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Development Learning Video of Integral Application Based on Conceptual Comprehension

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Abstract: During online learning, students were having difficulties in understanding the concept of the application of integrals to find an area. The provided materials in PowerPoint and learning sources such as books are still insufficient to understand the concept. The students' feedback showed that a learning video is required to help the students understand the concept of the application of integrals. This research aims to develop a learning video concerning the concept comprehension of integrals' application and determine its validity and practicality. This research utilized the analysis, design, development, implementation, evaluation (ADDIE) development model, where the subjects of this research were the students of mathematics education at the Ahmad Dahlan University. The data collection was conducted by using questionnaires and interviews. The obtained data was then analyzed for its validity and practicality. The media validity test result shows valid criteria with the assessment of the material expert of 4.629 (very good) and valid criteria with the material validity test of 4.735 (very good). The responses of the students to the learning video show 3.50 with the criteria of Very Good. Based on such results, this concept comprehension learning video is feasible to use.

Keywords: *Calculus, learning media, shape area, learning video.*

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Introduction

Since the year 2019, the whole world has been stricken by the Coronavirus disease COVID-19 pandemic. The Coronavirus first appeared in Wuhan, the capital of the Hubei province of Central China. Currently, the Coronavirus is popularly known as the COVID-19 (Mohan & Nambiar, 2020). Besides its impact on human health, it also affects other public sectors such as education. The extent of this issue differed depending on the alternative teaching and learning approaches (in particular, whether ICT-based delivery could be used as the primary strategy) and the unique conditions of countries and schools within countries (Rožman et al., 2022). Because of COVID-19, the Indonesian government suggested using online learning from kindergarten up to university level. The Ahmad Dahlan University (UAD) complied with the suggestion of the Indonesian government to adopt the online learning system. The lecturers had to prepare all the necessary equipment, tools, and other learning media for an online class during the online learning process. The class material was accessible to the students via the internet (Coman et al., 2020).

In its implementation, online learning is fundamentally different from offline learning. Online learning requires information technology such as Google Classroom, Zoom Meeting, Google Meet, WhatsApp, and other applications (Abidah et al., 2020). Therefore, the teaching process through PowerPoint slides in class or through a whiteboard is no longer viable. The students did not easily absorb the slides shown during online classes and the existing modules and textbooks. Additionally, it was also difficult for the lecturers to monitor the students' comprehension level of the material.

Purwadi et al. (2021) studied students' opinions about the practice of online learning amids the COVID-19 pandemic. The results show that the students consider it as "(1) ineffective learning activities, (2) unpleasant learning activities,

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(3) limit self atualiation in education, (4) helping to become an independent person in learning and (5) fun learning activities". From that finding, it was then expected to develop an operating standard in online learning implementation to grip the students' attention while learning online. Formulating a product that utilizes information technology may help the students learn in a more systematic and interesting learning process. Such development is expected to be able to facilitate the students to increase their motivation in studying.

There was a considerable amount of feedback from the students during the integral calculus online class where the students: (1) were still having difficulties in understanding the material through Google Meet and discussion via WhatsApp, (2) were struggling to follow the integral calculus lecture when it came to concept comprehension and how to solve integral calculus questions. The students then suggested and requested (1) a learning video covering the theories to understand the concept of applied calculus and questions along with their explanations that can be played repeatedly, (2) and that the video duration is between 5 to 7 minutes.

Based on the research the authors have conducted by reviewing the analysis of the students' conceptual misunderstanding of the integral calculus material and with the existing feedback given by the students, it can be concluded that:

1. It is necessary to create a learning video to provide a conceptual understanding of applied integral,
2. To formulate a video that is engaging with its duration of fewer than 10 minutes,
3. To prepare the video in several parts.

This learning video is expected to be able to make the learning process easier to follow and understand, engaging, efficient, to help maintain concentration, and to push the students to be more active, motivated, and creative (Brame, 2016) to improve the quality of learning (Shabiralyani et al., 2015).

Various media can be developed; in this case, the authors aim to create a concept comprehension-based learning video that is tested from its validity and practicality so that it is feasible to use. This learning video in a tutorial format is selected to help explain mathematical concept understanding in applied integral. The use of a video is much better than that of pictures (Puspitarini & Hanif, 2019). The video is presented in parts that begin with a theory presentation followed by a problem discussion. The video starts with a more accessible material and gets progressively more challenging, with material meetings and followed by exercises.

