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Development of Interactive Learning Videos on Grade IX Spatial Structure Material

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Abstract

Mathematics instruction on three-dimensional shapes in ninth-grade junior high school is still dominated by conventional media, such as textbooks, worksheets, and static teacher explanations. As a result, students often struggle to understand abstract concepts, including nets, surface area, and the volume of three-dimensional shapes. Therefore, learning media are needed that can present the material in a more engaging, interactive, and accessible manner through Android devices. This study aims to develop interactive Android-based educational video media for teaching solid geometry to ninth-grade students. The study employed a research and development (R&D) approach using the ADDIE model, which consists of five stages: Analysis, Design, Development, Implementation, and Evaluation. The developed media were validated by media experts and subject-matter experts and evaluated through user feedback questionnaires. The data were analyzed using quantitative descriptive methods based on a Likert scale. The results showed that the developed instructional media received feasibility scores of 87.5% from media experts, 91% from subject-matter experts, and 91% from users. All evaluation results were classified as highly valid, indicating that the media have an attractive interface, are easy to use, and present content that is aligned with the learning objectives. Based on these findings, the developed interactive educational video media are considered suitable for use as a supplementary learning tool for teaching three-dimensional shapes to ninth-grade junior high school students.

Keywords Interactive Learning Video; GDevelop; ADDIE; Three-Dimensional Geometry (Solid Figures); Mathematics Learning Media

INTRODUCTION

Mathematics plays a crucial role in developing students' logical, critical, analytical, and systematic thinking skills; however, its teaching at the junior high school (SMP) level still faces various challenges. Many students view mathematics as a difficult, boring, and unappealing subject (Leonard & Supardi, 2010) (Saparwadi, 2016) (Lestari et al., 2018), a situation that results in low motivation and poor learning outcomes. Solid geometry is one of the most challenging topics because it requires strong spatial visualization skills and a solid conceptual understanding. (Arifin et al.,

2017) identified three main difficulties students face in learning about three-dimensional shapes: an inability to recognize the elements of three-dimensional shapes, poor recall of formulas, and difficulty applying formulas to solve problems; meanwhile,(Anugrah & Pujiastuti, 2020)found that students' most significant errors occurred in the areas of process skills and transformations. These findings indicate that the challenges in learning about three-dimensional shapes are systematic and multifaceted, rather than merely technical difficulties.

In addition to conceptual factors, students' learning difficulties are also influenced by ineffective study habits and differences in learning styles, particularly for visual learners who need concrete representations to understand abstract concepts (Syah, 2015). These conditions underscore the need for more adaptive instructional media innovations. Instructional videos are considered a promising alternative because they can provide dynamic and interactive visualizations, as demonstrated by(Aurellia et al., 2023) and (Dimyati et al., 2023) who found that videos effectively enhance students' understanding of mathematical concepts and their motivation to learn. The choice of the Android platform further underscores this urgency, given the high rate of internet usage among school-age adolescents in Indonesia which stands at 99.16% (Asosiasi Penyelenggara Jasa Internet Indonesia, 2021), meaning that Android-based media has the potential to reach students widely, independently, and flexibly.

Based on the above discussion, the research question addressed in this study is: How can an Android-based interactive video learning medium for Grade 9 solid geometry be developed that is suitable for use in the learning process? It is important to answer this question given the suboptimal utilization of Android-based interactive video media specifically designed for solid geometry, meaning that the gap between students' learning needs and the availability of appropriate learning media still needs to be bridged.

In line with this research question, this study aims to develop an Android-based interactive video learning medium on the topic of three-dimensional shapes for ninth-grade students using the GDevelop application, while also testing its suitability based on evaluations by media experts, subject matter experts, and user feedback. This study makes a scientific contribution by offering a model for developing mathematics learning media that integrates an interactive approach, spatial visualization, and Android-based accessibility a combination that has been explored only to a limited extent in studies on the development of learning media for three-dimensional shapes at the junior high school level. Thus, this study is expected

to provide an alternative solution to the limitations of conventional learning media while enriching the body of knowledge on technology-based mathematics learning media development.

