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Development of Interactive Multimedia Through Realistic Mathematics Education Approach Assisted by Articulate Storyline

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Abstract

The purpose of this research is to develop interactive multimedia based on the Realistic Mathematics Education (RME) approach with Articulate Storyline, on the topic of Systems of Linear Equations in Two Variables (SPLDV), and to determine the validity and practicality of the product. This research employed the Research and Development (R&D) method using the ADDIE development model (Analysis, Design, Development, Implementation, and Evaluation). A small-scale trial involved with six students, and a large-scale trial was conducted with 26 eighth-grade students from MTs Urwatil Wutsqo Jepara. The results indicated that the interactive multimedia based on the RME approach supported by Articulate Storyline for SPLDV was highly valid and very practical for instructional use. The Evaluation by content experts resulted in an overall percentage score of 86.25% in the "highly valid" category. The assessment from media experts received an overall percentage score of 95% in the "highly valid" category. Additionally, the validation of the student response questionnaire experts obtained a percentage score of 87% in the "highly valid" category. The small-scale trial achieved a score of 83.33% in the "very practical" category, while the large-scale trial received a percentage score of 87% in the "very practical" category. This research provides an alternative for media developers to design digital teaching materials that are both interactive and mathematically meaningful. In addition, it can increase student engagement, especially in understanding abstract mathematical concepts. This study opens opportunities for future research on developing interactive multimedia using more flexible or AI-based platforms as innovative tools to enhance the quality of mathematics education.

Keywords: Development; Interactive Multimedia; Realistic Mathematic Education; Articulate Storyline; SPLDV.

Abstrak

Tujuan penelitian yaitu mengembangkan multimedia interaktif melalui pendekatan *Realistic Mathematics Education* (RME) berbantuan *Articulate Storyline* pada materi Sistem Persamaan Linear Dua Variabel (SPLDV) serta mengetahui kevalidan dan kepraktisan produk tersebut. Penelitian menggunakan metode *Research and Development* (R&D) dengan model pengembangan ADDIE (*Analysis, Design, Development, Implementation, Evaluation*). Pada tahap uji coba skala kecil pada 6 peserta didik dan uji coba skala besar dilakukan pada 26 peserta didik kelas VIII MTs Urwatil Wutsqo Jepara. Hasil penelitian menunjukkan bahwa multimedia interaktif melalui pendekatan RME berbantuan *Articulate Storyline* pada materi SPLDV dalam kategori sangat valid dan sangat praktis digunakan dalam pembelajaran. Penilaian dari ahli materi secara keseluruhan memperoleh nilai presentase 86,25% dengan kategori "sangat valid". Sedangkan penilaian dari ahli media secara keseluruhan memperoleh nilai presentase sebesar 95% dengan kategori "sangat valid". Selanjutnya hasil validasi oleh ahli angket respon peserta didik memperoleh nilai presentase sebesar 87% dengan kategori "sangat valid". Hasil uji coba skala kecil memperoleh nilai presentase 83,33% dengan kategori "sangat praktis". Pada uji coba skala besar memperoleh nilai presentase sebesar 87% dengan kategori "sangat praktis. Implikasi dari penelitian ini yaitu memberikan alternatif bagi pengembang media untuk menciptakan bahan ajar digital yang tidak hanya interaktif tetapi juga bermakna secara matematis. Selain itu dapat meningkatkan keterlibatan siswa, terutama dalam memahami konsep-konsep abstrak matematika. Penelitian ini membuka peluang bagi studi lanjutan mengenai pengembangan multimedia interaktif dengan platform lain yang lebih fleksibel atau berbasis AI dapat dijajaki sebagai inovasi untuk meningkatkan kualitas pembelajaran matematika di masa depan.

Kata Kunci: Pengembangan; Multimedia Interaktif; *Realistic Mathematics Education*; *Articulate Storyline*; SPLDV.

Introduction

Indonesia is beginning to enter the era of Industry 4.0 and Society 5.0, where technology plays a central role that accelerates and facilitates societal development (Kadarisman et al., 2022). In the era of Industrial Revolution 4.0, the education sector is expected to keep pace with the rapidly evolving technology and be able to effectively utilize it to support the learning process (Dwi Putriani, 2021). The presence of technology has given rise to various innovations that can enhance classroom learning activities. Educators must recognize that the education pursued by students cannot be separated from the development of an increasingly sophisticated era, the continuous growth of science and technology, which presents significant opportunities for improving the quality of education (Husaini, 2014).

