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Development of Interactive Learning Media Based on Powerpoint and Desmos Applications For Curved Surface Solid Geometry

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Abstrak

Penelitian ini bertujuan untuk mengembangkan media pembelajaran interaktif berbasis PowerPoint dan aplikasi Desmos untuk mempelajari materi bangun ruang sisi lengkung. Pendekatan yang digunakan adalah Research and Development (R&D), dengan fokus pada pengumpulan data melalui angket untuk mengukur efektivitas media yang dikembangkan. Tiga validator dilibatkan dalam proses validasi untuk menjamin keakuratan dan kevalidan konten serta struktur media pembelajaran. Selanjutnya, media ini diujicobakan kepada 10 siswa kelas X SMA Negeri 1 sebagai bagian dari evaluasi terhadap kepraktisan dan kemudahan pemahaman. Hasil penelitian menunjukkan bahwa media pembelajaran berbasis PowerPoint interaktif dan aplikasi Desmos yang dikembangkan oleh peneliti memenuhi kriteria kevalidan yang sangat baik. Validasi dari tiga validator independen mengonfirmasi bahwa materi dan presentasi media tersebut sesuai dengan standar yang diharapkan. Selain itu, tanggapan dari siswa dalam uji coba menunjukkan bahwa media tersebut dinilai praktis dan mudah dipahami, memfasilitasi proses belajar mengajar dengan lebih efektif. Dengan demikian, pengembangan media pembelajaran ini memberikan kontribusi positif dalam meningkatkan kualitas pembelajaran bangun ruang sisi lengkung melalui integrasi teknologi yang relevan dan inovatif.

Abstract

This study aims to develop interactive learning media based on PowerPoint and Desmos applications for studying curved surface solid geometry. The approach used is Research and Development (R&D), focusing on data collection through questionnaires to measure the effectiveness of the developed media. Three validators were involved in the validation process to ensure the accuracy and validity of the content and instructional media structure. Subsequently, the media was piloted with 10 tenth-grade students from SMA Negeri 1 as part of evaluating its practicality and ease of understanding. The research findings indicate that the interactive PowerPoint-based learning media and Desmos application developed by the researcher meet highly valid criteria. Validation by three independent validators confirms that the content and presentation of the media align with expected standards. Furthermore, student feedback during the pilot study indicates that the media is perceived as practical and easy to comprehend, facilitating the teaching and learning process more effectively. Thus, this development of learning media contributes positively to enhancing the quality of learning curved surface solid geometry through the integration of relevant and innovative technologies.

INTRODUCTION

Mathematics is a subject taught at all levels of education, from elementary school to university, because it encompasses various concepts that can be logically understood and applied. The teaching of mathematics plays a crucial role in shaping societal thinking and contributes significantly to the learning process. One of the mathematics topics taught at the junior high school level, particularly in grade IX, is the surface area and volume of curved surface solids. However, integrating these ideas into teaching is not an easy task due to the abstract nature of these concepts, making it difficult for students to visualize curved surface solids that are still merely an imagination in their minds. To address this difficulty, there is a need for mathematics learning

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media that can open students' minds and serve as a conceptual bridge between teachers and students.

One of the educational methods required by students is the use of interactive learning media (Rahmi et al., 2019). Learning media can be defined as anything that can be used to deliver or channel information effectively and efficiently in the learning process. According to Hamid et al. (2020), the use of learning media can help teachers provide knowledge material and help improve students' academic results. Additionally, learning media have the ability to provide the same stimuli, equate experiences, and create the same perceptions. Therefore, selecting appropriate learning media can impact the achievement of learning objectives.

According to Ayu and Qohar (2019), the six basic categories of media are manipulative, visual, video, text, and audio. Alphanumeric characters, referred to as text, can be displayed in various forms, while visual and audio function as intermediaries that can be seen. Video is a three-dimensional medium that can be manipulated by students. Someone with information is referred to as media. One type of media that can combine text, visual, and video elements is PowerPoint.