METHODS

This study employs the R&D (Research and Development) method using the ADDIE model, which consists of the following five stages.

Analysis

The first stage was a needs analysis, in which the researcher identified the learning challenges faced by students through field observations of the Grade 9 solid geometry curriculum. The results of the analysis showed that students had difficulty visualizing the shapes and geometric components of solid figures, and that the learning materials available at the school were still limited and not interactive. These findings served as the basis for the researcher to design interactive video learning materials capable of presenting the material in a realistic and engaging manner.

Design

The second phase is the design phase, which aims to develop a preliminary design for the media before moving on to the development phase. This design phase includes establishing the main program structure, creating a storyboard, and designing the app logo. The main program structure is designed to define the flow and navigation of the interactive educational video in stages, starting with the login menu screen, the developer profile page, and the Learning Outcomes (LO) and Learning Objective Flow (LOF) pages. After that, users are directed to an introductory video that discusses the definitions and types of three-dimensional shapes, then proceed to the map page containing four learning levels: nets of three-dimensional shapes (Level 1), surface area formulas (Level 2), volume formulas for three-dimensional shapes (Level 3), and an evaluation stage in the form of a score display (Level 4). This structure is complemented by navigation buttons on each page to ensure the learning process proceeds in a systematic and focused manner.

Next, a storyboard was created as a visual guide illustrating the sequence of screen displays, content, text, images, audio, and interaction formats for each section of the media, including the login page, profile, CP-ATP, floor plan, content menus at each level, video-based content presentations, multiple-choice practice questions, and the score display during the evaluation stage. In addition, the design phase also included the design of the app's logo as the media's visual identity, which reflects the theme of spatial geometry while creating an appealing impression for users. The overall results of the program structure, storyboard, and logo design served as the

foundational reference for the researcher in implementing the media during the development phase using the GDevelop application.

Development

The third stage consists of two steps: the creation of instructional media and expert validation. Interactive video media were developed using the GDevelop application, incorporating background elements, sound, instructional videos, practice questions, and coding to make the presentation more engaging and simplify the understanding of three-dimensional shapes. After the media was completed, two experts a media expert and a subject matter expert conducted a validation using a questionnaire to assess the product's quality and suitability. The subject matter expert evaluated the content, language, and functionality, while the media expert assessed the design, interactivity, and functionality. The questionnaire responses were categorized using a Likert scale, as shown in Table 1.

Table 1. Product Category: Likert Scale Assessment

Skor Nilai	Kategori
5	Very Appropriate
4	Appropriate
3	Somewhat Appropriate
2	Inappropriate
1	Very Inappropriate

After validation and pilot testing, data analysis was conducted based on the scores obtained from each instrument. This analysis phase involved calculating the average percentage for each component using the percentage formula proposed by (Kamelia & Farisi, 2025) as follows.

$$N\ (\%) = \frac{Scores\ obtained}{Score\ maximum} \times 100\%$$

Keterangan:

N= Average percentage

The resulting percentages were then interpreted based on the validity criteria presented in Table 2. According to the table, a product is considered valid if the percentage is greater than 68%. If not, the product must be revised and retested until it meets the validation criteria.

Table 2. Media Testing Criteria

Kategori	Persentase (%)
Very Valid,	$84 < N \leq 100$
Valid	$68 < N \leq 84$
Somewhat Valid	$52 < N \leq 68$
Invalid	$36 < N \leq 52$
Very Invalid	$20 < N \leq 36$

Implementation

The fourth stage is implementation, which involves directly testing the media in the classroom to observe how students use it in accordance with the designed learning sequence. The pilot test was conducted with 21 students from Class IX A at SMPN 1 Kotaanyar. After completing the entire learning sequence, the students filled out a user feedback questionnaire to assess the effectiveness and appeal of the developed media.

