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Tapping Into Creativity: Crafting Engaging Math Lessons for Middle Schoolers with Macromedia Flash

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Abstract
The aim of the research is to design media based on Realistic Mathematics Education (RME) spatial material; producing RME media with Macromedia Flash for class IX educators and students building materials; knowing the responses of educators and students after using the media; find out the results of learning about curved sided space figures. RME media development refers to the model of William W. Lee and Diana L. Owens by going through four stages out of five existing stages, namely: analysis; product design; development; implementation; and evaluation. In this research, the evaluation stage was not carried out. The results of expert validation obtained an average score of 88.8%, individual trials an average of 81.33%, small group trials an average of 80.89%, educators' responses to the media an average of 87.33%, and responses students average 83.73%. The use of RME media in learning has an impact on learning outcomes, where the average learning outcome for the experimental class is 81.65 while the average learning outcome for the control class is 78.39. The differences in learning outcomes show that RME media is effective when used in classroom learning.Explore a dynamic approach to math education as students delve into real-world scenarios, navigating building spaces with interactive Macromedia Flash tools. This innovative learning media sparks curiosity and deepens understanding, fostering a practical grasp of mathematics concepts for middle school learners.

Keywords: Instructional Media; Realistic Mathematics Education; Curved Side Space Buildings.

INTRODUCTION

The aim of national education is to develop the potential of students to become human beings who have faith and are devoted to God Almighty, have noble character, are healthy, have faith, are

creative, independent, and become democratic and responsible citizens in order to make the nation's life intelligent, Ministry of National Education (Ministry of National Education)(Diantoro et al., 2021; Wardani et al., 2019).Educational unit level curriculum 2006 emphasizes the active role of students(Ananda & Hudaidah, 2021). One of the learning strategies according to Educational unit level curriculum expectations is the Realistic Mathematics Education (RME) approach where RME combines views about what mathematics is, how to study it, and how mathematics is taught. Mathematics lessons to build student competence in mathematical problem solving, reasoning and communication(Palinussa et al., 2021; Rohid et al., 2019).

RME is a mathematics learning approach that places reality and experience as the starting point for learning as a source for the emergence of mathematical concepts(Febriyanti et al., 2019; Khotimah & Mahmudah, 2021). The characteristics of RME are that it uses real world context, models, production and construction, interactiveness and interrelationships(Juliawan et al., 2022). For realistic mathematics learning, it is necessary to develop RME-based media including design, development, presentation, practice, or both. RME media is expected to make the learning process more interesting, meaningful and contribute to learning outcomes. Learning mathematics using the Realistic Mathematics Education approach has three principles, namely; guided reinvention and progressive mathematization, didactical phenomenology and self-developed models(Mariana et al., 2021; Rusdi et al., 2020). The three principles of RME are described in 5 characteristics, namely using real contexts to explore, using vertical instruments, such as models, schemes, diagrams, symbols, and so on, constructive processes by students, contextual problem solving processes is the beginning of the next mathematization process, there is interaction, namely interaction between educators and students, interaction between students and students and there is intertwining of various materials to obtain a mathematical structure of the material.

Mathematics is a human activity, learning mathematics will occur if students can develop effective ways of solving problems(Putri et al., 2019; Ulandari et al., 2019). States the teachings of RME with the following principles: the starting point for learning must provide experience, students are involved in mathematical activities, the starting point can be explained based on the learning sequence, namely the use of mathematical symbols, learning sequences involve the activity of creating and outlining symbolic models from informal mathematical activities, the three teachings above are effective if they are realized in interactive learning and real phenomena of mathematical forms and concepts are manifested in the intertwining of various sub-subjects.

Previous research conducted byMahendra et al., (2021)where this research discussesdevelopment of macromedia flash-based mathematics learning for elementary school students. There are differences in research conducted byMahendra et al., (2021)with the research currently being carried out, namely the school level. This research urges to present a relevant and engaging learning approach in teaching mathematics to junior high school students, enabling them to develop a strong understanding of mathematical concepts in real contexts. By utilizing Macromedia Flash technology, this research shows how important it is to integrate technology in mathematics learning to help students prepare to face real world challenges in the future.

The novelty of this research is Revolutionize middle school math education with an immersive blend of Realistic Mathematics Education and Macromedia Flash technology, transforming abstract concepts into tangible experiences within building spaces. This groundbreaking approach not only enhances engagement but also cultivates practical problem-solving skills essential for students' future success. Based on the background above, the aim of this research is to design media based on Realistic Mathematics Education (RME) spatial material; producing RME media with Macromedia Flash for class IX educators and students building materials; knowing the responses of educators and students after using the media; find out the results of learning about curved sided space figures.