One way technology is used as a tool in the learning process is through interactive multimedia. Multimedia can be defined as various types of information, including text, images, video, audio, numbers or words, stored as digital data in the form of digital data in a computer. This aligns with Vaughan's definition, cited in Rukimin's article, which defines multimedia as a combination of text, music, images, animation, and video processed by a computer or developed digitally (Rukimin,

2015). Hofstetter also stated that multimedia is not limited to a computer's function as a creator and combiner of text, graphics, audio, and moving images such as video and animation, but also has a role in integrating links and tools (Pratiwi & Siswanto, 2020). Learning multimedia is considered interactive if it has features that allow users to actively control and interact with the program. In this context, interaction involves humans and computers, where humans issue commands and computers providing responses. For example, interaction begins when a user presses a button, moves the cursor, shifts an object, performs a drag-and-drop action, or initiates any other command to start an interaction with the media. In response, the media executes user commands, such as playing images, playing videos, toggling audio, and performing other functions (Surjono Herman Dwi, 2017).

According to Computer Technology Research (CTR), human memory remembers 20% of what they hear, 50% comes from what they both see and hear. However, people are able to retain 80% of what is seen, heard, and done simultaneously. Thus, the use of interactive multimedia or learning media allows students to retain 80% of the presented information from the interactive multimedia (Setyowati et al., 2020). This is consistent with Arsyad's view that the use of media in learning can generate interest, motivation, and stimulation to learn (Arsyad, 2013).

Among the many emerging technologies, one software that supports to support the creation of interactive multimedia is Articulate Storyline. Articulate Storyline is an application developed by the Articulate Company, which specializes in e-learning and media software. This application supports the creation of animations through features that are almost the same as Adobe Flash and Macromedia Flash, however, it has a simpler interface (Dewi et al., 2021). Fundamentally, Articulate Storyline is almost the same as Adobe Flash software, however, it differs in that Articulate Storyline does not require programming for the creation process (Mallu & Samsuriah, 2020). Articulate Storyline is often referred to as a multimedia authoring tool that enables the creation of interactive multimedia applications in the form of text, images, videos, even animations, and practice simulations (Maesharoh & M.Si, 2022). The Articulate Storyline software includes various interactive features such as a zoom button to enlarge images, a question button to see a deeper explanation of the material, and navigation buttons in the form of Next, Back, and Submit (Rinjani, 2023).

This highlights the crucial role of interactive multimedia supported by Articulate Storyline crucial role. Articulate Storyline facilitates the development of learning media that integrates text, images, animation, audio, video, and

interactivity within a single platform. With the help of this software, RME-based mathematics materials can be presented in a more engaging, exploratory manner, aligning with the digital-native learning style of today's students (Nurjanah, 2015). In addition to its advantages, it has disadvantages, including an inability to display on a smartphone that cannot be completely full screen. However, in terms of content, all features function well, similar to when used on a computer (Qonita, 2024).

Mathematics learning students often perceive difficult and boring by students because its presentation is abstract and has minimal relevance to everyday life. This results in low conceptual understanding and reduced student motivation to learn. To overcome this challenge, learning media are needed that are not only interactive and interesting, but also able to present mathematical concepts contextually and meaningfully. In mathematics education, the use of multimedia is expected to increase motivation and assist students in understanding abstract mathematical concepts. One way to increase motivation in the use of multimedia is through interactive activities. According to Fauzi, interactive multimedia has significant potential to transform the way of learning, how to obtain information, and how to play (Fauzi & Kusri, 2014). Mathematics is a fundamental science that plays an essential role in everyday life. However, many students now perceive mathematics as the most difficult subject due to the abundance of formulas and numerical calculations. This phenomenon has an impact on the lack of motivation to learn mathematics for students so that the impact on mathematics learning outcomes is low. This is proven by the results of the 2018 Programme for International Student Assessment (PISA) survey, which showed that Indonesian students' learning outcomes ranked 74th out of 79 countries with an average PISA score of 379.29 (Schleicher, 2018).

One of the branches of mathematics that is often associated with real-life or contextual problems is the System of Linear Equations in Two Variables (SPLDV). However, in the presentation of this material, it is often delivered using conventional methods, resulting in abstraction in students of students (Yasin, 2016). Based on the results of interviews with teachers at MTs. Urwatil Wustqo Jepara, it was found that most of the classroom instruction was conventional methods centered on teachers, with the main learning source being student worksheets (LKS). While the use of learning media was used approximately four times in one semester, using PowerPoint media and learning videos. In addition, the teacher noted that many students at MTs. Urwatil Wustqo Jepara still struggled to understand the concept of the System of Linear Equations in Two Variables (SPLDV). This was based on the final semester test scores of grade VIII students, where only one student had a score above 75, with a class average of 72.