Literature Review

Mathematics (Integral Calculus)

Mathematics is a fundamental science that has an essential role in the life of a nation and education. In everyday human life, mathematics is inseparable. Even though not all the existing problems in life are mathematical problems, mathematics still plays a role in solving those issues. Moreover, since mathematics is very important, everyone shall study mathematics without exception (Li & Schoenfeld, 2019; Maharani, 2014). Calculus is a part of mathematics that covers the limit of a function, differential, infinite series, and integral. Calculus talks about change, and it is divided into differential calculus and integral calculus, which are connected to the fundamental theorem of calculus (Fatimah & Yerizon, 2019). Integral is the reverse of differential (Ferrer, 2016). In the application of integral, the discussion revolves around: area of shapes, solid of revolution, and volume of a solid. The discussion in integral calculus is the continuation of the materials in differential calculus. This subject will be discussed further in advanced calculus, analysis of complex functions, and many others. The concept comprehension of calculating the area of shapes using integral is preceded with the concept comprehension of Riemann sum, which is emphasized on the basic formula of area of a rectangle. There are not many students interested in studying calculus because of their lack of basic knowledge (Carlson et al., 2015). Solving a calculus problem requires concept comprehension, formula comprehension, carefulness, and creativity (Ferrer, 2016; Li et al., 2017). Due to the lack of basic knowledge in integral calculus, it is crucial to find a suitable learning model and media to increase the students' motivation to study calculus and ultimately a better learning output.

Learning Video Media

The word media comes from the Latin word "medium," which means intermediary. Media is used as a tool to distribute learning information from the source to the receiver (Marpanaji et al., 2018). In the learning system, media functions as a non-verbal information tool. It is essential to use media in every learning process because it would not be optimal without media (Lin et al., 2017). The use of media in the learning process would raise the motivation to study (Sulihin et al., 2020). In formulating a learning media, there are a few things to keep in mind: (a) it must be simple and easy to understand; (b) it corresponds to the main subject of discussion; (c) it must not be too complicated; (d) it does not reduce the meaning and function of itself (Lin et al., 2017). A learning video is advantageous because: (a) it is more time-efficient; (b) offers a more active learning process; (c) it explains the material more clearly; (d) it decreases the lecturers' burden in conventional teaching (Sulihin et al., 2020). Additionally, the benefits of a learning video include (a) the students can understand the material; (b) it explains the material well; (c) there is no limitation of space and time;

(d) it can be played repeatedly (Arkorful & Abaidoo, 2014). Other benefits from using a learning video are: (a) it explains a phenomenon, a process, or an event clearly; (b) it enriches the explanation when integrated with other media; (c) the possibility to repeat certain parts; (d) it is faster and more effective in delivering the material; and (e) it shows steps or methods more clearly (Lailan, 2019).

Pócsová et al. (2021) showed the result of a questionnaire among students in the Technical University of Košice in a math class, in which 70% of them had used learning videos during online classes almost every week, and about 7.27% of the students had never used learning videos. That result answers the question of which online material was used more by the students during class. From five online materials (learning video, MATLAB tutorial videos, MATLAB Live Scripts, Online collection of solved examples, and Visualizations of models), the learning video was the most used online material at least once with 92.73% with an average score of 3.60. This study amplifies the importance of learning videos in math classes to increase the students' concept comprehension.

Kinnari-Korpela (2015) also tried to utilize short videos for classes to increase the experiences of mathematic learning in differential calculus and integral for engineering students in Finland. The learning output of using those short videos was satisfactory and beneficial in developing a learning method in mathematics. Video and audio recording were also used by several other scientists (Bollmeirer et al., Day & Foley., Green et al., Karnad et al., Owston et al.; Pinder-Grover et al., Prodanov et al., Secker et al., Soong et al., as cited in Kinnari-Kopela, 2015) stated that a blended learning process is necessary to be done in various situations and environments. Kinnari-Korpela (2015) showed that the learning focus and the student's achievements were affected after using videos and how the students preferred videos.

Even though there were many benefits in using those learning videos, Soong et al. in Kinnari-Korpela (2015) stated that many students were only watching half of the video or only a specific part of the video of watching it entirely. This idea is the basis of the significance of this research that focuses on creating a learning video in a shorter duration. This learning video is also designed to be in parts that begin with an explanation and follow with an easier to a more complex problem discussion, so it is more efficient and effective for the students to understand the material.

