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Development of Interactive Learning Video Media to Improve Mathematical Representation Ability on Data Presentation Material

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Abstract

One of the main challenges in learning mathematics is overcoming students' difficulties in understanding abstract mathematical material and the lack of engaging and interactive teaching methods. The aim of this research is to develop interactive learning videos that are valid, effective, and practical. This Research and Development (R&D) study uses the ADDIE model. The research subjects were 15 students of class VII A MTsS Ash-Shalihin.. The results of the study show that the interactive learning video is highly valid with a score of 3.7 from expert evaluations. Teacher responses received a score of 3.67, which is categorized as very practical, while student responses received a score of 3.34, indicating that the video is very effective. The t-test and N-Gain test showed a value of 0.67, indicating an improvement in students' mathematical representation abilities in the moderate category. Thus, the learning video has proven to be effective.

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INTRODUCTION

Education is a structured process that aims to facilitate learning, development of skills, knowledge, values, and habits in individuals or groups. Education helps humans evolve with the times, including advances in information technology (IT) (Zega & Mendrofa, 2023). As a global science that drives modern technological advances, mathematics plays an important role in developing human thinking skills and also in various other disciplines (Meisy Sella Maria et al., 2022). Mathematics is very important for education because it contributes to the development of learners' cognitive abilities. Thus, to be able to participate well in mathematics learning, we need to master mathematical skills (Mulyaningsih et al., 2020).

The National Council of Teachers of Mathematics (NCTM, 2014), says that "the mathematical thinking process in mathematics learning, students must have five competency standards, namely (1) Mathematical communication, (2) Mathematical connections, (3) Mathematical reasoning, (4) Mathematical problem solving and also (5) Mathematical representation". Based on the five mathematical abilities, an important skill mastered by students in the process of learning mathematics is the ability of mathematical representation, which involves the ability of students to show, interpret, and model mathematical data into various forms such as visual, verbal or symbolic (Apriliyani et al., 2022). Therefore, it is

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hoped that teachers will be able to find effective methods to improve students' mathematical representation skills.

Studies have been conducted by Pasehah & Firmansyah (2019) have found that the ability of material to be represented mathematically in data presentation is very low. In line with this, from the initial observation of Zega & Mendrofa (2023) that the mathematical representation ability of students with a value of 20.41 is categorized in the low category. This is considered in accordance with the learning achievement for mathematical representation skills stated in the students' exams and also the results of students' answers show that in terms of mathematical modeling they are still lacking in being able to model related problems given, have not been able to use mathematical expressions to solve a problem, and have not been able to make illustrations for tasks.

In addition, based on the results of interviews conducted with mathematics teachers in class VII at MTsS Ash-Shalihin, it can be seen that one of the obstacles in the learning process is the lack of learning media in the learning process that can be used to support the improvement of mathematical representative abilities in students. In addition, students' believe that mathematics is a difficult subject for them so that it can affect the way they think which can have an impact on the ability of students to understand the material after learning (Wati et al., 2022). This shows that in the learning process there are many things that must be considered not only about the subject matter. For example, the use of media in learning activities is very helpful for teachers in the learning process in the classroom. Learning media that can be adapted to students can help them with new things or experiences (Sapriyah, 2019). Mathematics learning programs will be better if they use technology and tools to help learners understand concepts, reason, and communicate (NCTM, 2014).

Research and development of interactive learning video media has been conducted by Zega & Mendrofa (2023) who concluded research and development of interactive learning video media. They found that there was an increase in students' mathematical representation skills in the use of learning video media, with a score of 20.41 in the initial test and 75 in the final test. The conclusion is that learning videos improve students' mathematical representation skills and can be said that interactive learning videos are effective to use. And in his research using the Plomp development model, while this research used the ADDIE development model. In addition, research on making interactive videos found that interactive videos are useful, effective, and suitable for use during the learning process. Maria Ayu Fitri Lestari et al. (2023) in her research using the 4 D development model and focusing on students' mathematical understanding and representation. Az zahra et al. (2023) also concluded that making interactive learning video media can make students' interest in learning increase and is suitable for use. In this study, the focus of the research is on the ability of mathematical representation in students, but previous research focuses on the progress of students' interest in learning.