The SPLDV concept is highly applicable in everyday life, such as determining profits, finding the base price of goods, or even comparing the prices of goods. Story problems in the SPLDV material usually involve real-life scenarios in real life (Samiah, 2022). These problems usually require a deep understanding of each step of the process, such as translating the story into a mathematical model, formulating the SPLDV, and using the solution to obtain the answer to the question (Imansari & Sunaryantiningsih, 2022).

A learning strategy is required that combines mathematics with real-world situations, actively engages students in acquiring learning experiences, and offers an opportunity for them to address issues using their prior knowledge (Salsabila, 2023). One learning approach that can be used is the Realistic Mathematics Education (RME) approach, which aims to motivate students to deepen their understanding of mathematical concepts by connecting them to problems that occur in everyday life (Ningsih, 2014). In addition, RME is a learning concept that uses children's real-life experiences as problems in learning (Royyanah & Wahyuni, 2024). Integrating mathematics with everyday life aims to make learning more meaningful, thereby enhancing students' retention of the material. The RME approach emphasizes presenting mathematical concepts in real-world contexts, enabling students can construct their knowledge through modeling and exploration. However, conventional RME implementation still faces limitations in terms of visualization and student engagement (A. Sari & Yuniati, 2018).

Rizkiani and Septia's research on the metacognitive abilities of junior high school students studying mathematics using the RME approach revealed that this method significantly enhances students' metacognitive skills compared to traditional techniques (Rizkiani & Septian, 2019). Purwadi's research, The Effect of the Kahoot-Assisted RME Approach on Understanding Mathematical Concepts, revealed that pupils instructed using the Kahoot-assisted RME approach exhibited superior conceptual comprehension relative to those educated through the traditional technique (Purwadi, 2022). Despite previous studies, there are few that combine interactive multimedia with pedagogically appropriate approaches. For example, this study integrates interactive multimedia developed using Articulate Storyline with the RME approach. The urgency of this research is reinforced by the growing need in education to develop adaptive and innovative digital learning resources, particularly following the COVID-19 pandemic, which highlighted the importance of educational technology. Therefore, this research is highly relevant in addressing the challenges of 21st century learning and supporting the implementation of the independent learning curriculum that emphasizes student autonomy and creativity. Accordingly, this research focuses on 1) Describe the

design and development process of RME-based learning media using the ADDIE model; 2) test the validity (content and design); and 3) test the practicality (use in the field) of the interactive multimedia developed.

Method

This study employed the Research and Development (R&D) method, which is a research method used to produce a product and test its effectiveness (Sugiyono, 2017). This study was conducted in January 2024 and involved 32 students of eighth-grade MTs. Urwatil Wutsqo Jeparu. The reason for choosing the research location was that the school had previously taught SPLDV material. In addition, the school had adequate facilities and infrastructure to support the use of digital-based learning media, such as computer laboratories, internet access, and projectors in the classroom. The mathematics teachers at the school also demonstrated enthusiasm and openness toward learning innovations. Students were also accustomed to using digital devices in the learning process. The result of this study was an interactive multimedia product through the RME approach assisted by Articulate Storyline on SPLDV material. The purpose of this study was to examine the development process, validity, and practicality of interactive multimedia.

The development model used in this research was the ADDIE model (Analysis, Design, Development, Implementation, and Evaluation), developed by Lee and Owens (Mulyatiningsih, 2014). The use of the ADDIE development model allows for repeated revisions and evaluations at each stage, with the aim of producing a feasible, practical, and effective product (Endah, 2020).

Figure 1. Stages of the ADDIE Model



At the analysis stage, researchers analyzed the need for the development of learning media, analyzed the feasibility, and identified development requirements, such as information about students' abilities and understanding in the learning process implemented by teachers (Cahyadi, 2019). This stage consisted of performance analysis and needs analysis. Performance analysis aimed to determine whether the challenges faced by educators require a solution through improvements in teaching programs. Meanwhile, the purpose of the needs analysis was to identify the abilities and competencies students needed to improve performance and learning outcomes (Pribadi, 2009).

The design stage aimed to ensure the intended learning objectives and determine the methods or strategies to be applied (Branch, 2009). At this stage, it was necessary to clarify how the learning program is designed to achieve the learning objectives (Pribadi, 2009). Furthermore, the development phase involved several development steps such as creating, purchasing, and modifying teaching materials to achieve the predetermined teaching objectives. In developing teaching materials, adjustments needed to be made to align with the teaching objectives that have been designed by the developer in the design phase (Pribadi, 2009). The purpose of the development phase was to produce and validate teaching materials to be used (Branch, 2009). In this study, RME was used as the main framework in designing content and learning flow in the developed multimedia. Contextual problems were used as the starting point of learning in the multimedia. Each part of the multimedia presented real or semi-real problems to encourage students to engage in mathematical thinking from everyday experiences. The presentation of concepts was carried out in stages: from concrete examples to formal models, in accordance with the stages in RME.