Methodology

The type of research method that is used is the ADDIE model. The reason behind choosing this model is because its method is easier to be implemented. Furthermore, many previous studies utilized the ADDIE method (Sundayana et al., 2017). The research subjects are taken from the third-semester students of Mathematics Education, Faculty of Teacher Training and Education of the Ahmad Dahlan University who take the integral calculus class. Meanwhile, the object of this research is the integral area of shapes material. Ten random students are taken for a small class trial using a lottery, while all third-semester students are taken for a large class trial. The collection instruments are questionnaire data and interviews, validated by the material expert and media expert, two lecturers of Mathematics Education with a doctoral degree. This research is conducted by using the ADDIE model. The ADDIE model starts with the problem analysis and the learning video formulation, which is then given to the experts to analyze feasibility. The subsequent stage is the evaluation, which is conducted in each further step to be perfected. The stages of the research are illustrated in the following flowchart:

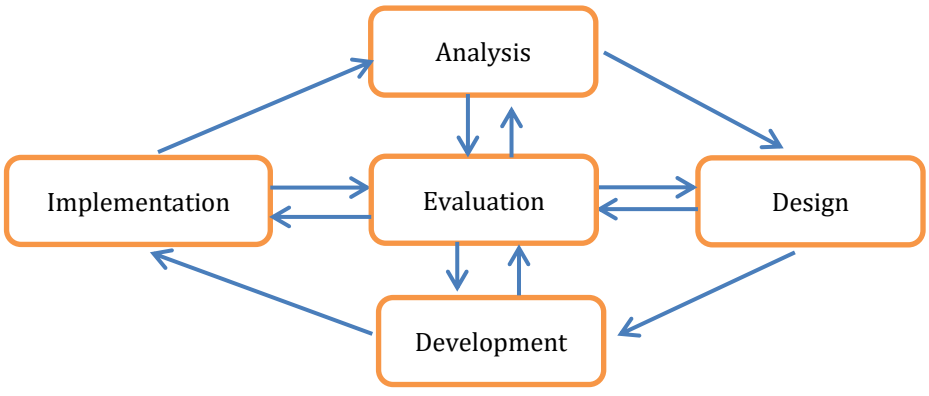


Figure 1. ADDIE Model Development

The first stage is the analysis, which is done by collecting the learning needs information. The characteristics of students and materials used as references for the learning video development are analyzed. The next stage is the design, which is the formulation of a media product in a learning video based on concept comprehension. There are three steps in this stage, which are

1. The framework formulation of the learning media in the form of a storyboard,
2. The material formulation,

3. The creation of an assessment instrument consists of evaluations from the media expert, material experts, and the questionnaire from the students.

The subsequent stage is the development, where the materials from the storyboard are then developed further. In this stage, the collection of references, making the learning video, and product validation are all conducted. After the product or the learning video is created, the video will be validated by the media and material expert. These experts will assess the initial development and then provide feedback and suggestion to improve the product. Based on the experts' feedback, revisions will be made to increase the quality of the product.

Next is the implementation stage, where the learning video is implemented or displayed directly in class. A trial is conducted involving a small group of four students where their feedback is taken afterward. Subsequently, another trial with a larger group involves the third-semester students of Mathematics Education of the University Ahmad Dahlan. After the video is played, the questionnaire is distributed among students to collect their thoughts and opinions related to the video. The last stage is evaluation, where the validity of the video and experts' assessment is analyzed, as well as the students' questionnaire data on the practicality of the video.

The validity assessment is based on the instrument given to the experts, who are two doctors competent in the field of analysis. The instrument comprises three aspects: the content aspect, the language aspect, and the presentation aspect. The media expert will assess the video for its visual design and operation, the space between the text and illustration, the layout and image description, and the images' relevance with the material.

An Analysis of the video's practicality is based on the students' questionnaire. This questionnaire asks questions involving: (1) whether the video is intriguing; (2) whether the video fosters the interest to study; (3) whether the video motivates the students to study; (4) whether the video increases the enthusiasm to study; (5) whether the video increases the students' concept comprehension; (6) whether the video is entertaining; (7) whether the video improves learning creativity; (8) whether the students can directly do exercise questions; (9) whether the video makes it easier for students to remember mathematical concepts; (10) whether the video makes it easier for students to study calculus; (11) whether the video prevents the students from getting bored; (12) whether the language in the video is simple and straightforward; (13) whether the audio in the video has a clear sound and intonation; (14) whether the video is not dull as the length of the video is less than 10 minutes; and (15) whether the video makes it possible to study independently at home.