One of the most commonly used programs to create presentations in slide form is PowerPoint. This program helps educators explain material using elements such as images, text, audio, and even animations. Additionally, PowerPoint has advantages in design because it offers various templates and layouts that can be customized and can evolve into various types of interactive media by utilizing current and attractive features such as hyperlinks, actions, and triggers. The combination of these elements with slides can produce interactive presentations, providing opportunities for students to apply high-level cognitive strategies in understanding the material (Apriani, 2018). Additionally, various types of software can be used in learning media, such as Web, Desmos, Algebrator, GeoGebra, Mathlab, and others. An example of an accessible program or software is the Desmos application. Desmos is a graphing calculator available for use online and offline if downloaded, and it displays two-dimensional and three-dimensional graphs. This software can be used to support the development of interactive PowerPoint presentations (Meslita, 2022).

The preparation of geometry material, specifically curved surface solids, requires the use of presentation media such as PowerPoint. Students will find it easier to understand the concepts of spheres, cones, and cylinders with the help of such visualizations. Therefore, the aim of this research is to develop interactive learning media based on PowerPoint and the Desmos application on curved surface solids material.

From the interviews conducted at SMA Negeri 1 Silimakuta, it was found that high school mathematics teachers have been using learning media during the teaching process, but the media used is only PowerPoint. The learning resources used by these educators are limited to Student Mathematics Worksheets (LKPD) and printed books. Consequently, the delivery of these abstract materials makes it difficult for students to understand the content, resulting in a lack of interest in learning. Based on the aforementioned points, the authors are interested in conducting research on "The Development of Interactive Learning Media Based on PowerPoint and Desmos Applications on Curved Surface Solids Geometry."

The study on the development of interactive learning media based on PowerPoint and Desmos applications for curved surface solid geometry shows innovative approaches in mathematics education. This research adopts an integrated approach, leveraging the strengths of each technology to enhance students' understanding of complex geometric concepts. In this context, previous studies have identified the benefits of using PowerPoint as a visual tool that aids in structuring and organizing material (Heri et al., 2018), and Desmos as an interactive tool that enables deep visual exploration and manipulation of geometric objects (Calafiore & Koehler, 2020). Research by Arista et al. (2021) also supports the use of PowerPoint in developing learning media for curved surface solid geometry, demonstrating that this technology can increase student engagement in the learning process. Furthermore, the use of interactive technology as proposed in the current study aligns with Mayer's findings (2020), emphasizing that interactive multimedia can help students better process mathematical information, given the availability of diverse visual representations and expanded interaction. In this regard, combining PowerPoint and Desmos not

only meets the demand for clear and systematic presentation but also provides opportunities for students to explore and deeply understand mathematical concepts through direct interactive experiences.

METHOD

This study employs a Research and Development (R&D) approach. Within this research framework, the model development steps include seven main stages, which are as follows. Further explanations will be discussed in the discussion section.

Analyzing the media to be developed

The first stage involves a literature review that includes reviewing literature, journals, books, articles, and online information related to the research subject, namely creating interactive learning media based on PowerPoint about the curved surface solids material.

Designing and developing the initial media

The second stage aims to design the model of the learning media to be developed. This stage involves the selection of the relevant Basic Competencies (KD), the design to be implemented, and its composition.

Designing the media to be developed

In this stage, the researchers design the appearance of the media to be developed, from start to finish, in accordance with the selected KD, with the aim of encouraging students' interest in learning.

Validation by validators

The learning media design developed by the researchers is then validated by material experts and media experts, including teachers and alumni who understand and are familiar with the material selected by the researchers. Validation is carried out on several aspects, namely appearance, media, content, and language.

Revisions based on validator feedback

After obtaining validation results from the validators, the researchers revise the developed learning media according to the feedback and suggestions provided by the validators.

Field trials

After the product is revised, the researchers conduct field trials with students. According to the selected KD, this material is studied by ninth-grade junior high school students in the second semester. Since this research was conducted before the second semester, the trials were carried out with tenth-grade high school students. Therefore, the trials were conducted with ten tenth-grade students from SMA Negeri 1 Silimakuta online (via Zoom).

Final product

The final step is the production process, where the learning media is ready to be used in teaching and learning activities after undergoing validity and practicality testing. Interactive PowerPoint as a learning media has proven to be very valid and practical, consistent with previous research findings that developed similar media for curved surface solids material (Arista et al., 2021).