The implementation stage referred to the stage referred to the developed teaching materials for students in the classroom. During implementation, the developed teaching materials were applied to real classroom conditions. After the teaching materials were applied, an initial evaluation was carried out to provide feedback or assessment of the teaching materials that had been implemented (Cahyadi, 2019). Each stage of media development was continuously evaluated so that minor errors in product development could be corrected immediately without waiting for the final product to be completed. The evaluation itself consisted of two types, formative evaluation and summative evaluation. Formative evaluations were carried out at every stage of development, from the analysis stage to the implementation stage. While summative evaluation was carried out at the end to assess the quality and feasibility of the product overall (Pribadi, 2009).

The instruments used in this study consisted of validation sheets and a students' response questionnaire. The validation sheets were submitted to expert validators, including media experts, material experts, and questionnaire experts. The validation sheets were used to assess the validity and feasibility of both the interactive multimedia and the questionnaires. The data obtained were then used as a reference for improving the product. The student response questionnaire was distributed to students with the aim of assessing the practicality of interactive multimedia.

The data obtained from these research instruments included quantitative and qualitative data. Quantitative data refers to numerical data that can be analyzed using statistics (Sugiyono, 2017). This data was obtained from the validation sheet assessment score by media experts, material experts, questionnaire experts, and the practicality assessment score by students for interactive multimedia using the Likert scale guidelines. Qualitative data are descriptive and do not prioritise numerical representation; they are conveyed through words or visuals (Sugiyono, 2017). In this study, the data were obtained from suggestions, comments, and conclusions from the validators who evaluated interactive multimedia. The trial results, obtained using the Likert scale, were calculated to determine the product's feasibility using the following formula (Irawati & Setyadi, 2021).

$$P(s) = \frac{s}{N} \times 100\%$$

Description:

$P(s)$ = presentage value

S = the number of scores obtained

N = number of maximum scores

After calculating the percentage value of each aspect and the overall assessment, the next step was to conclude the results of the average value obtained into qualitative data that was adjusted to the following criteria (Irawati & Setyadi, 2021):

Table 1. Validity Guidelines

Score	Category
$81\% < \bar{x} \leq 100\%$	Highly Valid
$68\% < \bar{x} \leq 81\%$	Valid
$52\% < \bar{x} \leq 68\%$	Quite Valid
$36\% < \bar{x} \leq 52\%$	Less Valid
$20\% < \bar{x} \leq 36\%$	Not Valid

Table 2. Practically Guidelines

Score	Category
$81\% < \bar{x} \leq 100\%$	Highly Practical
$68\% < \bar{x} \leq 81\%$	Practical
$52\% < \bar{x} \leq 68\%$	Quite Practical
$36\% < \bar{x} \leq 52\%$	Less Practical
$20\% < \bar{x} \leq 36\%$	Not Practical

Results

Analysis Stage

This stage represented the initial phase of interactive multimedia development using the RME approach. At this stage, the researcher conducted an interview with Mr. Joko Sutirno as a Mathematics teacher at MTs. Urwatil Wutsqo Jepara. From the interview, the researcher identified and categorized the existing problems that occurred into three categories, namely:

a. Analysis of Learning Material Needs

The use of teaching materials at Mts Urwatil Wutsqo identified and categorized the existing problems, namely only limited to student worksheet books (LKS). The lack of learning resources affected students' understanding. Thus, innovation in learning media was necessary as student learning materials, with interactive multimedia proposed as one of the solutions. With interactive multimedia was expected to increase students' motivation and interest in learning mathematics through engaging and visually appealing displays. Additionally, the material in the interactive multimedia was presented using the RME approach and structured systematically to help students develop a deeper understanding of the content.

b. Curriculum Analysis

At the time of the study, MTs Urwatil Wutsqo Jepara had begun implementing the Merdeka Curriculum in class VII, while Grades VIII and IX still followed the 2013 curriculum. In accordance with the subject of this study, the researcher referred to the basic competencies and learning objectives outlined for the SPLDV material in the 2013 curriculum. This curriculum also emphasized the active role of students in the learning process.

c. Analysis Of Student Characteristics

Based on the interviews, several students actively participated in class by responding to the teacher's questions and demonstrated an ability to understand the material presented. In addition, there were also several

students who tended to be passive, did not pay attention, and were even reluctant to read the source material they had. Based on the presentation of one student, there are also students who grasp the material during lessons, but when they are faced with exam questions, they often find it difficult to solve exam questions, especially the SPLDV material. Thus, this study aimed to provide a solution through the development of interactive multimedia through the RME approach, which is expected to increase students' interest and motivation to learn, make students more active in class, and help students understand the material more deeply.