RESEARCH METHODS

Development Model and Development Procedure

This development research uses the media development model from William W. Lee & Diana L. Owens with the principles of: (1) developing a tool development framework, developing specifications and standards; (2) developing parts of the media to match the framework; (3) improve the product; (4) final product implementation(Ariyanti, 2022).

The procedure for developing Realistic Mathematics Education (RME) learning media with Macromedia Flash uses the model from William W. Lee & Diana L. Owens which is taken through five stages, namely: 1) Problem analysis, 2) Product design, 3) Product development, 4) implementation, while the evaluation stage was not carried out. Implementation is only carried out at the trial stage. The RME media development procedure is depicted in the following chart:

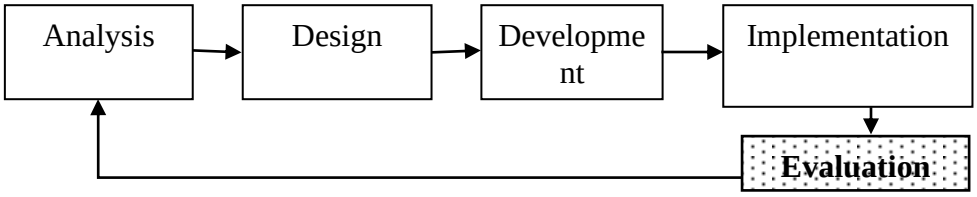

Figure 1. Development Procedure

Analysis in research includes analysis of student characteristics, analysis of learning objectives, and analysis of subject matter. The design stage is the systematic preparation of Realistic Mathematics Education (RME) learning, the preparation of the media structure framework, and the systematic presentation of material in the media. The product implementation stage is carried out through trials, namely expert validation, individual trials, small group trials, and field trials on educators and students.

Research Target/Subject

RME media development research was carried out at Adhyaksa I Middle School, Jambi City. The test subjects were carried out as in the following table:

Table 1. Test Subjects in This Research

Trial Phase	Trial Type	Amount	Respondent characteristics	Trial Process, Orientation, and Results
1	Validation of material experts, design experts and media experts	3 people	Field experts: materials, design and media design.	Qualitative, questionnaire, initial draft of the product; suitability of substance, methodology and media accuracy.
2	Individual trials	3 people	User: class IX students	Product suitability to users
	Small group trials	6 people	User: class IX students	Product suitability to users
3	Educator trial	2 people	Product users: class IX educators	Product suitability to users
	Field trials	39 people	User: class IX students	Product suitability to users

Instruments, and Data Collection Techniques

Research instruments are tools used to measure observed natural and social phenomena(Silalahi et al., 2022). The research instruments used were questionnaires and test equipment. Data analysis was carried out to gain an understanding of the feasibility and effectiveness of using media in learning(Mila et al., 2021; Nurhamidah et al., 2022). Data from expert validation, teacher and student responses were

analyzed using qualitative presentative and descriptive analysis, and learning outcomes data were analyzed using simple statistical analysis.

Data collected through filling out questionnaires is grouped into quantitative data in the form of numbers and qualitative data in the form of words or statement symbols. Qualitative data is analyzed logically and meaningfully, while quantitative data is analyzed descriptively as a percentage. Results of descriptive analysis to state the condition of the media.

The formula for analyzing data is as follows:

a. To process data per item are:

P = $\frac{X}{Xi} x\ 100$, To process data for groups of items and entire items: and P = $\frac{\text{X}}{\sum \text{Xi}}$ x 100,

Interpretation in providing meaning and decision making with the following criteria:

Table 2. Decision Making Criteria

Percentage (%)	Qualification	Decision
90 - 100	Very Good	Not revised (Product is ready to be used in the field for learning activities)
80 - 89	Good	Not revised (Product is ready to be used in the field for learning activities)
70 - 79	Pretty Good	The product can be continued by adding something that is missing, making certain considerations, the additions are not too big and not basic.
60 - 69	Not God	Revise by researching again carefully and looking for product weaknesses to improve
< 60	Very Not Good	Product fails, major and fundamental revision of product content.

To calculate the average test result score is:

Average($\overline{X}$) =$\frac{\text{Sum of all data}}{\text{amount of data}}or\overline{X} = \frac{\Sigma n}{n}$

Where: $\overline{X}$= is the average value, n = the amount of test result data, andΣn = the sum of all test result data.

