

Development of Android-Based Interactive Learning Media for Polyhedra Using the ADDIE Model

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ABSTRACT

The integration of technology in mathematics learning is essential to overcome students' difficulties in visualizing abstract concepts, particularly polyhedra. This study aims to develop an Android-based interactive learning media and to determine its validity and practicality. The research employed a Research and Development (R&D) method using the ADDIE model, which consists of five stages: analysis, design, development, implementation, and evaluation. The subjects of this study involved three material experts, three media experts, and 10 junior high school students in a limited trial. Data were collected using expert validation sheets and student response questionnaires, and analyzed using descriptive percentage techniques. The results showed that the developed media achieved a validity level of 82% from material experts and 90% from media experts, both categorized as very valid. Furthermore, the practicality test conducted on students resulted in a score of 86%, which is categorized as very practical. These findings indicate that the developed media is feasible and supports students in understanding and visualizing polyhedra concepts. In conclusion, the Android-based interactive learning media developed through the ADDIE model is valid and practical as supplementary learning media. It has the potential to enhance students' motivation, independence, and learning outcomes in mathematics learning.

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INTRODUCTION

The development of 21st century technology has a major impact in various fields, including education. Schools as the center for the development of the nation's generation are required to be able to carry out interactive, inspiring and fun learning as mandated in Permendikbud No. 22 of 2016. One of the efforts that can be made is the utilization of Information and Communication Technology (ICT) in the planning, process, and assessment of learning (Amrullah, et al., 2023; Hidayat, et al., 2024). The presence of interactive multimedia is one form of ICT implementation that plays an important role in increasing motivation, understanding, and learner involvement during the learning process (Setiyadi, 2023).

Although almost all students have smartphones, initial observations at SMP Negeri 7 Metro show that the use of smartphones has not been optimized to support learning.

Most students still utilize smartphones only to play games or access social media during learning, resulting in low motivation, academic achievement, and active engagement. This is also reflected in the learning outcomes of spatial building materials that show a gap in achievement, where some students are able to understand the material well, but others still have difficulties, especially in visualizing basic concepts and applying formulas.

Based on these conditions, a learning strategy that is more varied, innovative, and in accordance with technological developments is needed. The development of Android-based interactive learning media is one solution that can be implemented (Dewi, et al., [2021](#)). This media is expected to be able to optimally utilize the potential of smartphones, facilitate the visualization of spatial shapes, improve concept understanding, and foster student learning motivation. In line with the opinion of Aryaningrum & Pratama ([2017](#)) and Sudiman ([2023](#)), the development of technology-based media is very important to create effective, meaningful learning, and in accordance with the demands of the digital era.

The results of research by Apsari & Rizki ([2018](#)) show that the development of Android-based learning media can create a pleasant learning atmosphere and attract students' interest. This media has advantages in terms of interactive design, both through color, writing, images, and animation (Abidin, et al., [2023](#); Hamdani, et al., [2022](#)). In addition, Android-based media is relatively easy to operate, understand, and in accordance with the instructions for use, making it easier for students to access material and practice questions (Darwin, et al., [2022](#); Iswara, et al., [2023](#)). The presentation of content equipped with images and animations in accordance with Learning Outcomes (CP) and Learning Objectives (ATP). makes students not easily feel bored while learning.

In line with this, research by Asela, et al., ([2020](#)) revealed that interactive media that combines various forms of media can assist teachers in managing learning more systematically. The delivery of material does not have to be done thoroughly because it has been integrated in the media, so the teacher can more easily direct the learning process. Interactive media also plays a role in fulfilling the diverse learning styles of students (Nurmalisa, et al., [2023](#); Lubis, et al., [2023](#); Urba, et al., [2024](#); Wulandari & Wardhani, [2024](#)). If different learning styles are not accommodated, then student motivation will decrease. Therefore, the use of interactive media such as Microsoft PowerPoint, videos, or interesting digital content has been proven to increase students' attention, engagement, and motivation in the learning process.