Design Stage

The design stage marked the stage where researchers start designing an interactive multimedia concept. There were carried out several stages that researchers do in this phase, including researchers collecting various data needed to develop interactive multimedia products. This involved collecting SPLDV content from Grade VIII mathematics textbooks, web resources, and other pertinent references. After the data collection, researchers developed a concept with the help of a flow diagram that provides a brief overview of the entire interactive multimedia. After creating the concept of interactive multimedia, the researcher created a storyboard as an elaboration of the concept of interactive multimedia. In addition to being an explanation, this storyboard also functioned as a simple sketch of interactive multimedia.

Development Stages

In the development stage, researchers created interactive multimedia products using Articulate Storyline software. The interactive multimedia included several features and menus, such as the application homepage, main menu, about section, usage instructions, a competencies section with basic competencies, indicators, and learning objectives, a material menu with core SPLDV content using the RME approach, a quiz menu with practice questions and discussions, and a developer profile menu. The following is a display of the interactive multimedia that was developed:

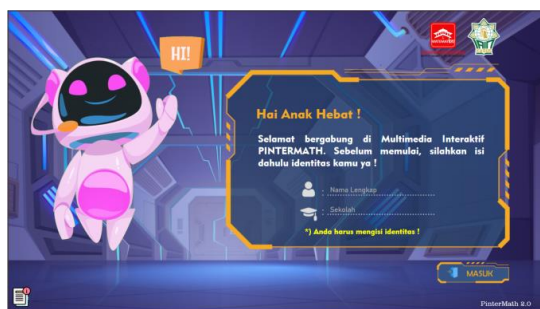




Figure 4. Display Of the Interactive Multimedia

After the product was completed, the researcher validated it with several experts in the areas of materials, media, and questionnaires before implementing it with students, with the aim of reviewing and evaluating the product. The following are the assessments conducted by the respective experts:

a. Material Expert Validation

Material expert validation aimed to assess the validity of interactive multimedia through the development of the RME approach assisted by Articulate Storyline on SPLDV material for grade VIII SMP/MTs in terms of material. his validation process involved two material experts: Naili Luma'ati Noor, M.Pd. as Validator 1, and Mulyaningrum Lestari, M.Pd. as Validator 2. Both material expert validators are lecturers in the Mathematics Education Department at IAIN Kudus. The results of the material expert validation are presented in the following table:

Table 3. The Result of Material Expert Validation

Aspect	validator		Total score	Max Score	Percentage Value	Criteria
	1	2				
Content Suitability	27	24	51	60	85%	Highly Valid

Aspect	validator		Total score	Max Score	Percentage Value	Criteria
	1	2				
Language	23	20	43	50	86%	Highly Valid
Presentation Suitability	24	20	44	50	88%	Highly Valid
Total	74	64	138	160	86,25%	Highly Valid

The validation results from the two material specialists were positive, demonstrating that the produced interactive multimedia fulfilled expectations. The product was developed by utilising the Realistic Mathematics Education (RME) approach and supported by Articulate Storyline, with a focus on the SPLDV material in Grade VIII SMP/MTs. In terms of content feasibility, multimedia scored an 85%, indicating that it is very genuine. The language element received an 86% rating, while the presenting feasibility aspect received an 88% grade. Overall, the multimedia received an average score of 86.25%, satisfying the extremely valid criterion and being deemed eligible for continued testing with minimal adjustments.

b. Media Expert Validation

Media expert validation was conducted to assess the validity of interactive multimedia developed using the RME approach, supported by Articulate Storyline, for SPLDV material for class VIII SMP/MTs in terms of media. This validation process involved two media experts, namely Nanang Nabhar F.A. M.Pd. who served as validator 1 and Rizqona Maharani, M.Pd. who served as validator 2. Both validators are lecturers in the Mathematics Education Department at IAIN Kudus. The presentation of the validation results is presented in the following table:

Table 4. The Result of Media Expert Validation

Aspect	validator		Total score	Max Score	Percentage Value	Criteria
	1	2				
Media Display	28	27	55	60	91,7%	Highly Valid
Language	15	15	30	30	100%	Highly Valid
Usage	34	33	67	70	95,71%	Highly Valid
Total	77	75	152	160	95%	Highly Valid

The validation results from the two media experts indicated that the interactive multimedia developed using the RME approach and supported by Articulate Storyline for SPLDV material in Grade VIII SMP/MTs received very high ratings. Specifically, it scored 91.7% for media display, 100% for linguistic quality, and 95.71% for usability, all of which fall under the “very valid”

category. Overall validation by media experts yielded an average score of 95%, which falls under the very valid category and was deemed the product suitable for testing with minor revisions.

