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Development of an interactive PowerPoint to instill a deeper understanding of polyhedron concepts in mathematics class

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Abstract:
Mathematics is generally considered a complex subject by the majority of students in Indonesia. Students tend to rely on simple learning strategies such as memorizing formulas. This perpetual trend distance our students from deeper mathematical understandings such as concept application. In this study, we develop an interactive learning media based on Microsoft PowerPoint to instill a deep conceptual understanding of polyhedrons in class VIII students. This Research and Development study follows the 4D development model with a limited dissemination phase. The research data was collected through validation techniques by expert validators to measure the feasibility level of learning media. The instruments used in the research were interview sheets, observation sheets, learning style tests, media validation sheets, language validation sheets, and material validation sheets. The data analysis technique uses the Method of Summated Ratings, then the eligibility percentage for the developed media is calculated. The results showed that the eligibility percentage for media experts was 92%, material experts 96%, and linguists 90%. The average percentage of the three assessments corresponds to the "very valid" category. In conclusion, the media developed is very feasible for its intended purpose.

Keywords: Development, interactive PowerPoint, polyhedron, understanding concepts

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Introduction

Mathematics is a basic science whose application is required by science and technology (Maskur et al., 2020). It is basic science because mathematics is very closely related to everyday life. We all know that all aspects of daily activities always prioritize the mastery of mathematics, such as calculating. In addition, mathematics is also a science that is arranged hierarchically, meaning that one material with another material

in mathematics is interrelated (Fauziah & Pawestri, 2022). It can be said to be related because to arrive at higher material in learning, one must master and understand the previous material. Of course, that way, it will be easier to understand and solve various kinds of problems. A similar opinion was expressed by Ruseffendi (2006) that the spiral approach in learning or teaching mathematics is learning or teaching concepts that begin with natural concrete objects intuitively. At a higher stage, the concept is taught again in a more advanced form abstract. In addition, Sudarwan & Retnawati (2015) also argue that mathematics is a knowledge that students need to increase their learning success to pursue higher education. Judging from how important mathematics is, students must have high abilities in mathematics. Instilling the correct understanding of the concept in each lesson needs to be done. According to Ali & Hassan (2019), learning and teaching mathematics is a complex process and requires the creation of a mentally healthy environment for doing mathematics. This space fosters mathematical thinking skills and a meaningful understanding of mathematical concepts. Concept understanding is an ability that is the foundation for developing the ability to connect, communicate, represent, argue, problem-solve, and think critically and creatively mathematically (Mulyani et al.., 2018).

However, unfortunately, what happens in the field is that many students need to instill the concept properly. Students find it challenging to understand the concept of the material being studied because students memorize more than they understand. Sometimes the teacher in explaining also only uses the lecture method. The statement be accordance with the opinion of Nasution & Surya (2017); they said that the lecture method used by the teacher could cause boredom and drowsiness during class learning. Thus resulting in a passive attitude in students in learning. An indicator of the attainment of understanding of mathematical concepts is needed to determine the level of students' understanding of concepts. Heruman (2007) states that several indicators restate a concept, classify objects based on whether the requirements that make up the concept are met, apply the concept algorithmically, give examples and non-examples, and present the concept in various forms of mathematical representation.

With students who memorize more and are less active in learning, a concept is not embedded in the minds of these students. Similar research conducted by Umam & Zulkarnaen (2022) shows that the research results of students' understanding of concepts still need to be higher, with a percentage of 35.90%. Students tend to memorize material so that the memory of concepts does not make a sharp impression. As a result, students easily forget and need clarification when solving a problem (Rahmiati et al.., 2017). Students have yet to be able to apply the concepts taught if they are given story questions or questions that differ from the sample questions (Suraji et al.., 2018). External factors from students, such as monotonous methods or strategies, make students less active in learning (Diana et al., 2020). Learning strategies and materials teachers use in learning have yet to entirely create pleasant conditions, making students feel bored (Buyung et al.., 2022). In general, it can be seen how the level of understanding of students' concepts at school.

