

# THE DEVELOPMENT OF VBA POWERPOINT-ASSISTED LEARNING MEDIA TO IMPROVE STUDENTS' COGNITIVE ABILITY

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## ABSTRACT

The Education plays a crucial role in developing cognitive skills, including critical thinking and problem-solving, which are essential for student learning and future competitiveness. However, many students in Indonesia face difficulties in understanding mathematics, particularly on topics such as ratios, due to the limited use of interactive learning media. This study aims to develop an interactive learning media using Visual Basic Application (VBA) for PowerPoint and to evaluate its validity and practicality. The development followed the ADDIE model, which includes five stages: analysis, design, development, implementation, and evaluation. Validation was conducted to assess both media and content quality, while practicality was measured through responses from students and teachers. Data were collected using validation sheets, questionnaires, and scoring rubrics, and analyzed quantitatively to determine validity and practicality categories. The results showed that the learning media obtained an average score of 3.09 for media validity and 3.47 for content validity, both categorized as "very valid." Student responses reached a score of 740 out of 800, while teacher responses achieved a perfect score of 40 out of 40, indicating that the media is highly practical. Based on these findings, it can be concluded that VBA-based PowerPoint learning media is valid, practical, and effective in enhancing cognitive engagement and supporting mathematics learning, particularly on the topic of ratios.

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## INTRODUCTION

Education is a key factor in improving human work quality and productivity. Through education, individuals develop psychomotor and cognitive abilities that enable them to generate

ideas, solve problems, and ultimately enhance both personal and national productivity (Widiansyah, 2017). It is also viewed as a human learning process that fosters skills and competencies essential for a country's economic growth (Nukholis, 2013). Quality education is fundamental to cultivating intelligent individuals who can compete in the future (Hasan et al., 2023). Learning, as a process, strengthens personality, improves attitudes and behavior, enhances abilities, and facilitates knowledge acquisition (Alamri et al., 2024).

Among the cognitive skills developed through education, critical thinking and problem-solving are particularly important (Said, 2023). However, research and observations in Indonesia have shown that many students struggle with these skills. For instance, at SMP N 6 Gorontalo, students often demonstrate low interest in mathematics, especially in topics such as ratios that require analytical thinking (Lasantu et al., 2025). Interviews with a seventh-grade mathematics teacher revealed that traditional media including textbooks, whiteboards, and non-interactive PowerPoint presentations dominate lessons, limiting student engagement. Students often remain passive listeners, leading to boredom and low cognitive stimulation. Additionally, the lack of creativity and technical skills among teachers in developing interactive media exacerbates the problem. Similar challenges have been reported globally, where insufficiently interactive teaching methods hinder students' development of higher-order thinking skills (Alamri et al., 2024).

Technological advancements offer practical solutions to these challenges. Computers and smartphones can serve as learning tools that facilitate cognitive engagement and information access (Usman et al., 2025). Although smartphone-based learning is convenient, it requires strict supervision to prevent misuse, making computer-assisted learning more practical in classrooms. The integration of technology in education enables teachers to adopt innovative methods and utilize the latest information and communication technologies effectively (Aminuddin et al., 2024). In mathematics education, computer-based applications such as Maple, MATLAB, GeoGebra, Cabri, Sketchpad, and Adobe tools provide interactive and personalized learning experiences. Teachers can also develop their own media using software like Microsoft PowerPoint, Excel, and Word (Rosmayanti & Zanthi, 2019).

Microsoft PowerPoint is widely used in education, but enhancing its interactivity requires creativity and programming skills. Visual Basic for Applications (VBA) provides a practical solution, enabling teachers to create interactive animations, incorporate mathematical formulas, and design dynamic learning activities directly within PowerPoint. This approach combines familiar software with relatively simple programming, allowing teachers to align media with specific lesson objectives. Previous studies have shown that VBA-based learning media can improve student participation, comprehension of mathematical concepts, and development of analytical and cognitive skills (Rosmayanti & Zanthi, 2019).