Data presentation material is one of the materials contained in the independent curriculum that needs to be mastered by every seventh grade student. This interactive learning video discusses material about presenting data in various formats, such as tables, lines, and circles. It is expected that students can read data diagrams and present data in these various formats. Every teacher wants their

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students to get optimal learning processes and results, through learning that is fun, innovative, active, creative, and liked by students who can be adjusted to learning objectives.

The efforts made by educators in building a learning process that is expected to make the representation ability of students increase, this is one of the problems that need to be overcome. Thus, researchers are interested in further examining the mathematical representation skills used to convey their ideas, especially in the use of interactive video learning media with the material used, namely, data presentation material. Therefore, this research aims to develop learning media in the form of interactive videos on data presentation material for class VII students at MTsS Ash-Shalihin that are effective and practical to use.

RESEARCH METHOD

This research is a type of development research that uses the Research and Development (R&D) approach. Seels & Richey (1994), as cited in the book "Research and Development Methods" by Setyosari (2016), explained that: "Development research, defined as a systematic study in designing, developing and evaluating instructional programs, processes and products that must meet the criteria of internal consistency and effectiveness". In line with that, the R&D research method according to Sugiono (2009: 407) is a research method that is applied in order to obtain a product, then test the effectiveness of the resulting product (Khaeroni, 2021) On the basis of this definition, the Research and Development approach is used with the aim of conducting a development of learning media in the form of interactive videos, especially on data presentation material.

The process of developing this interactive learning video follows the ADDIE model including: Analyze, Design, Development, Implementation, and Evaluation. The development process using the model:

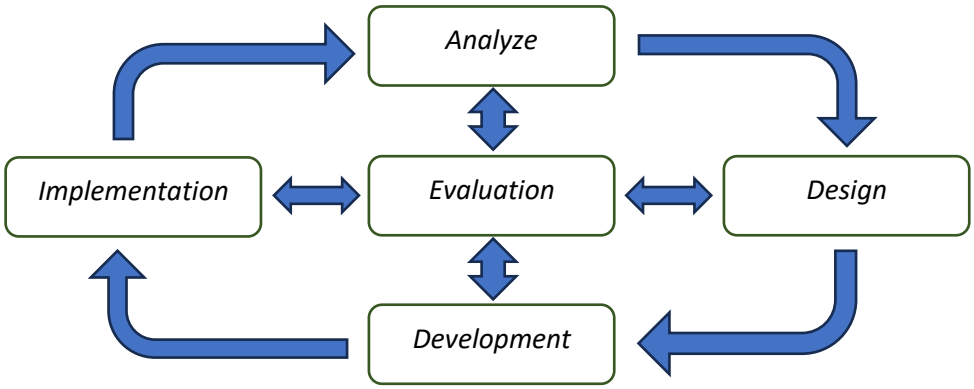

Figure 1. ADDIE model

Research Subject

The location of this study was conducted at MTsS Ash-Shalihin and the research subjects were 15 students of class VII A. This research took place for two meetings, namely on May 14, 2024 and May 21, 2024. This study aims to develop learning media in the form of interactive videos on data presentation material,

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which are expected to be effective and practical in their use by seventh grade students at MTsS Ash-Shalihin.

Data Collection

Data collection techniques used by researchers in this study include; (1) interviews, to get initial information from students and teachers about learning mathematics; (2) questionnaires, researchers use questionnaires in the form of validity questionnaires and teacher response questionnaires and also students; (3) tests, in this study the tests were in the form of pre-tests and post-tests, in order to determine the ability of mathematical representation in each student and determine the effectiveness of learning video media that have been developed by researchers; (4) documentation.

Data Analysis

The descriptive qualitative approach in this study was used to analyze the data, which aims to describe the results of data collection. The data analyzed included responses from validators, response questionnaires from students and teachers, and student test results. In addition, the instrument used for validators was made in the form of a Likert scale of 1-4.