Based on the results of interviews and observations of the learning process at SMP Negeri 2 Bintan, students relied more on memorizing formulas or material and working on simple questions according to the sample questions given. That way, it has an impact when given questions related to problems in everyday life; students have difficulties and even make mistakes in solving problems. Students tend only to memorize or know but need help understanding the application of more complex questions. In classroom

learning, the lecture method is still used so that students only receive information or material from the teacher, which makes students less active in learning, and the use of teaching materials in learning is still based only on mathematics textbooks. It should be with the development of education that is increasingly advanced for every educator and student to know what media can be used to support learning to create fun and active learning. In addition, the teacher also said that it was difficult for students to apply the formula for the volume and surface area of a polyhedron to problems related to everyday life. So to instill the concept in students, the researcher chose polyhedron material. The polyhedron is one of the materials in mathematics closely related to the use of formulas in applying to the problems associated with everyday life in the concept of finding volume or surface area. This polyhedron material is expected for students to understand better the concept of geometric shapes (Mutia, 2017). Through this material, students are expected to be able to instill an understanding of concepts correctly and well.

With the problems that have been presented before, it is necessary to make efforts to instill conceptual understanding in students. One of them is by using exciting and interactive learning media that can be used in learning mathematics so that students can be interested and motivated in the learning process (Ariyanto et al., 2019). The study was in accordance with the research by Sundari & Izzati (2020), which is to increase the activity of students in learning mathematics. It requires the teacher's sensitivity to manage the class to be a creative and active class. According to Cucum et al. (2018), many computer programs (software) can be used as learning media, one of which is PowerPoint. PowerPoint is software designed to display attractive multimedia, is easy to manufacture and use, and is relatively inexpensive (Indriyanti, 2017). According to Apriani (2018), PowerPoint has hyperlinks and valuable features that can be combined to create interactive multimedia presentations. Of course, this can be used to develop interactive media. Interactive learning media can provide good feedback or respond to what students want to get. As is the case when students are given the subject matter, material related to formulas and supporting pictures will be presented, there are examples of questions and practice questions that students can do. The use of interactive learning media is expected to have a positive impact on instilling students' conceptual understanding. Previous studies have shown that interactive learning media can improve understanding of concepts (Kurniawati & Nita, 2018). Additionally, research conducted by Raharjo et al. (2015) found that using interactive multimedia can encourage students to be actively involved in learning, and students' conceptual understanding of a subject matter can be achieved well.

Previous research that is relevant to the research that researchers are conducting, namely research by Gulo & Harefa (2022) the results of this study state that the resulting media is very feasible to use and can help increase students' understanding of social arithmetic material. Furthermore, research conducted by Cahaya et al. (2022) stated that the research results on the development of interactive PowerPoint media were suitable for use in learning to increase students' understanding of concepts. The relevance is that both use interactive PowerPoint, which produces media suitable for use in learning. However, in this study, the researcher will develop an interactive PowerPoint by adding an explanatory video to the PowerPoint. The explanatory video in question explains the application of the formula for a polyhedron's volume and surface area when faced with everyday problems. The benefits of adding explanatory videos to interactive PowerPoint are that it can instill the concept of volume and surface area of a

polyhedron, and this interactive PowerPoint can accommodate the needs of students with an audio-visual learning style.

Because of the previously described problems, it is essential to research whit the problem formulation is how to develop learning media in the form of interactive PowerPoint that is valid or suitable for use in learning. This research aims to explain the development of valid interactive PowerPoint learning media so that it can be used to instill students' conceptual understanding in learning. The benefit of this research is that interactive PowerPoint learning media can be used to instill an understanding of the polyhedron concept and as a reference for teachers to use the media produced by researchers.

Research Methods

The research was conducted at SMP Negeri 2 Bintan. The research subjects were VIII D class students. This research was carried out using a Research and Development (R&D) approach, starting with developing new products or perfecting existing products until the expected model was finally found (Sukoco et al.., 2014). This study aimed to develop interactive PowerPoint learning media to instill conceptual understanding in class VIII polyhedron material. Data collection techniques used in this study were interviews, observations, and learning style tests. Interviews and observations were conducted to determine what initial conditions were needed. The instruments used in the research were interview sheets, observation sheets, learning style tests, media validation sheets, language validation sheets, and material validation sheets to determine the validity level of the learning media in the form of interactive PowerPoint.