The solution offered in this research is to develop Android-based interactive learning media with the ADDIE development model. This model allows the development process to be carried out systematically through the stages of analysis, design,

development, implementation, and evaluation, resulting in products that are valid, practical, and in accordance with learning needs. This media is equipped with materials, practice questions, and interactive visual displays that are expected to help students understand the concept of flat-sided space building more concretely. With this capability, it is hoped that it can help students understand the concept of flat-sided spatial structures more concretely. In previous research, the development of this media used Construct 2 software to create interactive learning media. Using Construct 2 requires expertise and understanding in interactive design and requires time to learn the related software. In this study, the author used Microsoft PowerPoint to design and create interactive instructions without the need for coding. iSpring Suite 11 was used to convert it into HTML, then converted it into an application in Web 2 Apk Builder.

The purpose of this research is to develop Android-based interactive learning media on flat-sided space building material and determine the level of validity and practicality. The research results are expected to provide innovative media alternatives that support technology-based mathematics learning, increase students' motivation and learning independence, and help them understand concepts more deeply.

METHOD

This research uses the research and development (R&D) method with the ADDIE model which consists of five stages, namely Analysis, Design, Development, Implementation, and Evaluation. This model was chosen because it is suitable for the development of learning media that emphasizes a systematic process from needs analysis to product evaluation. According to Syahid, et al. (2024), ADDIE is an interconnected and sequential stage, functioning as a systematic assessment framework for the design, development, and evaluation of learning products to meet the standards of validity, practicality, and effectiveness. The stages of the ADDIE model cycle are illustrated in Figure 1.

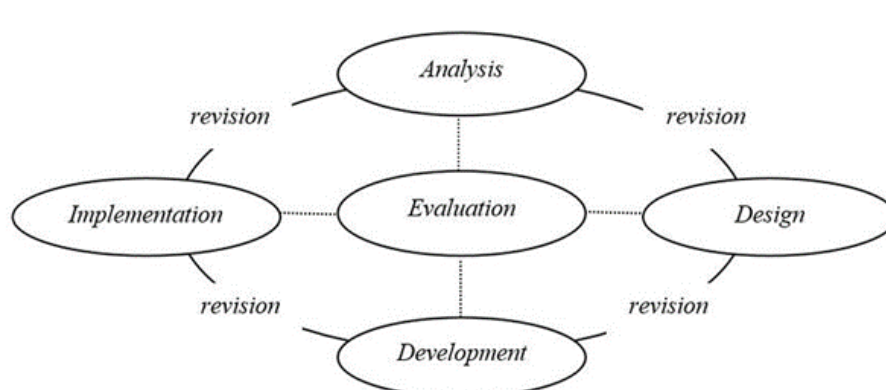


Figure 1. ADDIE Model Stage (Source: Branch, 2009)

In the analysis stage, needs, student problems, and learning characteristics were identified through classroom observations and teacher interviews. Identification of student needs was carried out by distributing needs questionnaires and analyzing student learning outcomes. The results of the analysis showed that students had difficulty visualizing spatial figures so that interactive learning media that could visualize objects clearly were needed. In classroom observations, it was found that 90% of students had smartphones brought to school. This could hinder learning activities. Therefore, the author developed interactive media with Android-based media. The design stage focused on preparing media designs in the form of display flows, navigation, content structures, and interactive features in accordance with basic competencies, indicators, and learning objectives, taking into account aspects of readability, ease of use, and attractive visual appearance. The development stage embodied the design into an Android application using supporting software, then validated by two material experts and two media experts to assess content suitability, clarity, and technical feasibility. After making improvements based on validator input, the product was implemented through a limited trial on 10 students. This implementation aimed to observe media use directly, assess ease of use, and measure student responses to the application. The evaluation phase was conducted continuously at each stage of ADDIE to ensure the achievement of objectives, with a primary focus on the product's validity, practicality, and potential effectiveness.