Table 1. Criteria for Validation Instrument Answers with Likert Scale Type 1-4 Along with the Score

No.	Answer	Score
1	Very Good	3,25 – 4
2	Good	2,50 – 3,25
3	Fair	1,75 – 2,50
4	Less	1 – 1,75

Source : (Meilina et al., 2020)

When the average of the validation results can be calculated using the formula:

$$\overline{X} = \frac{\sum X}{N}$$

Information :

$\overline{X}$: Final response score

$\sum X$: Average score for each respondent

N : Number of respondent in the study

The final score value obtained is then converted to a scale of four. According to Widoyoko (2012), in Meilina et al. (2020) expressed the determination of the interval distance (Ji) formula:

$$J_i = \frac{(t - r)}{JK}$$

Information :

t : Higher score on a scale of 4

r : Lowest score on a scale of 1

J_i : Number of interval classes = (4-1)/4 = 0,75

For data from teacher and learner response questionnaires, obtained from a Likert scale of 1-4. The following is a score limitation guide for the questionnaire:

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Table 2. Scoring Guidelines for Teaching and Learner Response Questionnaires

No.	Category	Statement Score	
		Positive	Negative
1	Strongly Agree	4	1
2	Agree	3	2
3	Disagree	2	3
4	Strongly Disagree	1	4

Source : (Damanik & Syahputra, 2018)

Then the average score of each aspect was calculated by applying the following formula:

$$\bar{x} = \frac{\sum_{i=1}^{n} x_i}{n}$$

Information :

$\bar{x}$: Average score
x_i : Score Description of i-th
n : Number of statement items for each aspect

Meanwhile, to see whether or not there is a difference in the results of the pre-test and post-test, by passing the application based on the Paired Samples T Test. After obtaining the pre-test and post-test scores, the scores obtained will be analyzed. To analyze the scores obtained, researchers used the Gain normality test (N Gain Test). The N Gain Test was conducted, to determine the effectiveness that occurred from the treatment that had been given in a lesson. The following is the formula used in calculating the normality of gain according to Meltzer.

$$N\ Gain = \frac{S_{post} - S_{pre}}{S_{maks} - S_{pre}}$$

Information :

N Gain : Gain normality test value
S_{post} : *Post-test* score
S_{pre} : *Pre-test* score
S_{maks} : Maximum score

There is an effectiveness standard that is interpreted based on the N gain value according to Meltzer, which is in table 3.

Table 3. Classification of Gain Normality Values

N Gain Value	Criteria
$0{,}7 \leq n \leq 1{,}0$	High
$0{,}3 \leq n \leq 0{,}7$	Medium
$0{,}0 \leq n \leq 0{,}3$	Low

Source : (Oktavia et al., 2019)

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RESULTS AND DISCUSSION

This research develops videos in mathematics learning with the aim of teaching seventh grade students about data presentation. The creation of this media follows a structured process in the ADDIE model, with the stages described as follows.

Analyze Stage

The initial stage of this research is the analysis stage. The researchers conducted an analysis through interviews with mathematics teachers and students at MTsS Ash-Shalihin. From the results of interviews with teachers, it was found that during the learning process, the teacher only used a limited number of textbooks, did not use learning media, did not utilize the technology provided by the school properly, and the students' mathematical representation skills were still low, especially in data presentation material.

Learners expressed that they were bored with monotonous learning methods, as stated by their interviews. Learners feel that they have difficulty understanding the material taught by their teachers during teaching and learning activities, especially about data presentation. They are still confused in solving problems related to data presentation using tables, bar charts, line charts, and pie charts. At this stage, the data collected shows that learners need learning media to increase their drive, their interest, and their understanding of what is being taught.

Design Stage

In this step, the process of creating and developing interactive learning videos begins. The video is organized based on learning objectives, which consider the developmental stage of students. Some of the activities carried out include the preparation of material scripts, which include data presentation material for class VII at MTsS Ash-Shalihin. This material includes the steps of presenting data in various forms, such as tables, bar charts, line charts, and pie charts. In addition, this stage involves designing video concepts, including background selection, video format adjustments such as layout and back sound, and the sound recording process.

In the design stage, various measuring tools were also developed to evaluate the validity and quality of the developed learning videos. These measuring instruments include validation sheets for learning media, questionnaires to assess students' and teachers' responses, and tests to measure students' mathematical representation skills. The validation sheet plays a role in assessing the quality of the learning video produced. The questionnaire for teachers is used to evaluate the practicality of using the learning video. At the same time, the evaluation of the effectiveness of the learning video in making students' mathematical representation skills improve is used as a questionnaire for students' responses and evaluation tests before and after learning.