Based on these considerations, this study aims to develop and evaluate VBA PowerPoint-based learning media for teaching ratio topics in mathematics. The research seeks to overcome students' cognitive difficulties, enhance engagement and motivation in mathematics learning, and contribute to broader goals of strengthening human resource competitiveness and potential in the modern era.

## **METHOD**

This research procedure follows the Research and Development framework using the ADDIE model, which consists of five stages: analysis, design, development, implementation, and evaluation (Adeoye, 2024). In the analysis phase, the researcher identifies the needs of students and teachers through interviews to address issues in mathematics learning, as well as analyzes the curriculum and relevant materials. The design phase involves creating a lesson plan, developing a flowchart, and designing the media's layout, along with preparing research

instruments such as validation questionnaires and response questionnaires. In the development phase, the researcher realizes the designed learning media through creation, validation, and revision of the product. In the implementation phase, the developed product is tested with teachers and students at SMP Negeri 6 Gorontalo, where they fill out evaluation forms and response questionnaires. Finally, in the evaluation phase, the researcher assesses the validity and practicality of the learning media based on established criteria, with evaluation results obtained through student response questionnaires.

The validity of the learning media is assessed based on data analysis from the validation sheets completed by lecturers and mathematics teachers. The researcher analyzes the completed evaluation sheets to assess the strengths of the developed product. The steps for analyzing the data from the learning media validation sheets are as follows: First, qualitative data is converted into quantitative data according to the Likert scale guidelines. According to Sugiyono, the Likert scale is a measurement tool used to assess the attitudes, opinions, and perceptions of individuals or groups regarding a social phenomenon.

**Table 1.** Scoring Guidelines (Sugiyono, 2018)

Criteria	Score
Strongly Agree (SA)	4
Agree (A)	3
Disagree (D)	2
Strongly Disagree (SD)	1

The collected data based on the validators' assessments is then analyzed by calculating the average score for each statement in the validation sheet using the formula:

$$X = \frac{\sum_{i=1}^n x_i}{n}$$

Overall average score = (Sum of average scores) / (number of aspects)

Where:

X : average score of the instrument

$x_i$  : score on the  $i$ -th statement

$n$  : number of statements

The result of the average score is then converted into a qualitative value based on the validity criteria in the table below:

**Table 2.** Media Validity Score Conversion (Putra et al., 2024)

Score Interval	Criteria
$x > 3,4$	Very Valid
$2,8 < x \leq 3,4$	Valid
$2,2 < x \leq 2,8$	Sufficiently Valid
$1,6 < x \leq 2,2$	Less Valid
$x < 1,6$	Not Valid

The practicality of the learning media is determined by analyzing data from the questionnaires filled out by teachers and students. The response data is analyzed using the Likert scale. The four scale options provided are strongly agree, agree, disagree, and strongly disagree, the student response questionnaire. Once the data is scored, it is then converted into percentages using the following formula:

$$V_p = \frac{T_{sp}}{T_{sh}} \times 100\%$$

Where:

$V_p$  : responden score

$T_{sp}$  : total empirical score from respondents

$T_{sh}$  : total maximum expected score

**Table 3.** Media Practicality Criteria

Practicality Level	Practicality Criteria
$80 \leq V_p \leq 100\%$	Very Practical
$60 \leq V_p \leq 80\%$	Practical
$40 \leq V_p \leq 60\%$	Sufficiently Practical
$20 \leq V_p \leq 40\%$	Less Practical
$0 \leq V_p \leq 20\%$	Very Impractical

## RESULTS AND DISCUSSION

### *Results*

This research was conducted in the even semester of the 2024/2025 academic year at SMP N 6 Gorontalo City. This study uses the ADDIE model to create a product in the form of a Visual Basic Application-based learning media on Microsoft PowerPoint, which includes a series of materials on comparison, along with examples and exercises. The development stages will be explained as follows:

#### **1. Analysis**

The analysis phase aims to analyze information for development and gather relevant data for the learning process. Through interviews with mathematics teachers at SMP N 6 Gorontalo, it was concluded that students were less engaged in learning due to uninteresting teaching methods. The learning media used were too basic, often just PowerPoint presentations that only allowed students to listen and watch without direct interaction. The conclusion was that students need more varied learning media to increase their interest in mathematics and make learning more engaging. Therefore, developing VBA-based media for PowerPoint can enhance student involvement and interest in learning mathematics. Additionally, the curriculum analysis was conducted to gather information about the curriculum applied at the school and to analyze the material for developing VBA-based media. This analysis focused on the learning goals and objectives related to the comparison material for 7th-grade students, based on the Merdeka curriculum.