The research instruments consisted of a student needs questionnaire, subject teacher interview forms, observation sheets, expert validation sheets, and student response questionnaires. There were two types of expert validation sheets: the material expert validation sheet and the media expert validation sheet. The material expert validation sheet comprised four aspects: learning objectives, content suitability, material presentation, and language. The material expert validation sheet was administered to two mathematics education lecturers and one mathematics teacher. The media validation sheet comprised three assessment aspects: animation, learning design, and audio-visual communication. The media validation sheet was administered to one mathematics education lecturer, one computer science lecturer, and one mathematics teacher. The student response questionnaire was used in a limited trial with 10 students. The questionnaire consisted of two assessment aspects: material and media. Data obtained through validation and questionnaires were then analyzed descriptively quantitatively using percentages to determine validity and practicality categories, while qualitative data in the form of comments and suggestions were analyzed to improve the product to suit learning needs. The level of validity and practicality was analyzed using a formula, and the percentage results were interpreted based on the validity and practicality categories so that the media could be said to be suitable for testing. The following percentage

formulas and media feasibility categories and practicality are listed in Formulas 1 and 2 and Tables 1 and 2.

Formulas 1. Product Validation Percentage Formula

$$Percentage = \frac{\text{Number of validator scores}}{\text{Maximum score}} \times 100\%$$

Table 1. Validation Result Criteria

Weighting	Category	Assessment
5	Highly Valid	$80 < N \leq 100$
4	Valid	$60 < N \leq 80$
3	Sufficiently Valid	$40 < N \leq 60$
2	Invalid	$20 < N \leq 40$
1	Highly Invalid	$0 < N \leq 20$

(source: Adaptation by Riduwan & Akdon (2020))

Formulas 2. Product Practicality Percentage Formula

$$Percentage = \frac{\text{The number of scores given syudent}}{\text{Maximum score}} \times 100\%$$

Table 2. Product Practicality Criteria

Weighting	Category	Assessment
5	Highly Practical	$80 < N \leq 100$
4	Practical	$60 < N \leq 80$
3	Sufficiently Practical	$40 < N \leq 60$
2	Impractical	$20 < N \leq 40$
1	Highly Impractical	$0 < N \leq 20$

RESULTS AND DISCUSSION

Analyze

The problem analysis shows the gap between ideal and reality mathematics learning, especially on flat-sided space building materials. Observations and interviews revealed that learning is still limited to books, blackboards, and 2D images, so students have difficulty visualizing 3D objects and tend to be passive. The absence of concrete media is the main obstacle, causing differences in learning achievements between students. The needs analysis confirms the need for interactive media that visualizes 3D objects, given students' low understanding of surface area and volume. Digital media is considered important to increase interest and make it easier for teachers to convey material. The task analysis refers to the grade VIII Merdeka Curriculum, focusing on the elements of building space, nets, surface area, and volume, with a systematic material structure, sample problems, LKPD, exercises, and interactive quizzes.

Based on the analysis stage, it is concluded that Android-based interactive learning media is needed for learning flat-sided space building material to maximize the use of technology and help students visualize the concept of space building.

Design

The design stage aims to design an initial representation of Android-based interactive learning media that is in accordance with the learning outcomes of flat-sided space building material. Researchers started with the selection of media that supports student understanding, attractive and interactive display design to increase motivation, and the selection of concise, clear, and contextual material. The material includes elements of flat-sided spaces, nets, surface area, and volume, presented interactively so that students can easily visualize three-dimensional objects. The Merdeka Curriculum is used as a reference, so that the media meets the Learning Outcomes (CP) and the Flow of Learning Objectives (ATP).

Page design is done systematically, including cover, opening page, main menu, instructions, Learning Outcomes (CP) & Learning Objectives (ATP), material, exercises, quizzes, and developer profile. Each page is designed to be interactive, with navigation buttons, hyperlinks, animations, and illustrations that facilitate access to materials and evaluations. The cover and opener attract initial attention, the main menu facilitates navigation, the materials and exercises are presented interactively, while the quiz is used to measure student understanding. The whole design is optimized using Ms. PowerPoint with the slide size adjusting the Android device, so that it becomes a foundation that supports learning media that is valid, interesting, and able to activate two-way interaction.