Assessment from material and media experts in the form of quantitative data by presenting four score options, namely: 4 (strongly agree), 3 (agree), 2 (disagree), and 1 (strongly disagree). All scores are added up to calculate the average. From the material and media validities of the video are assessed based on the guideline in the form of quantitative data, which is then calculated for its mean score. That data is then converted into qualitative data with its criteria based on the following Table 1 (Ebel & Frisbie, 1991):

Table 1. The Learning Video Validity Assessment Classification Guideline

Mean Score Interval	Classification
$\overline{X} > 4.20$	Very Good
$3.40 < \overline{X} \leq 4.20$	Good
$2.60 < \overline{X} \leq 3.40$	Decent
$1.80 < \overline{X} \leq 2.60$	Poor
$\overline{X} \leq 1.80$	Not Good

The product is valid in terms of materials and media if the obtained mean score is at least Good. The validity of the learning video based on the materials and media were obtained from the assessment data, which was calculated on the mean score by using the following formula.

$$\overline{X} = \frac{\text{Total Score from Experts}^*}{\text{Total Maximum Score}}$$

*Experts: two experts are required for each material and media validity.

Furthermore, the scores from the two experts for materials and media expert were combined. The mean score was obtained by the following formula.

$$\overline{X} = \frac{\text{Score Average of Expert}_1 + \text{Score Average of Expert}_2}{2}$$

From the score result of mean ($\bar{X}$) from the assessment of the two experts, then it can be classified as shown in Table 1.

In addition, the practicality data of learning videos that were created were derived from responses of students to a questionnaire. Students fill out the questionnaire with the given provided five kinds of answer choices, namely: 5

(strongly agree), 4 (agree), 3 (undecided), 2 (disagree) and 1 (disagree). From each respondent, the average score obtained is calculated using the formula:

$$\overline{X} = \frac{\text{Total Score from each respondent}}{\text{Total Maximum Score}}$$

The result of mean score of each respondent then combined and calculated the total score of mean using the formula:

$$\overline{X} = \frac{\text{Total Score from all respondents}}{\text{Total Maximum Score}}$$

The product is considered practical if the obtained mean score is at least good based on the formula. The conversion guideline from quantitative data to qualitative data is shown in the following Table 2 (Ebel & Frisbie, 1991):

Table 2. The Learning Video Practicality Assessment Classification Guideline

Mean Score Interval	Classification
$\overline{X} > 4.20$	Very Good
$3.40 < \overline{X} \leq 4.20$	Good
$2.60 < \overline{X} \leq 3.40$	Decent
$1.80 < \overline{X} \leq 2.60$	Poor
$\overline{X} \leq 1.80$	Not Good

Findings

Data analysis, planning, development, implementation, and evaluation are part of the trial data in research on the development of calculus learning video medium for students. Based on the analysis stage, the data obtained are (1) there was a lesson plan for integral calculus courses each semester, (2) the lesson plan was prepared by a team consisting of Ahmad Dahlan University lecturers in Mathematics Education who were members of the analysis team, (3) achievements were learning that was charged to integral calculus courses consist of learning achievement and final ability of each learning stage.

The material for integral calculus is presented in 16 meetings, with each meeting lasting three times 50 minutes for face-to-face meetings. According to the lesson plan, the integral material for the flat area is offered at meetings 13 and 14. The expected ability of students is able to identify certain integral concepts, draw graphs, apply, and analyze the area of flat areas.

The ability of students who are used as test subjects is very diverse. Students' abilities can be seen from the results of the final semester exam for differential calculus courses as a prerequisite course for taking integral calculus courses. From the results of the score of differential calculus course, 70.4% of the students received an A score (score ≥ 80). The percentage of students that receive $A-$ (A minus) score is 22.2%, with score of roughly between $76.25 \leq score < 80$. The last one is that 7.4% of the students receive $B+$ score when their score is located around $68.75 \leq score < 76.25$.

Data design is carried out in three steps: making an outline of the material presented in the learning video, compiling a learning video assessment instrument consisting of a material expert assessment, media expert assessment, and student response questionnaires. The design of the learning videos made is illustrated in the following chart (Figure 2).