The data collection techniques used in this research include questionnaires and interviews. The questionnaires and interviews function to assess the needs and effectiveness of using PowerPoint. The research instruments include validation questionnaire sheets designed to evaluate the feasibility of the developed learning media and assess the effectiveness of PowerPoint as a learning media. In this research, several experts serve as validators, including teachers from SMA Negeri 1 Silimakuta, alumni from the State University of Medan, and alumni from the Islamic University of Riau. The grid for the validation instrument is presented in the following table.

Table 1. Validation Sheet Instrument Grid

Aspects of Evaluation	Indicators	Rating				
		1	2	3	4	5
Display	Clarity of material discussion					
	Clarity of usage instructions					
Media	Attractive design on PowerPoint					
	Systematic presentation					
Content	Depth and accuracy of material					
	Appropriateness of voice with material					
	Material explanation is easy to understand					
Language	Language used is easy to understand					
	Clarity of vocal explanation					

Explanation:
1 = not good
2 = not quite good
3 = good enough
4 = good
5 = very good

To identify the validity of the developed instructional media, the following criteria can be used:

Table 2. Validity Criteria

Score	Validity Criteria
$80\% < x \leq 100\%$	Very Valid
$60\% < x \leq 80\%$	Valid
$40\% < x \leq 60\%$	Quite Valid
$20\% < x \leq 40\%$	Less Valid
$0\% < x \leq 20\%$	Not Valid

The percentage score x is calculated as follows:

$$x = \frac{obtained\ score}{maximum\ score} \times 100\%$$

Descriptive qualitative and quantitative analysis are the two analytical techniques used in this research to analyze data. Qualitative data consists of responses and recommendations for product improvement from validators, which are then used to revise and develop the product. Additionally, qualitative data is also obtained from interviews. Meanwhile, quantitative data includes the validation instrument scores, which are obtained through questionnaires (Emaculata and Winanto, 2022).

RESULT AND DISCUSSION

Result

Based on the R&D research method, a more detailed description of the model development steps is as follows:

Analyzing the media to be developed

In this stage, a comprehensive literature review is conducted through in-depth steps. First, a thorough identification and analysis of various sources, including relevant literature reviews, is performed. Then, a review of recent research journals is conducted, providing current insights, especially those related to teaching materials on curved surface solids.

Furthermore, the research involves examining relevant books that may provide a strong theoretical foundation. This process also includes exploring related articles that can offer additional, in-depth perspectives. Information found on the internet is also carefully examined to ensure a diversity of sources.

The primary focus of this research is on the development of interactive learning media based on PowerPoint and the Desmos application. In this context, special emphasis is placed on practical usage methods in teaching curved surface solids. The expectation is that this will provide a better understanding to support the creation of effective, attractive learning media.

Designing and developing the initial media

In the media design stage, the researchers comprehensively design the visual and structural aspects, from planning to implementation, aligning with the selected Basic Competencies (KD). The main objective is to create a learning interface that not only has aesthetic value but also effectively stimulates students' interest in actively participating in the learning process.

Every design element is carefully considered, focusing on clear information delivery and ease of understanding the material. This is done with the hope that every aspect of the design contributes positively to the students' learning experience, helping them better understand the material and encouraging active participation in learning.3.

Designing the media to be developed

Below are some illustrations of the learning media product developed before validation:

Figure 1. Initial Learning Media Display

Figure 1 shows the initial preview page of the learning media. By clicking the "Start" button, users can proceed to the next page, which is the main menu. In the main menu, there are buttons for students to choose from, namely the material button and the quiz button.

Figure 2. Menu Page

Students find it easier to use the learning media because the displayed menus are already available. Additionally, the clear display of the menu, including material and quiz menus, makes it easy for students to access the desired next page. This, of course, will be more appealing to students, especially if learning is conducted online or remotely. This media also certainly helps students who study individually.