Evaluation

The fifth and final stage is evaluation, in which the researcher synthesizes the data collected from experts and students to determine the practicality, feasibility, and user response to the media. The results of this evaluation are then used as the basis for improvements to enhance the quality of the final product. Data analysis in this study used a Likert scale, as shown in Table 1, and the conclusions are presented in Table 2. In addition to the results of the data analysis, an evaluation was also conducted based on observations made during the pilot test with students. Several issues that arose during the pilot test were recorded and used as input for evaluating the product.

FINDINGS AND DISCUSSION

The Capcut app is used to edit interactive video content according to a specified theme. After using the Capcut app to create interactive videos, practice questions, and explanations, the next step is to use the Gdevelop app to write code. The Gdevelop app is used to combine the interactive videos, practice questions, and explanations into a single video.

The initial screen displays a welcome page, as shown in Figure 1, which appears first when the learning media is launched. The welcome screen includes a field for entering a name, a play button, and a next button. To start the interactive learning media program, the user clicks the field to type in their name. The profile

screen is shown in Figure 2. Next, the user is directed to the CP ATP page, as shown in Figure 3. After that, the user is directed to an introductory video on the definitions and types of three-dimensional shapes, as shown in Figure 4.

Figure 1. Opening Screen

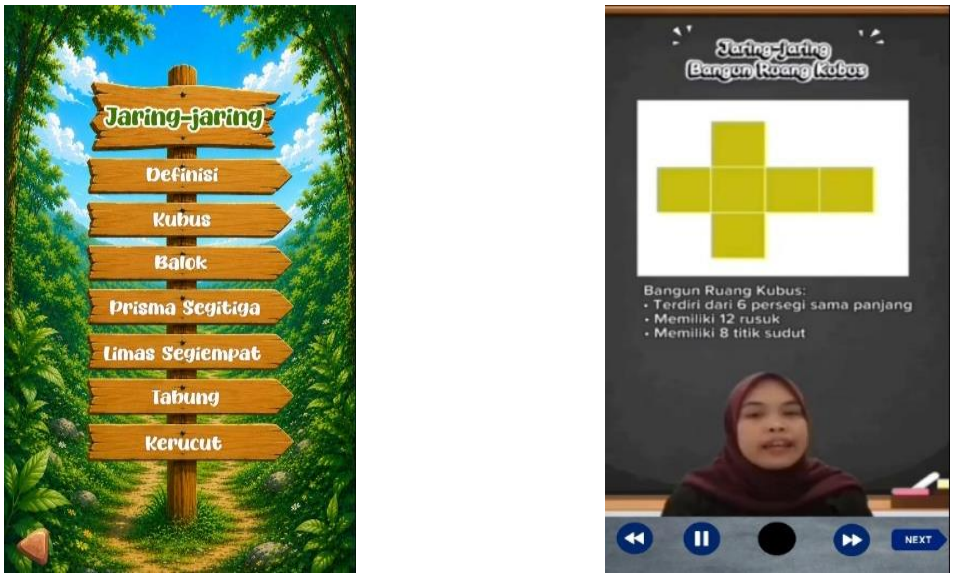
Figure 2. ATP CP Display

Figure 3. Introduction Section

After viewing the introductory material, users will be directed to the map page, as shown in Figure 5. The map page in this resource contains four learning levels. Users are required to work through the levels in order, from Level 1 to Level 4. However, users can revisit any level they wish to study again. Each level includes instructional material, practice problems, and video explanations. Levels 1 through 3 feature short instructional videos, practice problems, and video explanations. Level 1 covers nets, Level 2 covers surface area, and Level 3 covers volume. Level 4 is an assessment stage that presents 10 questions to measure students' skills and understanding after studying all the material.