The development research model used in this study refers to the 4D development model developed by Thiagarajan. This model has four stages: define, design, development, and dissemination (Natasya & Izzati, 2020). In this study, researchers only carried out up to the development stage to see if a developed product was valid or suitable for later use in the learning process.

Define stage, at this stage, the researcher conducts a needs analysis to create a design of learning media suitable for the problem to be studied. In this case, the intended needs analysis is the material and student analysis. In material analysis, researchers will review and explore the curriculum and material that is difficult for students to understand. Next is the analysis of students; the researcher will conduct a learning style test and create a form for the needs of students to see what students need in learning which will be adjusted in developing learning media.

At the Design stage, the researcher selects learning media according to the needs for designing media and expert validation sheets developed media. In designing media, it is necessary to design an interactive PowerPoint that can help students understand the concept of volume and surface area of a polyhedron by presenting indicators about understanding the concept. Furthermore, the validation sheet consisted of validation sheets from media experts, linguists, and material experts. Each expert validation sheet has several aspects of assessment. The media expert validation sheet contains four assessment aspects presentation, appearance, suitability and attractiveness, and ease of use. The linguist validation sheet contains three assessment aspects: readability, conformity with Indonesian language rules, and use of terms. And then the material expert validation sheet contains two aspects of the assessment: the material's suitability

and feasibility and completeness. The expert validation sheet instrument grid can be seen in detail at the design stage in the results and discussion section.

The development stage, at this stage the creation of interactive PowerPoint media is carried out by adding teaching material or materials, sample questions, exercises, and so on. Furthermore, the product design's feasibility was validated by experts, namely media experts, language experts, and material experts. This is done so that the media being developed is clear among media users (Azizah & Anggaryani, 2021).

In this study, the research results obtained were analyzed descriptively. The research data consisted of validation results by six expert validators: two media expert validators, two material expert validators, and two language expert validators. The research data is qualitative data obtained from the Likert scale validation sheet with the categories of Strongly Agree (SS), Agree (S), Enough (C), Disagree (TS), and Strongly Disagree (STS). Then the data is converted into quantitative data in the form of intervals using the transformation method, namely the Summated Ratings (MSR) Method (Dewi & Izzati, 2020). Data in the form of suggestions or comments from the validator will be explained further at the development stage. To calculate the validity level of the media that is made. Data processing formula (Arikunto, 2010):

$$V = \frac{\sum X}{N} \times 100\%$$

Information:
V : value
$\sum X$: score obtained
N : maximum score

Furthermore, the criteria for the level of validity refer to opinions (Sugiyono, 2017), as presented in Table 1.

Table 1. Criteria score validity

Intervals	Validity Level
80% < x ≤ 100%	Very valid
60% < x ≤ 80%	Valid
40% < x ≤ 60%	Quite valid
20% < x ≤ 40%	Less valid
0% < x ≤ 20%	Invalid

Result and Discussions

The main results of this study were interactive learning media in the form of PowerPoint on the appropriate polyhedron material for class VIII SMP based on the assessment of material experts, media experts, and linguists. The following is a description of the stages of product development.

Define stage

The specified stage is the needs analysis stage. This stage is carried out to establish and determine development needs. Needs analysis is carried out to obtain information about the needs of the course material to be presented. This analysis was carried out by conducting interviews at SMP Negeri 2 Bintan, and it was found that the curriculum used was the 2013 curriculum. In addition, information was also obtained that students needed help understanding the concept of one of the polyhedrons. This is a complaint because it will be easy for students to work on if faced with questions that have examples of questions. However, if the questions given are more complex or even in the form of contextual questions, students start to get confused and easily fooled. Material analysis was carried out to identify learning media concepts through interactive PowerPoint developed according to Core Competencies, Basic Competencies, and Indicators.