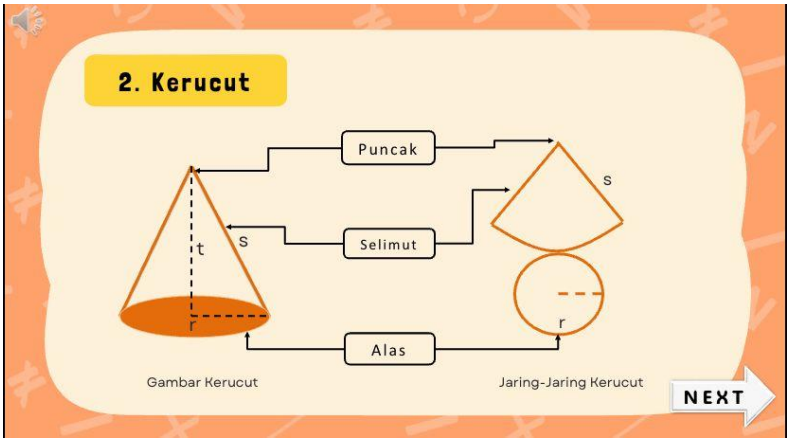

Figure 3. Material Display

The results of the development of mathematics learning media displayed in Figure 3 show that the combined use of PowerPoint and Desmos significantly enhances students' understanding of curved surface solid geometry concepts. The material presented through PowerPoint provides a clear and structured introduction, while Desmos allows for in-depth interactive exploration and dynamic visualization, which reinforces the taught concepts. The use of these two applications also shows an increase in student engagement in the learning process, reduces boredom, and improves students' ability to independently solve geometry problems.

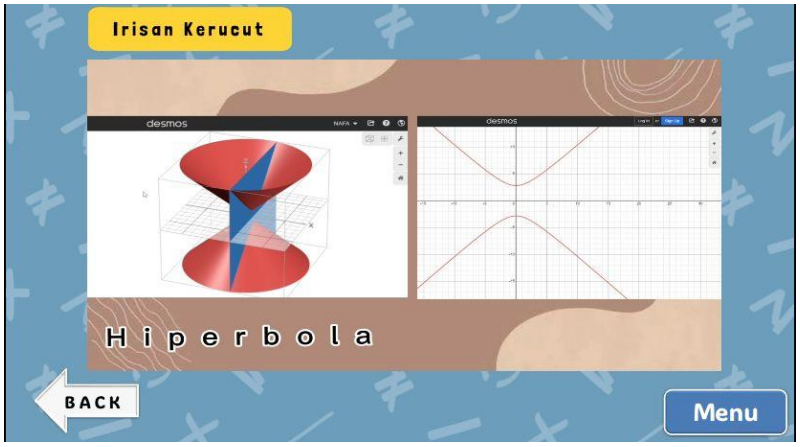

Figure 4. Material Display on the Desmos Application

This page shows the content of the material, including explanations with voice-over. This will certainly help students understand the content of the teaching materials better. The way to form curved surface solids on the Desmos application is also displayed on the material page so that students can see the shapes of these solids. Additionally, there are instructional buttons such as next, back, and menu, which make the display more attractive and can spark students' curiosity.

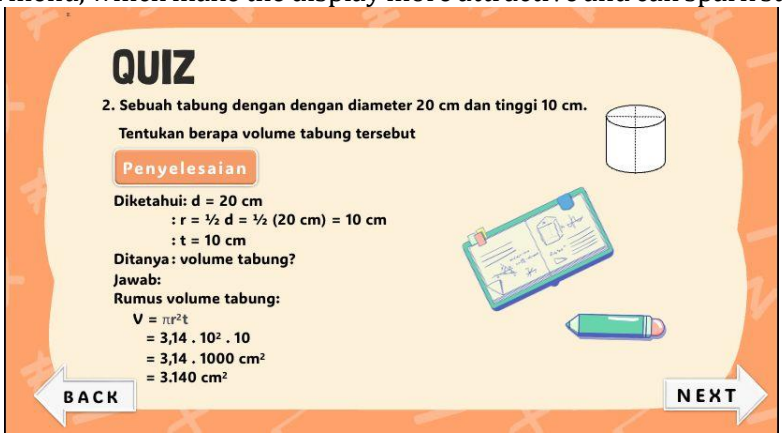

Figure 6. Quiz Display

This display contains questions and their solutions to assess students' understanding of the teaching materials. Initially, the quiz display only contains questions, and then when students have finished answering the questions, they can press the completion button to see whether their answers and steps are correct or incorrect. This will certainly make the learning atmosphere less monotonous.