RESULTS AND DISCUSSION

1. Analysis Stage

To obtain information about the need for computer-assisted media, this was done by giving a questionnaire to two mathematics educators at Adhyaksa I Middle School, Jambi City. Student analysis was also carried out by giving questionnaires to 10 students. The questionnaire contains information about students' abilities in using computers.

Analysis of learning components, namely by analyzing Content Standards which include Competency Standards, Basic Competencies, and indicators of achievement of learning outcomes in the syllabus in the Education Unit Level Curriculum developed at Adhyaksa I Middle School, Jambi City in in the last two years.

Analysis of learning materials was carried out through literature searches in accordance with the Educational Unit Level Content and Curriculum Standards developed at Adhyaksa I Middle School, Jambi City. Based on the Education Unit Level Curriculum for the 2011-2012 academic year at Adhyaksa

I Middle School, Jambi City, the material on cylinders, cones and balls had previously been taught in class VIII, even semester, combined with material on flat-sided geometric figures, namely cubes, blocks. , prism, and pyramid.

2. Learning Media Design

There are three sub-materials that will be included in the RME media, namely tube material, cone material and ball material. After writing the script, the next step is preparing the media which consists of 3 parts, namely the beginning, main part and final part (cover).

The initial part contains a short video related to the media theme which aims to provide stimulus. The core section includes the main menu and material sub menu. Each sub-menu section contains a tutorial that explains the curved-sided geometric figures of tubes, cones and spheres. The main menu consists of 5 buttons, namely the Standard Competency and Basic Competency buttons, the introduction button, the material button, the evaluation button and the competency test button. The final part contains thanks to Realistic Mathematics Education (RME) media users.

3. Learning Media Flowchart and Storyboard

The overall scenario for preparing Realistic Mathematics Education (RME) based media with Macromedia Flash is described using a Flowchart, then making a detailed explanation for each display which will be included in the storyboard. The RME media flowchart is depicted as follows:

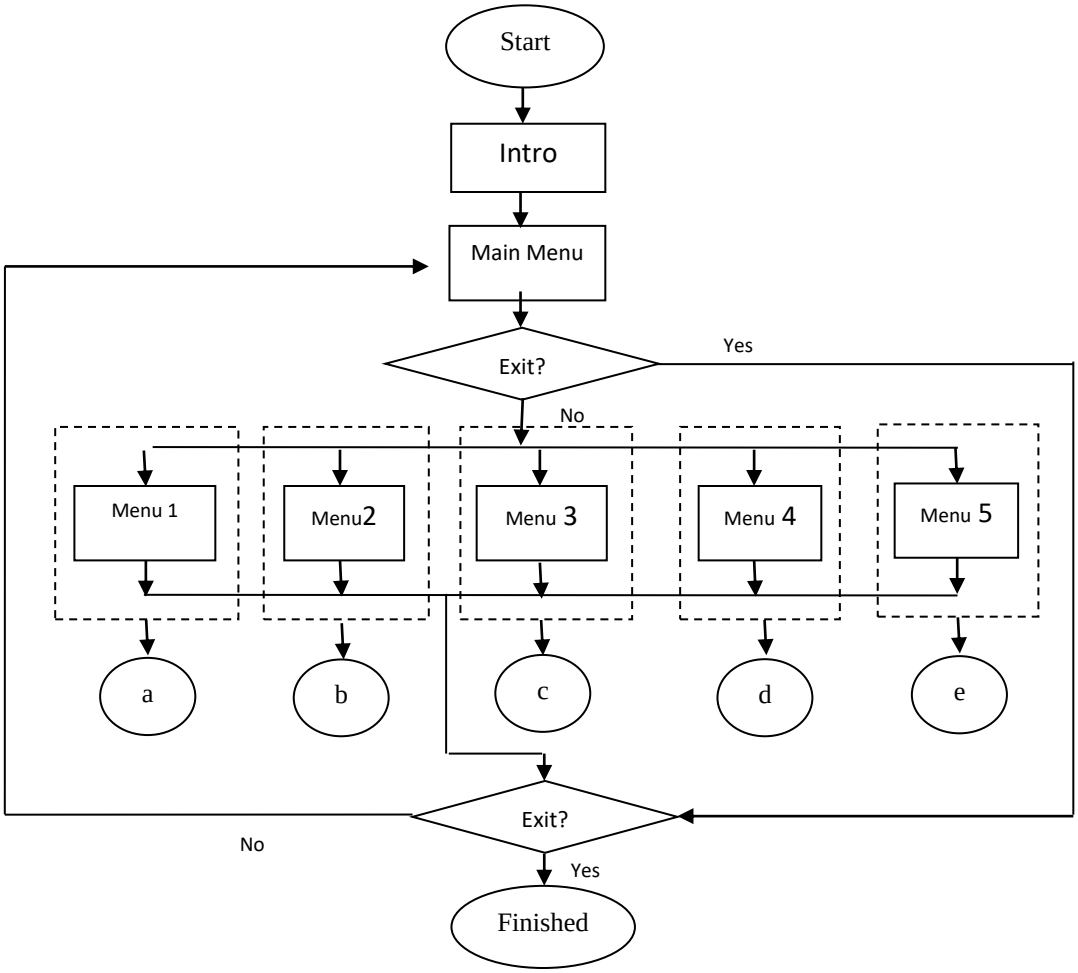

Figure 1. Learning Media Flowchart and Storyboard

4. Product Development and Implementation

The product development stages include preparing media pages, namely writing text, installing images, installing animation, installing audio, installing video, installing example questions, installing practice questions, installing evaluation questions, and installing competency test questions according to the designed storyboard. Next is designing the screen display which includes background coloring, navigation, animation, video and text.

The implementation of RME-based media is carried out in several stages, namely expert validation, individual trials, small group trials, and field trials to obtain data about the condition of the media.

5. Data analysis of material expert validation results

The results of the material expert assessment for Phases I and II are described in the following table:

Table 3. The results of the material expert assessment for Phases I and II

Validator	First validation		Second validation		Validation Decisions
	Results (%)	Qualification	Results (%)	Qualification	
Material expert	92,0	Very good	98,7	Very good	Very good

The data from the second stage of material expert validation was analyzed with a score of 98.70%, and was qualified as "very good" so that the media product had not been revised and was ready to be used for learning activities, and in accordance with the decision of the material expert's validation results it was "very good".

6. Presentation and Analysis of Data from Design Expert Validation Results

The results of the phase I and II design expert assessment are described in the following table:

Table 4. The results of the phase I and II design expert assessment

Validator	First validation		Second validation		Validation Decisions
	Results (%)	Qualification	Results (%)	Qualification	
Design expert	78,0	Pretty good	89,0	Good	Very good

The data from the phase II design expert assessment was analyzed so that the score obtained was 89.0% and qualified as "good" so that the media did not need to be revised and was ready to be used for learning. The validation result by the design expert was "very good".

7. Presentation and Analysis of Data from Media Expert Validation Results

The results of the phase I and II media expert assessments are described in the following table:

Table 5. The results of the phase I and II media expert assessments

Validator	First validation		Second validation		Validation Decisions
	Results (%)	Qualification	Results (%)	Qualification	
Media expert	60,0	Not good	78,7	Pretty good	Good

The results of the media expert's assessment were with a score of 78.7%, and qualified as "fairly good", and the validation result by the media expert was "good", so it could be used as a trial in learning.

8. Individual Trials and Small Group Trials

Data from the assessment results in individual trials obtained a score of 80.9%, and qualified as "good". Data from the assessment results from small group trials obtained a score of 80.89%, and qualified as "good".

9. Educator Trials and Student Trials on Media

The field trial took place at Adhyaksa I Middle School, Jambi City. The product trial began with trial activities on two mathematics educators, namely M. Nurcholis, S.Pd, and Rohamin. The results of the trial of 2 mathematics educators were analyzed so that an assessment score of 87.33% was obtained and the qualification was "good" so that the media was not revised, and was ready to be used in learning, namely in mathematics learning on the material of geometric shapes with curved sides of tubes, cones and balls.

Student responses to RME media are described in the following table:

Table 6. Student Responses to RME Media

No	Variable	Score	(%)
1	The attractiveness of the media display for me	171	87,7
2	The ease of using this media for me	150	76,9
3	Clarity of the learning objectives that I will achieve	157	80,5
4	Clarity of the sequence of learning material for me	159	81,5
5	I can easily understand the sequence of learning material	159	81,5
6	By displaying pictures, it makes it easier for me to study the material	168	86,2
7	Clarity of learning summary for me	156	80,0
8	Example questions and evaluation questions can improve my understanding of the material	167	85,6
9	I easily understand evaluation questions	157	80,5
10	The questions in the evaluation questions are according to my abilities	157	80,5
11	The feedback provided helps me to measure the success of my learning	162	83,1
12	I need enough time to complete the activity	159	81,5
13	This media can motivate me in studying	173	88,7
14	The size and type of letters are easy for me to read	175	89,7
15	The benefits of this media for me	179	91,8
	Total score	2.449	83,73 %
	Maximum Score	2.925	

The data from the trial results on educators were analyzed so that the score was 83.7%, and qualified as "good" so that the media was not revised and was ready to be used in learning.