Development

The development stage is the process of implementing the design that has been compiled in the previous stage into a learning media product that is ready for use. Researchers implement the design through a digital platform, utilizing Ms. PowerPoint which is exported to HTML using iSpring Suite 11, then converted into an application (.apk) through Web 2 APK Builder Pro.

Next, the media was validated by material experts and media experts to determine the validity of the Android-based interactive learning media. The validation process involved three material experts, consisting of two lecturers in mathematics education and one junior high school mathematics teacher, all of whom have expertise in mathematics content and curriculum implementation. Validation by material experts assessed four aspects: learning objectives, content feasibility, material presentation, and language.



In addition, the validation involved three media experts, consisting of one lecturer in mathematics education, one lecturer in computer science, and one mathematics teacher with experience in developing instructional media. These experts evaluated three aspects: animation, learning design, and audio-visual communication. The results of the material expert validation assessment are presented in Table 3.

Table 3. Content Expert Validation Results

Aspect	Validator			Score	Max. Score	Percentage	Category
	1	2	3				
Learning objectives	10	7	10	27	30	90%	Highly Valid
Content suitability	20	16	20	56	75	76%	Valid
Presentation of material	25	20	24	69	90	77%	Valid
Language	24	24	28	76	90	84%	Highly Valid
Final Percentage Expert Validation				228	285	82%	Highly Valid

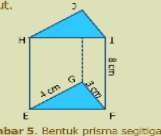
Based on Table 3, the final percentage of material expert validation results is 82% which falls into the "very valid" category, which indicates that the learning media is suitable for testing with revisions. Suggestions for improvement from material experts include the addition of learning objectives at the beginning of learning activities, sample problems are changed to fill-in guides to train students to solve problems, and "Let's try" is given a place to submit answers. Input from validators was used to revise the product so that it met the validity criteria and was feasible to be tested. Revisions made based on material expert suggestions are presented in Table 4.

Table 4. Revisions from Material Expert

Before Revision	After Revision
	

Contoh 2.1 Luas Permukaan Prisma

Gambar berikut merupakan prisma tegak segitiga siku-siku. Tentukan luas permukaan prisma tersebut.



Gambar 5. Bentuk prisma segitiga

Alternatif Penyelesaian

Untuk mencari luas permukaan prisma segitiga tersebut, terlebih dahulu kita cari panjang semua alasnya, yaitu

$$PK = \sqrt{KE^2 + KP^2} = \sqrt{4^2 + 3^2} = \sqrt{16 + 9} = \sqrt{25} = 5$$

Sehingga,

$$L = 2 \times \text{luas alas} + \text{keliling alas} \times \text{tinggi}$$

$$= 2 \times \frac{1}{2} \times 3 \times 4 + (3 + 4 + 5) \times 8$$

$$= 12 + (12) \times 8$$

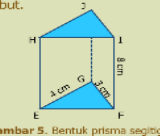
$$= 12 + 96$$

$$= 108 \text{ cm}^2$$

Jadi, luas permukaan prisma tegak segitiga siku-siku adalah 108 cm².

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$$= 2 \times \frac{1}{2} \times 3 \times 4 + (3 + 4 + 5) \times 8$$


$$= \dots + (\dots) \times \dots$$

$$= \dots + \dots$$

$$= \dots \text{ cm}^2$$

Jadi, luas permukaan prisma tegak segitiga siku-siku adalah 108 cm².

Ayo Mencoba 1



Sumber: grid.id Sumber: Lazada.co.id
Sumber: infomawaz.com Sumber: iStockphoto.com

Coba identifikasi bentuk-bentuk bangun ruang di atas. Unsur apa saja yang terdapat pada bangun ruang berikut. Jawablah pada lembar jawaban yang sudah disediakan.

Ayo Mencoba 1



Sumber: grid.id Sumber: Lazada.co.id
Sumber: infomawaz.com Sumber: iStockphoto.com

Tuliskan jawabanmu pada LKPD 1 yang sudah disiapkan atau di buku tulis sesuai dengan LKPD 1.