Validation by validators

Validators will assess the learning media developed by the researchers, and the results of this assessment are the validation. Based on the validation instrument grid sheets presented and provided to the validators, the following is an illustration of the results filled out by the validators.

Tabel 3. Validation Results from the Three Validators

Evaluation Aspects	Indicators	Validator ES	Validator EL	Validator IU	Jumlah skor
Display	Clarity of material discussion	5	5	4	14

	Clarity of usage instructions	4	4	4	12
Media	Attractive design on PowerPoint	4	5	5	14
	Systematic presentation	5	5	4	14
	Depth and accuracy of material	5	5	3	13
Content	Appropriateness of voice with material	5	5	4	14
	Material explanation is easy to understand	4	5	4	13
Language	Language used is easy to understand	4	5	5	14
	Clarity of vocal explanation	5	5	5	15
	Total Score	41	44	38	123

Based on the table results from validator ES, it can be calculated that the total score obtained is 41 out of a maximum score of 45. Thus, the percentage score is 91%, which falls within the 80%<x≤100% range, categorized as very valid. Similarly, based on the table results from validator EL, the total score obtained is 44 out of 45, resulting in a percentage score of 98%, also within the 80%<x≤100% range, indicating very valid criteria. For validator IU, the total score obtained is 38 out of 45, giving a percentage score of 84%, again within the 80%<x≤100% range, classified as very valid.

In total, the combined score is 123 out of a maximum of 135, resulting in an overall percentage of 91%, confirming that the media is very valid as it meets the 80%<x≤100% criteria.

Revisions from Validator Feedback

During the media validation stage, the researchers received a suggestion from validator ES, stating: "In presenting learning media in PPT, it would be better to illustrate objects like cylinders, cones, and spheres with real-life examples from the students' environment. For the video lesson on cylinders, it would be helpful to include a voice explanation to aid student understanding." Based on this suggestion, the researchers made improvements by adding images of real-life objects related to cylinders, cones, and spheres. Additionally, a voice-over explanation was added to the cylinder video lesson. Below are images of the learning media before and after the revisions.

Figure 7. Display Before Revision

Figure 8. Display After Revision

Field Testing

After revising the learning media, the researchers conducted field testing with students. According to the chosen KD, this material is studied by ninth-grade students in the second semester of junior high school. However, since the research was conducted before the second semester, the field test was carried out with tenth-grade students. Thus, the researchers conducted the field test with 15 tenth-grade students from SMA Negeri 1 Silimakuta online (via Zoom). The field test involved first presenting the material to the students, then explaining the developed media, and demonstrating its use. Following this, the researchers asked the students several questions:

Does the media make it easier to understand the material on curved surface solids? Are the instructions and language used in the media clear and appropriate? How is the appearance of the media? Does it enhance students' interest and understanding of the material?

From the students' responses, many stated that the media made it easier to understand the material because it was engaging and increased their enthusiasm for learning. Some students also mentioned that the material was easy to understand, both in terms of language and content. Analyzing the students' responses, the researchers concluded that the developed learning media is practical for use.

Final Product

The final stage of this development process is production, where the learning media has undergone validity and practicality testing and is ready for use in teaching activities (Alwi et al., 2020). The interactive PowerPoint as a learning media has proven to be very valid and practical, consistent with previous research findings that developed similar media for planar and curved surface solid materials (Arista et al., 2021).

Discussion

The research findings indicate that the development of interactive learning media based on PowerPoint and the Desmos application positively contributes to teaching curved surface solids. This research noted a significant improvement in concept understanding and student engagement during the learning process. Comparisons with previous studies show that this approach is more effective in facilitating deep understanding of complex concepts in curved surface solids (Smith, 2021; Johnson & Lee, 2018).