Next is student analysis, which is intended to determine what needs students need in the learning process in the classroom. In this case, the analysis of students can be in the form of learning what is expected of students and the media used as a complement to learning so that it is not monotonous and boring. The results of the analysis of the needs of students showed that 84% of students tended to like interactive learning, namely media that displayed interesting pictures and was supported by explanatory videos, as well as material accompanied by examples of questions. Then, based on the interviews with mathematics teachers at SMP Negeri 2 Bintan revealed that the teacher did not use technology-based learning media in class VIII because the teacher's competency still needed to be improved in technology. Teachers still use media in the form of printed books the school provides. Even though currently, students tend to be more proficient in using technology which should be utilized in the learning process. Not only that but students also do not play an active role in the learning process because the method used by the teacher still applies the lecture method in explaining the material, so learning seems monotonous and boring. Research by Dewi & Izzati (2020) also states that a lack of interest causes difficulties in understanding the subject matter, and students get bored quickly learning.

The results of the learning style test conducted on class VIII students of SMP Negeri 2 Bintan showed that 45% had a visual learning style, 40% had an auditory learning style, and 15% had a kinesthetic learning style. So that learning media can be developed to visualize the material to be discussed in the form of PowerPoint presentations supported by explanatory videos. This opinion is also reinforced by the research of Wijaya et al. (2022), which states that using audio-visual media, such as learning videos, can help students who have difficulty learning or understanding a material.

Design stage

This stage aims to design instructional media as interactive PowerPoint on polyhedron material for class VIII SMP. This interactive PowerPoint is a medium used in learning and can be applied to all learning models that require it. The design stage that the researcher did was the initial preparation by preparing the Microsoft PowerPoint application. The interactive PowerPoint components are divided into three parts, namely the intro (opening), content (material), and closing. An interactive PowerPoint is designed to help students understand a polyhedron's volume and surface area by presenting indicators about understanding the concept. The sub-

sections contained in this interactive PowerPoint include the front page, main menu, core competencies, basic competencies, learning objectives, instructions for use, materials, explanatory videos, sample questions, practice questions, and closing pages. The same media was developed in research conducted by Damayanti & Qohar (2019); the difference lies in media development content, displaying material, next and back buttons, and simple animations.

In addition to media design, researchers also prepared instruments in the form of expert validation sheets related to the media being developed. The lattice validation sheets of media experts, linguists, and material experts can be seen in Table 3.

Table 2. Lattice validation sheets of media experts, linguists, and material experts

Media Expert Validation Sheet		
No.	**Aspect**	**Item Number**
1	Presentation	1-2
2	Appearance	3-8
3	Appropriateness and attractiveness	9-11
4	Ease of Use	12-13
Linguist Validation Sheet		
1	Legibility	1-3
2	Conformity with the rules of the Indonesian language	4-7
3	Use of terms	8-9
Material Expert Validation Sheet		
1	Material suitability	1-5
2	Feasibility and completeness of the material	6-8

Development stage

At this stage, interactive PowerPoint learning media is made, which is used based on the previous design. This interactive PowerPoint learning media includes:

Intro Section (Opener)

The media's front page shows the material's name to be studied. The geometric figures found on the second page of the media show that we will discuss various types of polyhedrons in this material. The selection of shape images as the main menu increases students' understanding of concepts because by presenting these images, students will understand them more easily. The interactive layout of this media can be seen on the front page. There is an oval shape with the word "start," which, when clicked on that section, will display the next slide or, in this case, enter the main menu. On the main menu, pictures of shapes can be clicked too, so if you click on one of the pictures, a slide

will appear according to the description. The display of the intro (opener) section can be seen in Figure 1.

Figure 1. Frontpage view on the first slide and the main menu view on the second slide

Contents section

In the content section, the figure shows when clicking on one of the images in the main menu, in this case, clicking on the "cube" image. At the same time, figure b shows when we click on one of the tools in picture a, in this case, clicking on the "cube net" tool. The interactive form is the ease of using media with one click to visit the slide we need.