Kirim jawabanmu dengan mengklik tombol berikut. Kirim jawabanmu dengan mengklik tombol terhubung dengan internet.

JAWABAN

Coba identifikasi bentuk-bentuk bangun ruang di atas. Unsur apa saja yang terdapat pada bangun ruang berikut. Jawablah pada lembar jawaban yang sudah disediakan.

Validation was also conducted by three media experts, covering three aspects: animation, learning design, and audio-visual communication. The results of the media expert validation assessment are presented in Table 5.

Table 5. Media Expert Validation Results

Aspect	Validator			Score	Max. Score	Percentage	Category
	1	2	3				
Animation	23	25	22	70	75	90%	Highly Valid
Learning design	28	29	26	83	90	92%	Highly Valid
Audio-visual communication	46	47	40	133	150	89%	Highly Valid
Final Percentage of Media Expert Validation				286	315	90%	Highly Valid

Based on Table 5, the final percentage of media expert validation results is 90%, which falls into the "very valid" category, indicating that this learning media is suitable

for testing with revisions. The media experts suggested improvements, including diversification of 3D objects to increase relevance, modification of access to question discussion, and addition of explanation sounds to facilitate students' understanding of the material. The revisions made based on the media experts' suggestions are presented in Table 6.

Table 6. Revisions from Media Experts

Before Revision	After Revision
 <p>CAPAIAN PEMBELAJARAN Di akhir fase D peserta didik dapat membuat jaring-jaring bangun ruang (prisma dan limas) dan membuat bangun ruang tersebut dari jaring-jaringnya. Mereka dapat menjelaskan cara untuk menentukan luas permukaan dan volume bangun ruang (prisma, tabung, bola, limas dan kerucut) dan menyelesaikan masalah yang terkait.</p> <p>TUJUAN PEMBELAJARAN</p> <ol style="list-style-type: none"> 1. Mengidentifikasi unsur-unsur bangun ruang sisi datar (prisma dan limas) serta membuat jaring-jaring dan membuat bangun ruang sisi datar (prisma dan limas). 2. Menentukan luas permukaan dan volume prisma. 3. Menentukan luas permukaan dan volume limas. 4. Menyelesaikan permasalahan yang melibatkan luas permukaan dan volume prisma dan limas. 	 <p>CAPAIAN PEMBELAJARAN Di akhir fase D peserta didik dapat membuat jaring-jaring bangun ruang (prisma dan limas) dan membuat bangun ruang tersebut dari jaring-jaringnya. Mereka dapat menjelaskan cara untuk menentukan luas permukaan dan volume bangun ruang (prisma, tabung, bola, limas dan kerucut) dan menyelesaikan masalah yang terkait.</p> <p>TUJUAN PEMBELAJARAN</p> <ol style="list-style-type: none"> 1. Mengidentifikasi unsur-unsur bangun ruang sisi datar (prisma dan limas) serta membuat jaring-jaring dan membuat bangun ruang sisi datar (prisma dan limas). 2. Menentukan luas permukaan dan volume prisma. 3. Menentukan luas permukaan dan volume limas. 4. Menyelesaikan permasalahan yang melibatkan luas permukaan dan volume prisma dan limas.
 <p>Pendidikan Matematika UIN Metro</p> <p>Aplikasi Pembelajaran Matematika</p> <p>Bangun Ruang SISI DATAR Materi SMP/MTs Kelas VIII</p> <p>MASUK</p>	 <p>Pendidikan Matematika UIN Metro</p> <p>BangunKu Bangun Ruang Sisi Datar</p> <p>Untuk Siswa SMP Kelas VII</p> <p>Disusun oleh: Amalia Nurhayati Syakinnah</p> <p>MASUK</p>

After revision, a small group trial was conducted on 10 random students to assess the response, and practicality of the media. The small group trial involved 10 students from SMP Negeri 7 Metro. The results of the learner response assessment are presented in Table 7.