## 2. Design

After conducting various analyses in the initial phase, the next step is for the researcher to develop an initial design of the media to be developed. The material used in this learning media is aligned with the material in the 7th-grade mathematics book published by the Ministry of Education, Culture, Research, and Technology. The chosen material for the development of this media is the topic of ratios, which is supplemented with example problems to help students understand the topic after reviewing the examples presented. When opening the "Materi" menu in this media, the researcher provides a display of material choices, which are designed into two main topics: the concept of ratios and proportional ratios. Additionally, a flowchart is created to illustrate the planning process. The flowchart will help organize and clarify the media production phase.

Furthermore, the researcher prepares validation sheets to evaluate the validity of the learning media from both the material and media perspectives. These validation sheets are filled out by three validators, consisting of two lecturers and one mathematics teacher. Finally, the researcher prepares the teacher and student response questionnaires, which include filling instructions, explanations for each statement point, a section for responses, and the signature of the respondent.

## 3. Development

Here are the steps taken in the development phase:

### a. Creation of Learning Media

The learning media interface is designed to open with an introduction and a button to start the lesson. According to the flowchart for the Visual Basic Application for PowerPoint mathematics learning media, there are 4 options in the "Start" menu, namely: profile, instructions, material, and quiz.

#### 1) Intial Display

The initial display contains the title of the material to be discussed and a "Start" button. Below is the initial display of the learning media.



**Figure 1.** Initial Display of the Media

#### 2) Learning Media Menu Display

In the learning media menu, there are 4 options: Developer Profile, Instructions for the buttons used in the media, Material, and Quiz. The menu display can be seen in the following image.



**Figure 2.** Learning Media Menu Display

### 3) Button Instructions/Information Display

This menu contains instructions on how to use the buttons in the media. The buttons in the media include: exit button, home button, back button, next button, on button, and off button. The instructions display can be seen in the following image.



**Figure 3.** Button Instructions/Information Display

### 4) Material Display

The material menu contains 2 material options: the concept of proportions and direct proportions. The display can be seen in the following image.



**Figure 4.** Material Display

### 5) Exercise Questions Display

Students can practice by working on the practice questions available in the exercise menu, which contains 3 story-based questions. The display can be seen in the following image.





**Figure 5.** Exercise Questions Display

## 6) Quiz

In the quiz menu, there are 10 multiple-choice questions. The display can be seen in the following image.



**Figure 6.** Quiz Display

## b. Validation

After the learning media is developed and created, the next step is for the author to validate the learning media and the material presented. The media expert validators are chosen based on their experience as validators in previous research and also have a background as lecturers in the mathematics department. The validation of the Visual Basic Application for PowerPoint-based learning media involves 6 validators, consisting of 3 media validators and 3 material validators.

### 1) Media Validation

The media validation by the media experts focuses on several aspects, namely design appearance, audio, animation, and ease of use of the media. The results from the three validators can be seen in the table of media validation calculations included in the appendix.

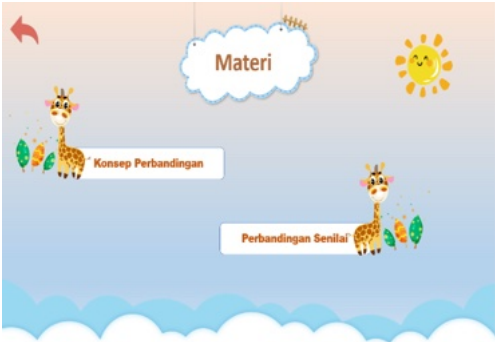



## 2) Material Validation

The material validation by the material experts focuses on the relevance of the content and the appropriateness of the language. The validation results from the three validators are presented in the table of material validation calculations included in the appendix.