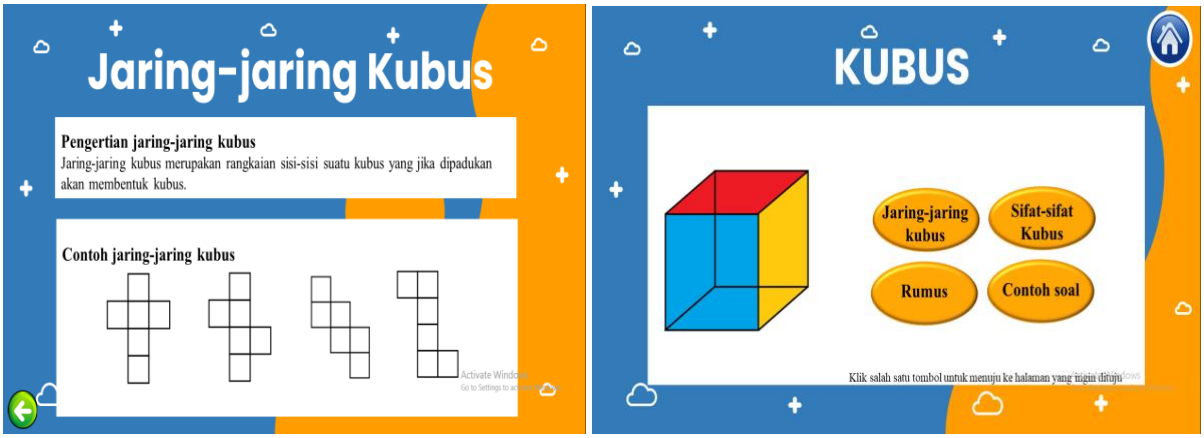


Figure 2. The menu view on the content section and the view of material in the content section

Furthermore, this learning media presents an explanatory video of the material discussed. The content of the video includes explanations of formulas and examples of questions along with their discussion. Then in figure b shows a practice question in which students can choose one of the answers from the available answer choices by clicking on the objective A, B, C, D, or E. The interactive form is if the answer is correct, then a correct statement and a smiley emoticon appear immediately. And continue to the next question page. However, if it is wrong what appears to be a wrong statement and the emoticon does not smile, students are asked to find the correct answer to the same question.