Table 7. Small Group Trial Results

Aspect	Score	Max. Score	Percentage	Category
Media	483	550	88%	Highly Practical
Content	359	400	90%	Highly Practical
Benefits	122	150	81%	Highly Practical
Final Score	286	315	86%	Highly Practical

Based on Table 7, the results of the student response questionnaire show a final percentage of 86%, which is categorized as very practical. This result indicates that the Android-based interactive learning media is easy to use, attractive, and beneficial for supporting mathematics learning, particularly in polyhedra material. The practicality aspect of the media is reflected in several indicators, including usability, content clarity, and visual appearance. The media aspect obtained a score of 88%, while the benefit aspect reached 81%, indicating that students perceived the media as helpful in facilitating their understanding.

Students also reported that the visual design, supported by animations and audio features, made the learning process more engaging and assisted them in visualizing abstract three-dimensional concepts. However, this study focuses on the validity and practicality of the developed media, and does not provide direct experimental data to measure its effectiveness in improving learning outcomes.

Evaluation

Evaluation is carried out in each phase of the ADDIE model development. At the analysis stage, the evaluation shows that learning at SMP Negeri 7 Metro still relies on textbooks so that students have difficulty learning independently, so an Android-based interactive media innovation is needed. At the design stage, the evaluation is carried out to ensure the quality of the media design in accordance with the learning objectives. Furthermore, at the development stage, the evaluation is obtained through the validation of material experts and media experts as well as student responses. The validation results show that the media is in the very valid category and feasible to use, while the students' responses confirm that the media is easy to use, interesting, and supports concept understanding. Thus, Android-based interactive learning media is declared feasible to be implemented at the next stage to measure product practicality.

Discussion

This study shows that the validity of Android-based interactive learning media on the material of flat-sided solid shapes is obtained from the validator's assessment with an average validation score of 86% which is included in the very valid category. This validity indicates that this interactive media has met the eligibility standards from the didactic

aspect, material content, language and presentation (Ariani, [2025](#)). The learning activities contained in the interactive learning media are systematically arranged with the concept of plane geometry. Improvements made based on suggestions from the validator, such as adding explanations regarding the context of the material delivery and the structure of the explanation of the material on flat-sided solid shapes, further strengthen the accuracy of the concept and presentation of the material in accordance with the criteria of a valid learning tool (Amanda, et al., [2025](#)). Furthermore, the practicality test shows that the Android interactive media achieved a practicality score of 93%. The practicality of the Android interactive media is reflected in positive responses from teachers and students, which indicate that this tool is easy to use, provides clear activity instructions, presents a systematic learning sequence, and has an attractive and easy-to-understand design, thus supporting the learning process (Pangestuti, et al., [2025](#)). Learning tools can be considered practical if they are easy to implement in the classroom and help teachers and students conduct teaching and learning processes effectively (Ulya, et al., [2025](#)). Thus, Android-based interactive learning media not only strengthens students' academic abilities but also contributes to ICT skills in the 21st century.

The materials presented in the application are structured using clear, concise, and communicative Indonesian language, making them appropriate for students' developmental characteristics and easy to understand. Based on the results of expert validation, the language and material presentation aspects were categorized as very valid, indicating that the content is suitable for learning use. Furthermore, the results of the student response questionnaire showed a practicality score of 86%, which falls into the very practical category. This indicates that students perceive the media as easy to use, engaging, and helpful in understanding polyhedra concepts. Students also reported that the combination of visual design, animations, and interactive features supports them in visualizing three-dimensional objects more clearly. Therefore, based on the findings of this study, the developed Android-based interactive learning media meets the criteria of valid and practical learning media and is feasible to be used to support mathematics learning, particularly on polyhedra material.

CONCLUSION

The results of research and development show that Android-based interactive learning media on flat-sided space building material developed with the ADDIE model obtained a very valid and very practical category, with an average material expert assessment of 82%, media experts 90%, and small group trials 86%. Further development is expected to be able to optimize file size, expand access to various platforms, add a variety of interactive questions, and expand the scope of material to better suit the needs

of students and school conditions, so that the media can be used more effectively in learning.

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