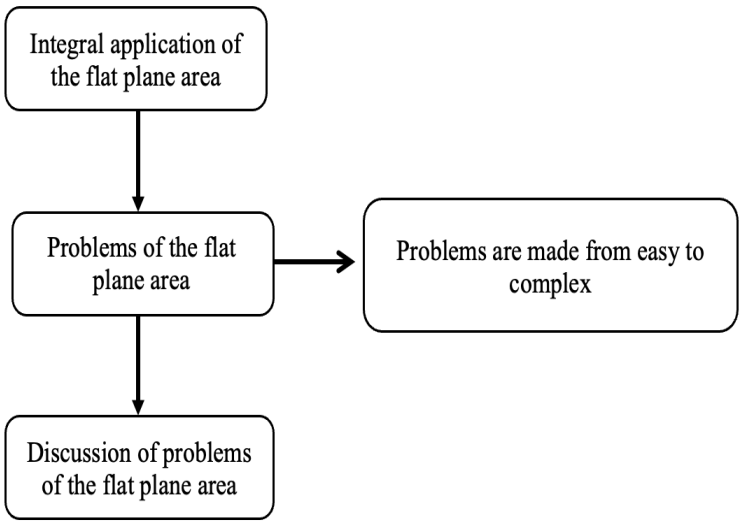


Figure 2. Video Design Flow

Table 3 shows the data acquired from the two material experts' assessments during the development stage.

Table 3. The Material Expert Assessment Result

No	Validator	Score	Classification
1.	Material Expert 1	4.71	Very Good
2.	Material Expert 2	4.76	Very Good
	Mean	4.735	Very Good

The first material expert gave an average score of 4.71, and the second material expert gave an average score of 4.76. So, it can be concluded that the average assessment of learning video products made in terms of material was very good criteria. For the assessment of media experts, the results are shown in Table 4 below.

Table 4. The Media Expert Assessment Result

No	Validator	Score	Classification
1.	Media Expert 1	4.556	Very Good
2.	Media Expert 2	4.704	Very Good
	Mean	4.629	Very Good

The first media experts' average score is 4.556, while the second media experts' average score is 4.704. The average evaluation of learning video goods developed in terms of media is 4.629, which indicates very good criteria.

The implementation stage is carried out after the video is assessed by material experts and media experts. From the results of the questionnaire filled out by the test subjects, the average score was 4.13 in the interval $3{,}40 < \bar{X} \leq 4{,}20$ so that it was included in the good category. Proceed to the evaluation stage after the implementation stage is completed. The data from the assessment findings of material experts, media experts, student responses, and the inputs supplied by the two experts are used in the evaluation stage.

Discussion

During the analysis stage, there are three aspects: the observation of the semester study plan, the characteristics of the students, and the integral calculus class material. The observation of the semester lesson plan is concentrated in the integral calculus class. The outputs of the lesson plan include behavior and values, general and special skills, managerial skills, and comprehension of knowledge. The general skills that the students need to achieve are the ability to apply logical, critical, systematically, and innovative thinking during the integral calculus class. As well as the ability to demonstrate independent, excellent, and measured performance while in class. From the analysis of the expected output of integral calculus course, the integral calculus material presented must be able to make students think critically, systematically, and grow innovatively. All of them are presented in the form of theories, questions and discussions in the learning video media that are made. Therefore, to achieve all the outputs mentioned above, a learning video is to be created.

The prerequisite for taking the integral calculus course is a differential calculus course. From the results of the data obtained, only 22.2% of students got an A score, this shows that there are still not half of the total students who get an A score. It is showing that the ability of the prerequisite courses that students have is not optimal. The students' grades

in the differential calculus class, which spread from $B+$ to A, the students' characteristics or basic knowledge levels are varied. Based on the interviews conducted with five random students, the students were having difficulties during the COVID-19 pandemic in studying with their peers, including technical issues such as the lack of internet connection speed and the troubles that occur when asking questions online compared to offline class. The students reviewed the lecturer's PowerPoint slides, searched for reference books, and browsed videos on YouTube to overcome these issues. Even though they found some YouTube videos about applied calculus, the students felt that the videos were not precisely what they needed. Eventually, the students requested a specific learning video to improve their concept comprehension.

The materials in integral calculus include integral, application of integration, transcendental function, and integration techniques or methods. Based on the analysis and feedback from the students, it has been found that the application of integration in shapes area is complicated to understand for the students. Integral application material for flat area in lectures is given in two meetings with a duration of 4×50 minutes. From this time of 200 minutes to present the material the area of the flat area is not enough. This is because students usually have difficulty: (1) in drawing a graph of a function as a boundary for the area to be searched for, (2) finding the intersection point of the two functions given, and (3) the use of integral formulas that many forget and have not mastered. Therefore, the material about the area of shapes is added to a video.