Closing Section

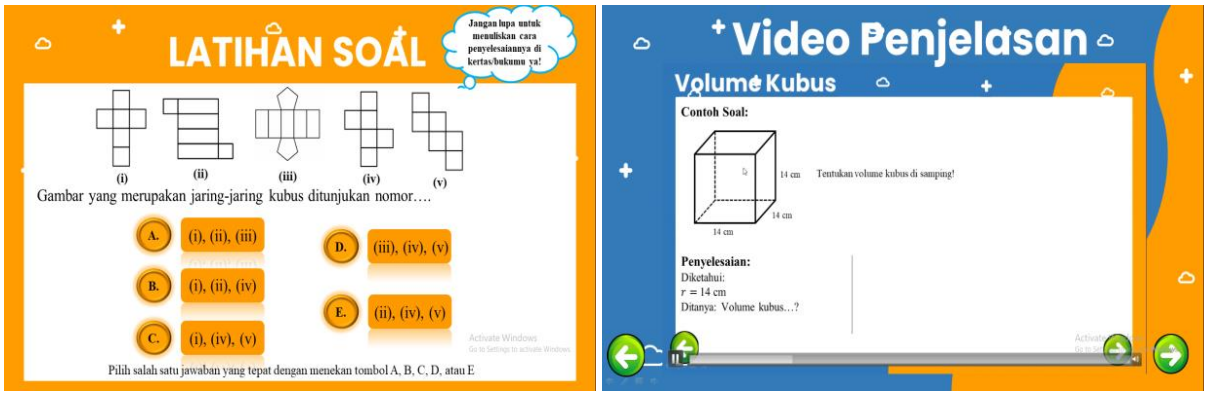
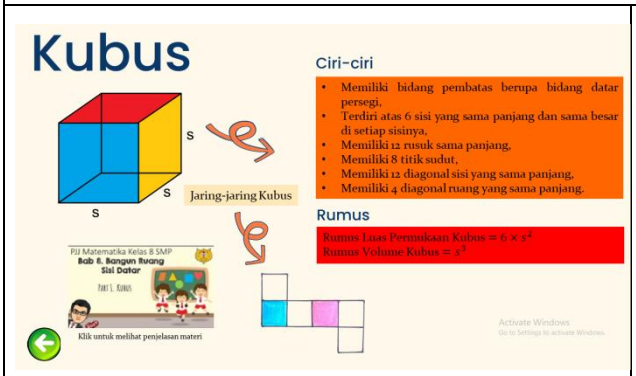
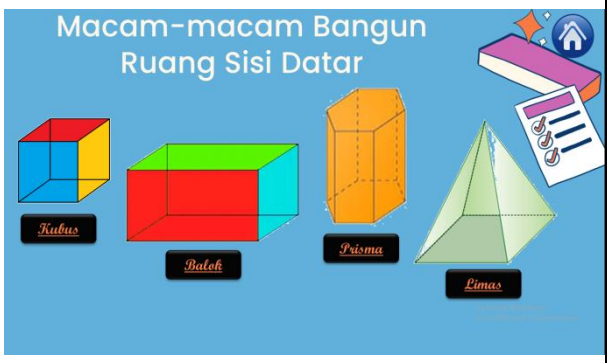
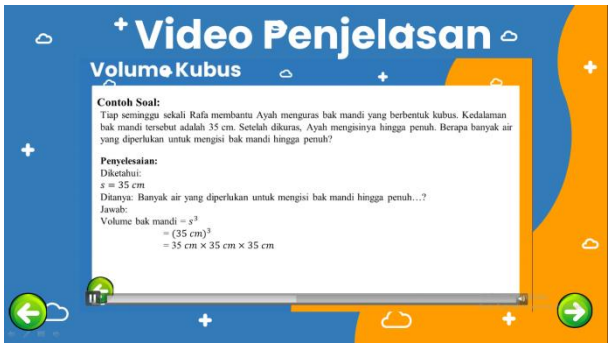


Figure 3. The view of sample questions in the video content and the exercise menus

The assessment results are obtained through expert validation sheets from the learning media that has been developed. The researcher takes six validators: two as media expert validators, two as material validators, and two as language validators. The validation sheet consists of several assessment components: the media expert validation sheet consists of 13 statements. The material expert validation sheet consists of 8 statements, and the linguist validation sheet consists of 9 statements, so the total statements on this validation sheet are 30. On the media expert validation sheet, statement items 1, 5, 7, 8, 11, and 13 of the two validators each provide sufficient (C) and agree (S) choices; in statement, items 2 and 6, both validators provide a choice of agree (S); statement items 3 and 9 both validators provide good choice (C); statement item 4 both validators each provide a choice of disagree (TS) and agree (S); as well as statement items 10 and 12, the two validators each provide a choice of agree (S) and strongly agree (SS). On the material expert validation sheet, statement items 1, 3, and 8 of the two validators each provide sufficient (C) and agree (S) choices; in statement items 2 and 7, both validators each provide disagree (TS) and sufficient (C); statement item 4 the two validators provide a choice of agree (S); statement item 5 both validators provide good choice (C); as well as statement 6, the two validators each provide sufficient (C) and strongly agree (SS) choices. Furthermore, on the linguist's validation sheet, statement items 1 and 3 of the two validators each gave the options to agree (S) and strongly agree (SS); statement items 2, 4, and 5, both validators provide good choice (C); statement item 6 the two validators provide a choice of agree (S); statement item 7 both validators each provide disagree (TS) and sufficient (C); statement items 8 and 9 both validators provide enough (C) and agree (S) choices, respectively.

From the validation results by six expert validators, there are also three suggestions or comments, namely: (1) pay attention to the proportions of the video presentation so that it is easily seen, (2) be consistent in using background and do not use too many colors, (3) pay attention to the quality of the images presented, (4) add explanatory material (video) for each flat side shape. A brief explanation of the media results before and after revision can be seen in Table 3.