c. Validation of Student Response Questionnaire Experts

After the material and media expert validators stated that the interactive multimedia was deemed ready to be tested on students using the student response questionnaire. The questionnaire validation was validated by two expert reviewers of the student response questionnaire, namely Wahyuning Widiyastuti, M.Pd. as validator one, who is a lecturer in the Mathematics Education Department at IAIN Kudus, and Joko Sutrisno as validator two, who is a Mathematics Teacher at MTs. Urwatil Wutsqo Jepara. The results of the validation of the student response questionnaire expert are presented in the Table 5.

Table 5. The Result of Questionnaire Experts Validation

Aspect	validator		Total score	Max Score	Percentage Value	Criteria
	1	2				
Questionnaire Presentation	41	46	87	100	87%	Highly Valid
Total	41	46	87	100	87%	Highly Valid

Based on the table of validation results of the student response questionnaire from the two questionnaire experts, it states that the student response questionnaire to interactive multimedia through the RME approach assisted by Articulate Storyline on SPLDV material for grade VIII SMP/MTs received an overall score of 87%, categorized as very valid and is suitable for use without revision. After obtaining data from expert validation, the researcher then refined the product before testing it on students by incorporating comments and suggestions from expert validators.

Implementation Stage

Products that had passed the validation and improvement stages were then tested to assess student responses and determine the practicality of interactive multimedia developed using the RME approach and supported by Articulate Storyline for SPLDV material for grade VIII SMP/MTs. This assessment was conducted in two stages: small-scale and large-scale.

The results of a small-scale trial of interactive multimedia through the RME-based Articulate Storyline product on SPLDV material for grade VIII SMP/MTs were

conducted with six students from MTs. Urwatil Wutsqo Jepara. The results of the small-scale trial can be seen in the following table:

Table 6. The Result of Small-scale Student Assessment

Aspects	Total score	Max Score	Percentage Value	Criteria
Effectiveness	102	120	85%	Highly Practical
Interactive	123	150	82%	Highly Practical
Efficient	147	180	82%	Highly Practical
Creativity	151	180	84%	Highly Practical
Usability	102	120	85%	Highly Practical
Total	625	750	83,33%	Highly Practical

Based on the table, the results of the questionnaire to the interactive multimedia developed using the RME approach and supported by Articulate Storyline for SPLDV material, overall it received a percentage score of 83.33% categorized as very practical and no comments, criticisms, or suggestions were provided, indicating that the product was well-received and ready for large-scale testing. The large-scale trial involved 26 students of grade VIII MTs. Urwatil Wutsqo Jepara. The results of the large-scale trial are presented in the following table:

Table 7. The Result of Large-scale Student Assessment

Aspect	Total score	Max Score	Percentage Value	Criteria
Effectiveness	462	520	88,84%	Highly Practical
Interactive	562	650	86,47%	Highly Practical
Efficient	672	780	86,16%	Highly Practical
Creativity	694	780	88,97%	Highly Practical
Usability	440	520	84,61%	Highly Practical
Total	2830	3250	87%	Highly Practical

Based on the results from the large-scale trial, interactive multimedia developed using the RME approach and supported by Articulate Storyline for SPLDV material received an overall percentage score of 87%, categorized as very practical. Specifically, the multimedia scored 88.84% for effectiveness, 86.47% in the interactive aspect, 86.16% in the efficiency aspect, 88.97% in the creativity aspect, and 84.61% in the usability aspect.

Evaluation Stage

The evaluation phase was conducted at each phase of ADDIE development. During the analysis phase, evaluation was conducted through interviews with mathematics teachers at MTs. Urwatil Wutsqo Jepara. The evaluation of the analysis

stage addresses the analysis of teaching material needs, curriculum analysis, and analysis of student characteristics. At the design stage, the evaluation was conducted by the developer during the preparation of interactive multimedia. The evaluation of the design stage included incorporating the agency logo in interactive multimedia. At the development phase, the evaluation was conducted by expert validators, both material expert validators, media expert validators, and questionnaire expert validators. The evaluation at this phase was based on comments and suggestions from the validators. In the implementation phase, students from MTs. Urwatil Wutsqo Jepara evaluated the multimedia through small-scale and large-scale trials by completing response questionnaires to assess its practicality. .