10. Learning Result Test Data

The purpose of carrying out tests in the experimental class and control class is to determine differences in learning outcomes as a result of differences in learning treatment. Student trials were carried out in the experimental class and were attended by 39 students and 38 students as the control class. The experimental class took lessons using Realistic Mathematics Education (RME) media, while the control class did not use RME media. The lesson material is delivered in 5 meetings with 2 hours of

learning time per face to face. The computer used is one computer for two students. The results of field trials on educators were 83.7%, and the qualifications were "good". The purpose of carrying out tests in the experimental class and control class was to determine differences in learning outcomes as a result of differences in learning treatment. From this average, it can be seen that the average score in the experimental class is higher than the average in the control class, namely 81.65 for the experimental class and 78.39 for the control class. This proves that RME media is effectively used in learning.

Adhyaksa I Middle School, Jambi City has adequate facilities to carry out mathematics learning using computer-assisted learning media, namely using Realistic Mathematics Education (RME) media with macromedia flash. The development of Realistic Mathematics Education (RME) based media with macromedia flash was carried out in several stages. Each stage is carried out as well as possible in order to produce appropriate and quality media, namely achieving the set learning objectives. The use of RME media in learning, although it encounters various obstacles, according to researchers, is temporary. These obstacles will be overcome if the RME approach is applied frequently. This really depends on the wishes of educators, students and other related parties.

The results obtained in the design stage are writing scripts, flowcharts, storyboards and screens. The manuscript that has been written is loaded on media using the Macromedia Flash application and consists of three parts, namely the beginning, the main part and the end (cover). The first part is an opening before entering the material which contains a welcome video. The core section contains the main menu and sub-menu material which is presented in an attractive manner. The main menu contains five sections, namely SK-KD-Objectives, introduction, materials, evaluation, and competency test. Meanwhile, the material sub menu contains material tutorials, namely definition, elements, properties, side area, volume, example questions and practice questions. The closing section contains thanks to media users. After the script is determined, a flowchart is created to describe the flow of the material and a storyboard to explain the appearance of the media.

Preparing scripts related to media pages includes writing text, images, animation, audio, video, sample questions, practice questions, evaluation questions, and competency test questions according to flowcharts and storyboards, and creating screen designs which include background coloring, navigation structure, animation and text. After all the parts are finished, the next step is to provide narration and sound effects, then the file is saved and a test movie is carried out. The final process is editing and packaging the RME media onto a CD. Validation aims to systematically evaluate the product. The Realistic Mathematics Education (RME) media product focuses on interactivity, therefore the material in the media must contain problems related to curved sided geometric shapes (BRSL) material.

Learning using Realistic Mathematics Education (RME) media allows students to interact effectively, makes it easier to provide guidance to students to be more active in developing their attitudes and knowledge about mathematics according to their abilities and can present material more meaningfully, thereby fostering motivation in order to improve learning outcomes(Ardina et al., 2019; Yetri et al., 2019). The test aims to determine the difference in learning outcomes after using RME-based media and the learning outcomes of the control class which does not use media in learning. The learning outcome test data shows that the average score for the experimental class is higher than the average score for the control class, where the experimental class score is 81.65 and the control class is 78.39. Based on the results of this analysis, it is informed that Realistic Mathematics Education (RME) media can improve learning outcomes. This proves the effectiveness of using Realistic Mathematics Education (RME) media in learning material on curved geometric figures.

CONCLUSION

The conclusion of this research is that the development of RME media goes through four stages, namely analysis, planning, development and implementation. A needs analysis was carried out by examining the need for computer-assisted learning media and supporting facilities at Adhyaksa I Middle School, Jambi City. At the design stage what is carried out is (1) writing the manuscript; (2) making storyboards, making flowcharts and designing screens; (3) collection of material, example questions and exercises, evaluation questions and competency test questions, animated images, videos, music, buttons and navigation. RME media development was carried out using the Macromedia Flash Pro 8 application as a programming tool, and other supporting programs such as Ulead, Power Point and so on. Product implementation is carried out through three stages, namely expert validation, individual and small group trials, and field trials. The use of Realistic Mathematics Education (RME) media in learning can improve students' mathematics learning outcomes in flat curved geometric shapes.

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