Table 3. Comparison of media before and after revisions

Before revision	
	
After revision	
	

The research method explains that the expert validator's answer choice data will be converted into quantitative data with an interval scale through the Summated Ratings (MSR) method. Thus, each of the categories of Strongly Agree (SS), Agree (S), Enough (C), Disagree (TS), and Strongly Disagree (STS) categories will be given weight. The reason for converting data to an interval scale is to be able to calculate the percentage because qualitative data cannot be performed arithmetic operations. Then, after processing quantitatively, it was obtained a recapitulation of the results of media validation by media experts, namely 92%, a recapitulation of the results of material validation by material experts of 86%, and a recapitulation of validation results by linguists of 90%. Based on the three percentages by the validator, the average value of the expert validator is 89%. Thus, it can be said that the development of interactive PowerPoint media designed by researchers is suitable for use in learning. In addition, this media can instill students' conceptual understanding, as seen from the result of validators' assessments where the instrument used includes statement items that have supported a conceptual knowledge about polyhedrons. The six expert validators agreed that the interactive PowerPoint learning media the researcher developed could instill an understanding of the polyhedron concepts for class VIII. Hotimah & Muhtadi (2017), the validation results carried out by four expert validators state that interactive learning media is feasible and can increase understanding of concepts seen from learning aspects, material or content aspects, and aspects of the media being developed. Furthermore, the results of this study align with research conducted by Nursit (2016), where the research stated that the media developed met very valid interpretation criteria and that this interactive *PowerPoint* learning media could or was feasible to use.

In general, the media developed in this study is suitable for learning. There is similar research on learning media that researchers have developed, namely research by Gulo & Harefa (2022), with the components contained in this learning media, namely material descriptions, multiple choice practice questions, and answer keys. Furthermore, research by Cahaya et al. (2022) also developed interactive PowerPoint as learning media with media components, namely material, questions, and answers, which are presented in buttons that can be clicked, and written explanations appear. The advantages of the media developed by researchers at this time are that there are tools that can be operated, there are explanatory videos related to material and examples of questions related to everyday life, and there are practice questions where students can choose one answer from several choose the answer by clicking on one of them. If the answer is correct, then the correct statement and smiley emoticon will appear, and vice versa. Furthermore, the developed learning media can instill students' conceptual understanding so that students not only know about the polyhedron formula but also how to apply it to problems related to everyday life. The drawback of this study is that the media developed has only been tested to the level of validity.

The development of interactive PowerPoint media in this study only reached the level of validity because no provisions or rules required that the research be carried out to produce products tested for validity, practicality, and effectiveness. The research conducted by researchers can be continued by further researchers so that it can be developed even better. This shows that researchers can be more thorough in producing a perfect product. Therefore, with the limitations of the researchers, this research has only been tested to a level of validity and can be continued by subsequent researchers to test the practicality and effectiveness of this developed media.

Conclusions and Suggestions

This research is development research that produces a product in the form of interactive PowerPoint media, which is developed in 3 stages: define, design, and development. From the results of the first media development carried out by the researcher, there are three suggestions or comments that need to be revised. After revision, a product was obtained that was validated by six validators, consisting of two media expert validators, two material expert validators, and two language expert validators. This interactive PowerPoint can be a learning medium to instill conceptual understanding in class VIII polyhedron material. Based on the results of the overall development process that has been carried out, the percentage of validity or feasibility obtained from the validation results of media experts is 92%, material experts are 86%, and linguists are 90%. Furthermore, if the average is 89%, it is categorized as very valid, or the developed media is suitable for use.

Based on the results of the research that has been obtained, as for the suggestions that the researcher can give as material for consideration for improvement in learning, namely (1) the researcher hopes that this interactive PowerPoint learning media can be used as a reference in instilling students' conceptual understanding, (2) there is a need for research further to see the practicality and effectiveness of the media that has been developed, (3) it is necessary to develop interactive PowerPoint media on different materials.

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