### c. Revision

In the previous validity test, several deficiencies were found in the developed media. The researcher received some suggestions that were used as revisions according to the validator's recommendations. Some of the revisions for the learning media are outlined in the table below.

**Table 4.** Suggestions and Improvements for the Media

No.	Before Revision	After Revision
1.	Add a home button on each slide	The home button is already available on each slide
		
2.	The images do not support the material	Images related to the topic of proportions have been added
3.	Add an audio reading option for the material to accommodate students with an audio learning style	An audio reading option has been added for each material
4.	Some slides do not have a back button	Added a back button on several slides
		

### d. Implementation

After the learning media is validated by media and material experts, the next step is to test the media in a learning activity.



## 1) Analysis of Student Response to the Learning Media

After using the learning media during the learning process, students are expected to fill out a response questionnaire, providing ratings for each statement category and giving their opinion about the learning media. The researcher conducted a trial related to the use of mathematics learning media in Grade VII at SMP Negeri 6 Gorontalo, specifically in class VII.9, with a certain number of student respondents.

## 2) Analysis of Teacher Response to the Learning Media

After observing the use of the learning media by students and testing the media, teachers are expected to fill out a teacher response questionnaire and provide their opinions on the developed learning media. This study aims to assess the practicality level of the learning media designed by the researcher.

**e. Evaluation**

In the evaluation phase, the researcher conducted an evaluation of the student and teacher response questionnaires to assess the practicality of the learning media. Based on the data obtained, the average percentage of student response scores was 92.50%, and the teacher response score was 100%.

Based on these results, both student and teacher responses indicate that the Visual Basic Application for PowerPoint-based learning media is suitable for use in teaching the topic of proportions.

**Discussions**

This study aimed to develop an interactive learning media using Visual Basic Application (VBA) for PowerPoint to teach ratios to Grade VII students at SMP N 6 Gorontalo, with the goal of enhancing students' cognitive engagement and understanding of mathematical concepts. The findings indicated that the media was valid, practical, and effective in achieving these objectives.

Compared to Ahdana (2022), who developed VBA PowerPoint media for triangle material, our study achieved slightly higher student engagement, with practicality reaching 92.50% versus 87.58%, although the validity scores were slightly lower. This is consistent with Argarini & Sulistyorini (2018), who stated that media is considered valid if the average score from media and content experts meets the valid criteria, which our media successfully achieved. In line with Hestari et al. (2016), who emphasized that practical learning media provides convenience for students, both teacher and student responses in this study (100% and 92.50%, respectively) confirm the practicality of VBA-based media.

Supporting Millah et al. (2025), technology can enhance student engagement, and the interactive features of VBA in our media increased participation and interest. In accordance with Said (2023), interactive media strengthens cognitive skills such as critical thinking and problem-solving; our quizzes and exercises on ratio problems promoted analytical thinking. Furthermore, as suggested by Rosmayanti & Zanthi (2019), VBA enabled the integration of animations and mathematical formulas into PowerPoint, making the learning process more engaging and supporting conceptual understanding.

Overall, these findings demonstrate that VBA-based PowerPoint learning media is valid, practical, and effective, capable of enhancing students' comprehension, participation, and cognitive engagement in mathematics learning, particularly in ratio topics.

## CONCLUSION

The Visual Basic Application for PowerPoint (VBA for PowerPoint) learning media developed through the ADDIE model has proven to be valid, practical, and effective for teaching ratios to Grade VII students. Validation results indicate that the media meets very high validity criteria, while the analysis of student and teacher responses shows that it is highly practical and enhances students' cognitive engagement, participation, and understanding of mathematical concepts.

This study demonstrates the potential of VBA-based interactive media to improve mathematics learning outcomes, particularly in topics requiring analytical thinking such as ratios. It also contributes to the broader adoption of multimedia tools in education. Future research could explore the application of this media for other mathematical topics or subjects, as well as integrate additional interactive features to further enrich students' learning experiences.

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