Discussion

Interactive Multimedia Development Process

The development of interactive multimedia was carried out by referring to the ADDIE development model, which consists of five phases, namely analysis, design, development, implementation, and evaluation. In the examination stage, the researcher analyzes the problems encountered in the teaching process through interviews. During the interviews, aspects related to teaching materials, curriculum implementation, and student characteristics. In the aspect of teaching materials, *the* researcher found issues including the minimal use of learning resources, which only used student worksheets (LKS). The lack of learning resources resulted in a lack of understanding and independence in student learning. The curriculum aspect is the stage where the researcher examined the curriculum implemented at Mts Urwatil Wutsqo as a reference in developing interactive multimedia. Currently, the school has started implementing the Merdeka Curriculum in grade VII, while grade VIII and IX still use the 2013 curriculum. Thus, the researcher referred to the 2013 curriculum in developing interactive multimedia because the subject of this research was grade VIII. The final element analyzed in this stage was the characteristics of the students. At MTs. Urwatil Wutsqo, some students actively participated by answering the teacher's questions and demonstrating understanding of the material. In addition, there were also several students who tended to be passive, showed a lack of attention, and were even reluctant to read the source material.

Based on the presentation of one of the students, some students appeared to understand the material during instruction, but when they were faced with exam questions, they often struggled to solve exam questions, especially the SPLDV material. Overall, these findings align with the research of Buyung et al. that students' low comprehension and interest negatively affect on mathematics

learning outcomes, partly due to the limited availability of instructional media in mathematics learning (Buyung et al., 2022). Furthermore, the use of learning media supports the view of Donasari and Silaban that such media play a role in increasing student motivation (Donasari & Silaban, 2021).

This research contributes to the body of knowledge in the development of mathematics instructional media. This aligns with the findings of Farida et al, who argued that media containing instructional media containing engaging videos and visually appealing content will enhance students' understanding of the material (Farida et al., 2019). Additionally, research by Sari and Wulandari stated that one of the factors that can increase students' interest and engagement in the Articulate Storyline learning media is the appearance of the media (Sari & Wulandari, 2020).

The development stage involved creating interactive multimedia with the help of Articulate Storyline. This interactive multimedia included the application homepage, main menu, about the application, instructions for use, competencies containing basic competencies, indicators, and learning objectives, a material menu containing the main material of SPLDV with the RME approach, a quiz menu containing practice questions and discussions, and finally a developer profile menu. Supports the findings that teaching has a positive influence and has the potential to improve students' abilities in solving mathematical problems (Habuke et al., 2022). Furthermore, Afifah, as cited in Ariani's research, explains that students better understand how to solve problems related to SPLDV if the material is presented through the cultural concepts that they encounter every day, which they can observe and experience directly (Ariani, 2021).

The subsequent stage was product implementation. However, before being implemented for students, interactive multimedia had to undergo a validation stage by expert material validators and expert media validators. Overall validation results, interactive multimedia developed using the RME approach and supported by Articulate Storyline on SPLDV material for grade VIII SMP/MTs that was developed, met the criteria of being very valid and suitable for use. This finding is supported by Utami and Wahyudi, who stated that expert validation allows evaluators to, expert validators will provide an evaluation of the product being developed. Comments and suggestions from expert validators served as a reference for refining the product, ensuring its readiness for classroom implementation (Utami & Wahyudi, 2021). Following expert validation and revisions based on their feedback, the product was tested on students to evaluate its practicality using a student response questionnaire that had also undergone expert validation. The results of the overall questionnaire expert validation indicated that the student response questionnaire

that was created met the criteria of being very valid and suitable for use without revision. This aligns with research by Irawan and Hakim, which emphasized that the practicality of instructional media is ultimately determined by its users (Irawan & Hakim, 2021).

The evaluation stage was conducted to enhance and refine the interactive multimedia developed. This stage was implemented at each phase of the ADDIE model. At the analysis stage, the evaluation is carried out by the mathematics teacher at MTs Urwatil Wutsqo. The design phase of the evaluation was conducted by the supervising lecturer. At the development stage, the evaluation was conducted by expert validators, including material experts, media experts, and questionnaire experts. At the implementation stage, the evaluation is carried out by students to assess the practicality of the product. This is consistent with the view that product quality evaluation is based on the questionnaire responses from media experts, material experts, and students involved in the practicality trials (Zulaikha, 2023).

This research related to the development of RME-based teaching materials is also supported by research by Ulandari et al. In their research, it was concluded that learning materials based on a realistic mathematics education approach met the criteria for effectiveness and improved mathematical problem-solving ability and student self-efficacy. Based on the results of the study, it was suggested that mathematics teachers implement instructional strategies using learning materials based on a realistic mathematics education approach (Ulandari et al., 2019).