Development Stage

At this stage, related to the design that has been prepared previously will be carried out for the video development process. The following are the development steps that will be implemented:

a. Making Learning Videos in accordance with the Design in the Previous Stage

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According to Nurwahidah et al. (2021), video is the incorporation of audio-visual technology simultaneously using electronic media to produce dynamic and interesting impressions. The learning video was created using several software, namely Canva, FlipaClip, Cap Cut, and Pinterest. The video begins by greeting and displaying the title of the material to be discussed, then displays the learning objectives on the data presentation material. Next, the video highlights the discussion of the material with sample questions. In addition, there is also a closing section that includes a closing greeting and a thank you. The video is designed to be as interesting as possible by using background music to attract learners' attention and prevent boredom. The display of the video made by the researcher is as follows.

Figure 1. Opening and Title Material Display

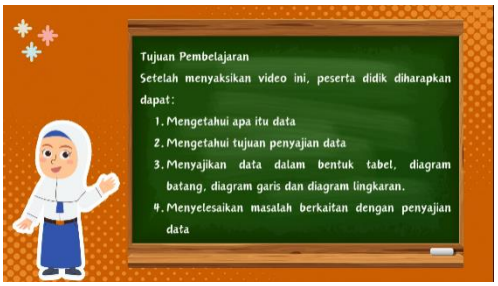

Figure 2. Learning Objectives Display

Figure 3. Display of Introduction to Material

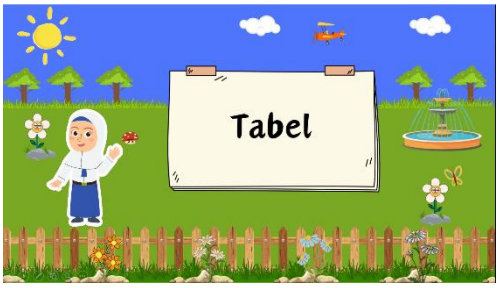

Figure 4. Display of Material Subchapter Title

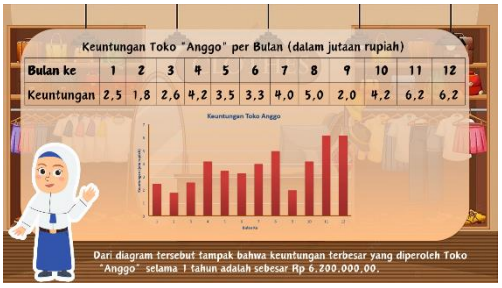

Figure 5. Material Display

Figure 6. Closing View

b. Learning Video Validation

After the learning video is developed, it will then undergo a validation process by experts. The purpose of this validation is to find and correct

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weaknesses before the video is applied in the classroom. Video assessment is conducted based on three main aspects: media quality, language clarity, and material richness. The validation sheet provides the following answer options: 1 (very invalid), 2 (invalid), 3 (valid), and 4 (very valid).

Table 4. Learning Video Validity Assessment Results

No	Assessment Aspect	Average Score	Category
1	Media Quality Aspects	3,6	Very Valid
2	Aspects of Language Use	3,7	Very Valid
3	Material Quality Aspect	3,7	Very Valid
	Total	3,7	Very Valid

Implementation Stage

The next stage, 15 seventh grade students at MTsS Ash-Shalihin will receive videos that have been made and passed the validation process to be tested. This trial took place in class VII A using a projector. Before showing the learning video, students work on pre-test questions to measure their understanding of data presentation material. Then the delivery of the material is done by showing the learning video that has been declared very valid for learning. After that stage, learners will evaluate their mathematical representation skills through post-test questions. Then, teachers and students will provide an assessment and response to the learning video that has been prepared through filling out a response questionnaire that has been prepared previously.

The results of the assessment conducted by teachers and students through the response questionnaire are the score obtained from the teacher's questionnaire is 4 which means that the learning video made is very practical to use. In addition, the effectiveness of learning videos is seen through giving response questionnaires to students after using learning videos. The student response questionnaire gives a score of 3.34 which is included in the very effective category.

In this test, there are four description questions for the pre-test and four more for the post-test, this test is prepared based on indicators of students' mathematical representation abilities. The results of these two tests are shown in Table 7.