Figure 4. Floor Plan View

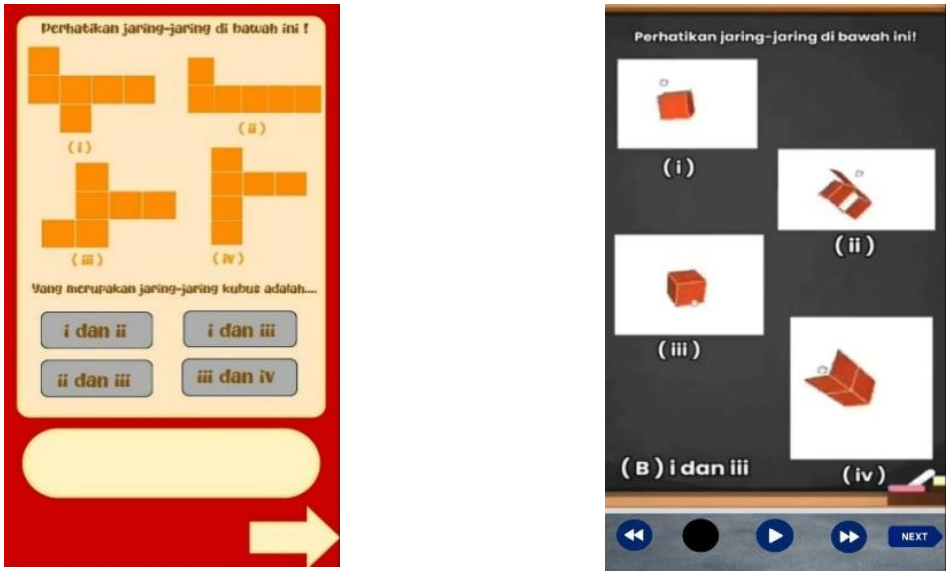
The course material menu in this media consists of three levels: Level 1, Level 2, and Level 3, with different content coverage at each level. Figure 6 (a) shows the course material menu. When a user selects a course from the menu, the media will display an instructional video corresponding to the selected course. Figure 6 (b) shows the learning material display. After the video finishes playing, a button will appear that directs the user back to the content menu, allowing the user to select the next topic in the desired order. Once all topics at a given level have been studied, a button will appear to proceed to the practice exercises for that level.



(a) (b)

Figure 5. Course Materials Menu and Video Materials

The platform also provides practice questions in a multiple-choice format with four answer choices A, B, C, and D as shown in Figure 7 (a). Each time a user answers a question, they receive instant feedback indicating whether the answer is correct or incorrect. Then, by pressing a button, users are directed to explanatory videos for Levels 1 through 3; the layout of these videos is shown in Figure 7 (b). Next, at Level 4, there is an evaluation section consisting of ten questions with an automatic scoring system. Each correct answer earns ten points, while incorrect answers earn no points.



(a) (b)

Figure 6. Preview of practice questions and video explanations on the platform

After the user completes all the assessment questions at Level 4, a final screen appears showing the total score based on the number of correct answers. This screen is intended to provide feedback on the student's level of understanding of the topic of three-dimensional shapes, while also marking the end of the learning sequence in this interactive video. Once the learning materials and the Gdevelop application have been developed, the next step is validation. Validation assesses the suitability of the learning materials before they are pilot-tested. During this validation phase, two experts a subject matter expert and a media expert evaluate the validity of the developed product.

Table 3. Analysis of Data from Media Experts

Aspect	Indicators	Score	Score Maximum

Design	Consistent layout and a uniform appearance across different sections of the media promote order and ease of use for media users	4	5
	Choosing colors and font types	4	5
	Clarity of text and visualization	4	5
	Image, animation, and video quality	4	5
Interactivity	Clear navigation and interactive buttons	5	5
	User-friendliness in operating the media	5	5
	Consistency in media usage patterns	5	5
	The media can run smoothly without any issues	4	5
Total		**35**	**40**
Percentage		**87,5%**	