Validity of Interactive Multimedia

In this study, validation was divided into three components, namely validation by material experts, media experts, and questionnaire experts. The results of the validation of material experts indicated that the interactive multimedia developed received a score of 86.25%, placing it in the 'very valid' category. This aligns with the findings by Irawati and Hakim, who stated that a score above 81% can be categorized as very valid media (Irawati & Setyadi, 2021).

The results of the media expert validation showed that overall interactive multimedia obtained a percentage value of 95%, which exceeds the 81% threshold and is therefore categorized as very valid and ready to be used with minor revisions. This is supported by Utami and Wahyudi, who concluded that the use of interactive media based on Articulate Storyline is valid, as demonstrated by a media expert validation score from media experts of 81.4% classified as 'very good' (Utami & Wahyudi, 2021).

The validation results from the student response questionnaire expert indicated that the questionnaire received a score of 87%, exceeding the 81% threshold, and was therefore categorized as very valid and suitable for use by students in assessing interactive multimedia without requiring revision. This finding aligns with Vadilla's assertion that before being used, the student response questionnaire was first validated by a questionnaire expert through evaluation and suggestions in order to obtain a valid questionnaire (Vadilla, 2022).

Practicality of Interactive Multimedia

The practicality test stage was conducted in two phases, namely small-scale trials and large-scale trials. small-scale trials involving six students of MTs. Urwatil Wutsqo. The overall results of this test yielded a score of 83.33%, which the percentage value was above 81% and was therefore categorized as very practical. In terms of individual aspects, the multimedia received 85% for effectiveness, 82% for interactivity, 82% for efficiency, 84% for creativity, and 85% for usability. These findings align with the research conducted by Utami and Wahyudi, who conducted a limited trial on six students by giving a student response questionnaire, which was then used as the basis for assessing the practicality of interactive media. In this study, interactive media obtained a score of 80.5% with a good category (Utami & Wahyudi, 2021).

The large-scale trial phase involved 26 eighth-grade students, MTs Urwatil Wutsqo. The results showed that the interactive multimedia developed using the RME approach received an overall score of 87%, qualifying it as very practical across all assessed aspects: effectiveness, interactivity, efficiency, creativity, and usability. Individually, the multimedia achieved 88,84% in effectiveness, 86,47% in interactivity, 86,16% in efficiency, 88,97% in creativity, and 84,61% in usability. This is relevant to the research conducted by Ariani, who conducted a practicality test of multimedia assisted by Articulate Storyline on 26 students by obtaining a score of 98.28%, with the criteria of being very practical as teaching materials in assisting the teaching process in SPLDV material (Ariani, 2021).

Conclusion

Based on the results of hypothesis testing and the discussion conducted, it shows that this study successfully developed interactive multimedia through the RME approach to SPLDV material. The product was developed using the ADDIE model, which consists of the following stages: a) Analysis stage, the researcher conducted an analysis of three aspects, namely analysis of teaching material needs, curriculum analysis, and analysis of student characteristics; b) Design stage, The

researcher designed the learning media by collecting reference materials, developing a concept through flow diagrams, and creating a storyboard for the multimedia elements; c) Development stage, where the researcher implemented the multimedia concept in the design stage with Articulate Storyline software; d) Implementation stage: before the product was tested with students, it was validated by material experts, media experts, and questionnaire experts. Following revisions based on expert feedback, a small-scale trial was conducted with six eighth-grade students at MTs Urwatil Wutsqo Jepara. After analysis, a large-scale trial was carried out with 26 students from the same school; e) Evaluation, conducted to improve and perfect the interactive multimedia developed. This stage is at each phase of the ADDIE development model.

The validity of the interactive multimedia development, based on validation results from material experts, overall achieved a score of 86.25%, with a highly valid category. The validation from media experts yielded a percentage value of 95% with a highly valid category. Therefore, it can be concluded that interactive multimedia developed using the RME approach for SPLDV material is highly valid both in terms of content and media.

The practicality of interactive multimedia was assessed through student response questionnaires. The multimedia received an overall practicality score of 87%, with 88.84% for effectiveness, 86.46% for interactivity, 86.1% for efficiency, 88.97% for creativity, and 84.6% for usability. Therefore, interactive multimedia through the RME approach on SPLDV material can be categorized as highly practical for instructional use.

This study was limited to the development of interactive multimedia aimed at enhancing students' cognitive abilities (conceptual understanding and problem-solving). The affective and psychomotor domains were not explored in depth. In addition, the development of interactive multimedia is only on the SPLDV material. These limitations present opportunities for future research. For example, future studies could incorporate assessments of attitudes, learning motivation, or student character when using this multimedia, aligning with the objectives of the Independent Curriculum. The multimedia could be expanded to cover other mathematical topics such as inequalities, trigonometry, or probability, enabling broader integration of the RME approach into the curriculum.

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