Table 7. Students' Pre-test and Post-test Results

Pre-test Results		*Post-test* Results	
Value Range	Number of Participants Educate	Value range	Number of Participants Educate
$0 \leq$ Value ≤ 20	3	$0 \leq$ Value ≤ 20	0
$21 \leq$ Value ≤ 40	6	$21 \leq$ Value ≤ 40	0
$41 \leq$ Value ≤ 60	1	$41 \leq$ Value ≤ 60	1
$61 \leq$ Value ≤ 80	5	$61 \leq$ Value ≤ 80	9
$81 \leq$ Value ≤ 100	0	$81 \leq$ Value ≤ 100	5
Total Learners	15		15

To ascertain whether there is a significant difference between the pre-test and post-test results, a Paired-Samples T Test will be conducted. In addition, N-

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Gain testing will be used to assess the level of progress made by the students in their mathematical representations.

Table 8. Paired Samples Statistics

		Mean	*N*	*Std. Deviation*	*Std. Error Mean*
Pair 1	*Pre-test*	*48,00*	*15*	*23,664*	*6,110*
	Post-test	*80,00*	*15*	*13,628*	*3,519*

Table 9. Paired Samples Test

		Paired Difference							
		Mean	*Std. Deviation*	*Std. Error Mean*	*95% Confidence Interval of the Difference*		t	df	*Sig. (2-tailed)*
					Lower	*Upper*			
Pair 1	*Pre-test - Post-test*	*-32,000*	*12,071*	*3,117*	*-38,685*	*-25,315*	-10,267	14	,000

Using the Paired-Samples T Test analysis, the data from Table 8 shows that the average score of the post-test is 80.00, which is higher than the average score of the pre-test, which is 48.00. In addition, a significance value of 0.000 was obtained, which is lower than the significance value of 0.05. Therefore, it can be concluded that the pre-test score and post-test score are significantly different.

Table 10. Results of Improvement in Students' Mathematical Representation Ability

No	Description	Number of Learners	Average Improvement
1	High Category	4	
2	Medium Category	11	0,67
3	Low Category	0	
	Total	15	Medium

Based on information from Table 10, there is an average increase in students' mathematical representation skills of 0.67, which indicates that there is an increase in mathematical representation skills in students categorized in the medium category.

Evaluation Stage

The last stage is evaluation, which focuses on evaluating how effective the learning video media that has been developed is. The implementation of this learning video shows an increase in students' mathematical representation skills. Evaluation of the strengths and weaknesses is done by using validation sheets and also response questionnaires filled out by students and teachers. The results show that this interactive learning video is very valid, which means that this interactive learning video is very practical to be applied in learning activities. In addition, the assessment was also given by the teacher regarding the learning media developed

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and the results obtained that the interactive learning video media on data presentation material is very practical as a medium in learning activities.

Research and development that has been carried out using the ADDIE model produced a product in the form of an interactive learning video that aims to improve mathematical representation skills in data presentation material. This product has gone through several processes, namely analysis, design, development, implementation, and evaluation and is declared valid, practical and effective. This is based on a needs analysis using the ADDIE model, that the development of interactive videos using the ADDIE development model by producing products that are feasible and effective for the entire learning process and obtaining an excellent percentage of feasibility, which indicates that the ADDIE development model is successful in creating useful learning media (Jalal et al., 2023; Kasturi et al., 2022; Rahmawati et al., 2021).

Improving the ability of students in terms of mathematical representation can be achieved by utilizing this interactive learning video. This is by Murni et al. (2024) stated that students' ability to represent mathematics is more accurate when they use animation-based learning video media.

As a result, most respondents really liked the product designed for data presentation material. Therefore, it can be concluded that the learning video is effective and practical, and makes it easier for students to understand the material.

CONCLUSION

This research resulted in a learning video media that is considered very valid in improving mathematical representation skills. This assessment is based on the evaluation results from the validator who gave a score of 3.7. In addition, from the results of filling out the questionnaire by teachers and also students who gave a score of 3.67, which means that this media is also considered practical to be used in the learning process. The development of this media is considered effective for improving mathematical representation skills with a moderate improvement category determined from the results of the N-Gain pre-test and post-test by obtaining a value of 0.67. Thus, it was concluded that the interactive learning video media developed met the standards of validity, practicality, and effectiveness.

The interactive learning video developed in this study offers a solution to create more interesting learning and improve students' mathematical representation skills. It is also recommended for future researchers to further explore the development of interactive learning video media for various other materials and mathematical abilities.

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