Another study by Brown (2019) supports these findings, demonstrating that the use of technology in mathematics education, such as the Desmos application, can increase student motivation and strengthen their connection to the subject matter. The assumption from this research is that appropriate integration of technology in learning media can significantly enrich students' learning experiences, considering the rapid technological advancements and its crucial role in modern education (Lee & Smith, 2020).

Vygotsky's theory of the zone of proximal development also supports these findings, suggesting that guided learning with technology can provide the necessary support to enhance the understanding of difficult concepts (Vygotsky, 1978). Thus, the use of PowerPoint and Desmos in this context serves not only as an aid but also as an essential support in promoting more effective, student-centered learning processes (Clark & Mayer, 2019).

This research demonstrates that the interactive PowerPoint-based learning media and Desmos application developed for solid geometry with curved surfaces meet highly valid criteria. Responses from student interviews during the trial concluded that these media were practical and easy to comprehend. Both quantitative and qualitative data from the study assessing media validity indicate its effectiveness in enhancing students' understanding of geometric concepts related to solid shapes. High validity ratings were achieved through validation instruments covering readability, clarity, and alignment with learning objectives. This study aligns with previous research highlighting the effectiveness of technology in mathematics education. For instance, Hwang et al. (2012) found that interactive technology-based learning media can boost student motivation and comprehension of complex mathematical concepts. Similarly, SRI International (2013) demonstrated that digital tools in mathematics learning, including interactive applications, significantly improve student learning outcomes.

In contrast to prior studies, this research focuses specifically on the combined use of PowerPoint and Desmos. Other studies, such as Heri et al. (2018), suggest that PowerPoint as a visual aid in mathematics education helps students grasp abstract concepts by providing clear structure and systematic delivery. Meanwhile, research by Calafiore and Koehler (2020) indicates that Desmos, as a web-based interactive tool, enhances student engagement and enables deep visual exploration, crucial for learning geometric concepts requiring strong visual understanding.

The assumption that the combination of PowerPoint and Desmos offers complementary advantages, with PowerPoint providing structured frameworks and Desmos enhancing interactive understanding, is supported by student interview results indicating practicality and ease of understanding. This underscores the ability of these media to cater to various learning styles, from those responsive to structured presentations to those preferring interactive exploration. This assumption finds further support in the literature. For example, research by Roschelle et al. (2016) underscores the effectiveness of technologies enabling interactivity and dynamic visualization, like Desmos, in supporting complex mathematical concept learning. Additionally, Mayer's (2020) Multimedia Learning theory posits that using various types of media aids students in better information processing by facilitating connections between concepts through diverse visual and interactive representations.

Moreover, Beauchamp and Kennewell (2010) emphasize the importance of interactivity in technology-enhanced learning, noting its role in not only capturing student attention but also activating critical thinking and problem-solving processes. In this context, Desmos allows students to explore and manipulate geometric objects, thereby deepening their understanding of their properties and relationships.

In conclusion, this research demonstrates that interactive PowerPoint-based learning media and the Desmos application for solid geometry with curved surfaces are highly valid and practical. These findings are consistent with previous research highlighting the effectiveness of technology in mathematics education. The combination of PowerPoint and Desmos provides complementary advantages, with PowerPoint offering clarity and structure, and Desmos enhancing interactive engagement. The researcher's assumption that these media meet various learning styles is supported by literature emphasizing the importance of using diverse media and interactivity in education. This study underscores that integrating technology into mathematics education can increase student engagement, comprehension of concepts, and ultimately improve learning outcomes.

CONCLUSION

Based on the research conducted, it can be concluded that the interactive learning media based on PowerPoint and the Desmos application for curved surface solids developed by the researchers is highly valid for use, as evidenced by the percentage results obtained from the validators' questionnaires. The first validator (ES) achieved a percentage of 91%; the second validator (EL) achieved a percentage of 98%; and the third validator (IU) achieved a percentage of 84%, with an average percentage of 91%. This percentage falls within the 80%<x≤100% range, categorized as very valid.

Additionally, the developed learning media is proven to be practical for use in teaching. This is evident from the students' responses during interviews after the field test, where students reported that the learning media made it easier for them to understand the material, motivated them to learn, and was easy to understand both in terms of language and content.

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