Table 4. Analysis of Data on Subject Matter Experts' Findings

Aspect	**Indicators**	**Score**		**Score Maximum**
		Validator I	**Validator II**	
Contents	The material aligns with the learning outcomes and objectives.	4	5	10
	The material presented covers all aspects of solid geometry.	5	5	10
	The relevance of the examples and exercises to the material on three-dimensional shapes.	5	5	10
	Clarity of the question discussion.	5	4	10
Language	Use of language appropriate to the students' level of understanding	4	5	10
	Clarity of sentences in presenting the material	4	5	10
	Communicative and easy-to-understand language	4	5	10
	Media helps students	5	4	10

Functions	understand the concepts of three-dimensional shapes			
	Media support the mathematics learning process in the classroom	4	4	10
	Media can increase students' interest and motivation to learn	5	4	10
Total		**45**	**46**	**100**
Percentage		**91%**		

To assess whether the developed instructional materials met quality standards, one faculty member from the Mathematics Education Program was selected. Meanwhile, to assess whether the developed instructional materials met students' needs, two subject matter experts were selected: one faculty member and one mathematics teacher. The results of the instructional materials and subject matter expert validations are presented in Table 3 and Table 4, respectively.

Based on the validation results from media experts and content experts, the Android-based interactive video learning media on the topic of Three-Dimensional Shapes for 9th grade received a score of 87.5% from media experts and 91% from content experts; both scores fell into the "Highly Valid" category. These results indicate that the developed media meets the criteria for suitability, both in terms of appearance, navigation, and interactivity, as well as the alignment of the content with the learning objectives. After revisions were made in accordance with the validators' suggestions, the media was deemed suitable for pilot testing with students during the implementation phase. Since the media had been deemed highly suitable, a pilot test was then conducted with 21 9th-grade students to gather user feedback on the developed media. Table 5 contains data from the product pilot test results.

Table 5. Analysis of Data from User Testing Results

Nama Siswa	Aspek Penilaian	Jumlah	Skor Maksimum
A.K.S		25	25
H.N.J		25	25
K.A.R		24	25
M.A.R.D		22	25
M.I.F.G		25	25
F.O.N.H		22	25

K.D.T.R	23	25
M.R.H	18	25
T.D.J	24	25
F.A.P.J	24	25
A.F	25	25
N.S	25	25
Z.O	22	25
N.S	21	25
A.R	18	25
S.K.A	25	25
H.B	22	25
A.F	23	25
M.N.R	22	25
A.F.A	25	25
R.J	18	25
Total	478	525
Persentase	91%	

Based on the results of the user test data analysis in Table 4, the maximum total score was 525 and the total test score was 478, resulting in a percentage of 91%, which falls into the "Highly Valid" category according to the validity criteria in Table 2. These results indicate that students responded very positively to the developed educational media. Most students stated that the media's presentation was engaging, the material was easy to understand, and the available interactive features helped them learn independently. Additionally, students felt more motivated to study three-dimensional shapes because this media integrates videos, practice problems, and assessments into a single application

CONCLUSION

Based on the results of the research and development conducted, an Android-based interactive video learning medium on 9th-grade solid geometry was successfully developed using the ADDIE model (Analysis, Design, Development, Implementation, Evaluation). The development process was carried out systematically through the stages of needs analysis, media design, product development, implementation for users, and evaluation and revision based on validator feedback. The resulting product includes a splash screen, developer profile, CP and ATP pages, a learning map, interactive video content, practice questions, an assessment, and a total score display.

This media has undergone a validation process by media experts and subject matter experts, yielding results of 87.5% and 91%, respectively, both of which fall into the "Highly Valid" category. In addition, the user response survey results achieved a 91% rating in the same category, indicating that the media is easy to use, engaging, and helps students learn about three-dimensional shapes. Thus, the research objective of developing Android-based interactive video learning media on three-dimensional shapes for ninth-grade students has been achieved, and the resulting media is suitable for use as an alternative mathematics learning tool in junior high school.

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