer and bigger	The column formula has been enlarged and the text is clearer.

Discussion

The development of interactive learning multimedia based on Indonesian realistic mathematics education in mathematics subjects on the perimeter and area of flat shapes in class IV MI was developed with the ADDIE model procedure. The ADDIE model was chosen to be used as a development model because it has systematic stages, is easy to understand, and can be implemented. In addition, because it has simple stages that are suitable for solving learning needs problems, the ADDIE model remains relevant to the times and is used to develop various types of learning devices (Febriyanti & Ain, 2021; Kurnia et al., 2019; Siregar, 2019). The ADDIE model as a development process and has the ability to create high-quality products that meet industry needs. In developing this interactive learning media, the ADDIE model begins with the analysis stage. This stage is used to identify the needs for the development product based on concrete data in the field. This ensures that the developed product is truly developed based on real conditions in the field rather than assumptions or subjective views of researchers. The results of the analysis are then used as the basis for the product design and development process. Next, an evaluation of the development procedure and product evaluation were conducted. This assessment is based on the suitability of the design and product assessment. The ADDIE development model is suitable for developing interactive learning media based on its advantages.

Trials have been conducted on the developed product to determine how feasible the product is from the point of view of learning content experts, design experts, and learning media experts, as well as students as users. The results of the learning content expert assessment show that the product is stated very well, which means that in terms of the content or material contained in it, the product is suitable for use in learning about the perimeter and area of flat shapes. The content of the developed learning media has been made based on student needs. This is in line with the purpose of designing learning multimedia, which is to help teachers increase students' interest and enthusiasm in learning, which leads to the achievement of learning objectives. The material presented in the media, whether in the form of images, audio, animation, or video, must be in accordance with the abilities of students and the material that has been determined (Novaliendry, 2013; Supriyono, 2018). The media can be used by teachers and students to study coastal, lowland and highland scenes. The media can include images to visualize the scene, videos that provide a thorough explanation of the material, text and background music to support the learning atmosphere. The use of electronic devices increases the utilization of the media, as it can be accessed and used at any time (Apriani et al., 2021; Tang & Chaw, 2016).

Second, interactive learning multimedia based on Indonesian realistic mathematics education in mathematics subjects on the material of the perimeter and area of flat shapes is suitable for learning grade IV MI. This is because this multimedia is used easily. Good learning media should be easy for students to understand and encourage them to actively participate in learning, including expressing opinions, participating in discussions, and exploring various information. In addition, it should ensure that students maintain good behavior during learning. Media can also help students remember and achieve learning objectives (Puspitarini et al., 2019; Shalikhah, 2017). By using media, students are expected not only to memorize lessons, but also to be able to understand and use the information learned effectively (Chuseri et al., 2021; Lin et al., 2021). Therefore, the learning multimedia created includes text, video, images and audio that use real-life examples to help students understand the concept of natural appearances. The purpose of implementing contextual learning is to help students find the connection between what they learn and its application in the real world (Dwi Saputra et al., 2022; Fitriyana & Adha, 2020). This shows that interactive learning multimedia products are feasible to use in terms of design and learning media.

Students, as part of the learning process and the center of learning activities, require learning facilities that are adequate and appropriate to student needs. This means that factors such as student motivation and ease of using interactive learning media are included in the assessment of student product tests. Media that is able to increase student motivation can produce better results (Diah Kurniawati et al., 2018)(Hapsari & Zulherman, 2021). Motivation serves as a driving force and direction for students to act. In the context of learning, the expected learning motivation is indicated by the behavior of students who actively participate in learning activities to achieve goals. If the learning motivation is right, students will

be better able to achieve optimal results (Andriani & Rasto, 2019; Juliya & Herlambang, 2021). In addition to providing motivation, the ability to operate the media easily will make students comfortable and enjoy the process of using the media in learning activities. One of the factors that affect the quality of students' learning is their comfort while learning. If they are in a comfortable learning environment, free from pressure and challenges, students can perform learning activities to the fullest and achieve their best potential (Fakhrurrazi, 2018; Murod et al., 2021). The results of student assessment show that students like the development of interactive learning media.

Based on the results of the study, interactive learning multimedia based on Indonesian realistic mathematics education in mathematics subjects on the circumference and area of flat shapes is feasible to be applied to the learning process of mathematics subjects in grade IV MI. The findings are reinforced by previous research which states that Indonesian realistic mathematics education learning is suitable for use in mathematics learning (Fitra, 2018; Maghfiroh et al., 2021). The existence of realistic learning into interactive learning multimedia that has an effect to streamline learning, help student-centered learning, and students can understand mathematics learning directly through learning multimedia in learning activities (Pratiwi & Wiarta, 2021; Putra & Purnomo, 2023). Realistic learning has a significant impact when compared to conventional learning methods or models in motivating students followed by an increase in student learning achievement (Faot & Amin, 2020; Lestariningsih & Trismawati, 2020; Septiana et al., 2018). Some of these research results prove that the combination of interactive learning multimedia with Indonesian realistic mathematics education is feasible to be applied in mathematics learning.

The implications of this research for the world of education are the increased availability of learning tools in the form of interactive learning multimedia in accordance with student needs, able to increase student enthusiasm for learning. Helping teachers in carrying out effective and efficient learning. This development research is still limited to the feasibility of interactive learning multimedia based on Indonesian realistic mathematics education in the material of the circumference and area of flat shapes for class IV MI, so further research is still needed to test the effectiveness of the product and it is hoped that other researchers can develop various kinds of quality learning multimedia. quality.

4. CONCLUSION

Interactive Learning Multimedia based on Indonesian Realistic Mathematics Education in mathematics subjects on the material of the perimeter and area of flat shapes that have been declared feasible for use in learning activities based on the assessment results of experts and grade IV MI students. Other researchers should conduct further research on the relationship between this development research and the implementation of education because it will increase the availability of learning tools that apply contextual learning that suits the needs of students, relevant to technological advances and the times. The results will increase students' enthusiasm for learning and help teachers do learning well.

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