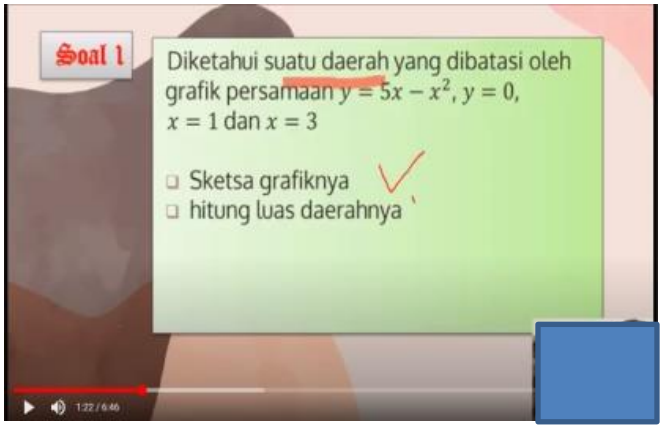
At the designing stage, five videos are made and put in order according to their difficulty level. Each video includes an introduction, title of the topic, theory, questions, discussion, conclusion summary, and closing. Figure 3 depicts a design example of the introduction and closing. The opening video as a greeting for all students watching the video, aims to generate motivation and focus students to start learning. The closing section is the part to end the display on the learning video, to encourage students to always study and listen to the next video. While the title of the video includes the title itself, and the chapter description is shown in Figure 4. Each video is given the title of the sub material discussed and also given a description of part 1, part 2 and so on. This aims to make it easier for students who watch this video to listen coherently from part 1 to part 5 sequentially and continuously. Theories will be presented in the form of one or two questions along with their discussions (Figure 5). The presentation of questions in the video is presented from the easiest questions to the more difficult questions. The purpose of this presentation is that students are able to think critically, systematically and independently. The last one is Figure 6 shows the design example of the conclusion. This section discusses the questions given in detail with the addition of a few scribbles to confirm the answers to the questions given. In addition, the discussion also presented some of the prerequisite materials used. In this section, the emphasis is on understanding the concept of calculating the area of a flat plane.

Figure 3a

Figure 3b

Figure 3. Introduction (3a) and Closing 32b)

Figure 4. The Title of the Material



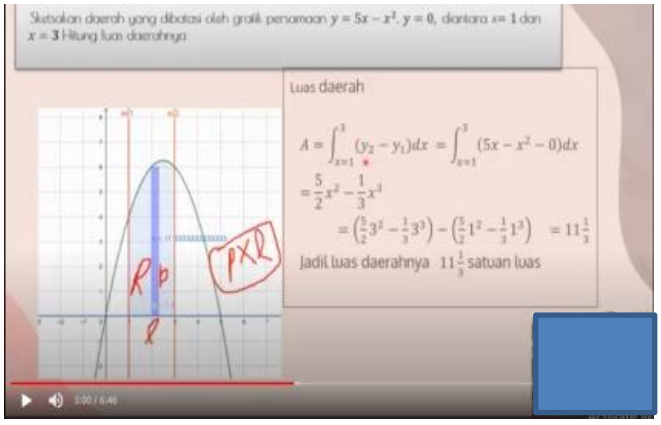


Figure 5a *Figure 5b*

Figure 5. Question Example (5a) and Discussion (5b)

Figure 6. Summary of the Material

The learning video is then given feedback by the material expert, as shown in Table 5.

Table 5. Feedback from the Material Expert

Media Expert	Feedback
Material Expert I	In the polygons question illustration, remind the students again about the concept of definite integral as the limit of a Riemann sum.
Material Expert II	The writing of a particular integral result after the integral process needs to be added to the limits.

Based on the feedback from the material expert, revisions are made by adding the description of the concept of area of shapes, reminding the concept of Riemann sum in determining the area of shapes, and adding the integral limits. Feedback from the media expert is shown in Table 6 below.

Table 6. Feedback from the Media Expert

No	Validator	Feedback
1.	Media Expert I	Add animation for the texts or the question illustrations.
2.	Media Expert II	An editorial mistake for video number 1, there is a space in between the words in step 5

According to the feedback, revisions are made by adding animation for the texts and the question illustrations, together with editorial correction on video number 1, step 5.

Based on the assessment from the material expert, the obtained mean score is 4.735 with the category Very Good. The material in the learning video is presented fully for concept comprehension to help achieve the learning objective. The presentation structure uses the introduction, body, and closing format. The concept and definition given in the video do not cause multiple interpretations as they align with the concept and definition acknowledged in calculus. Facts are presented according to reality and effectively to improve concept comprehension. The use of notation and symbols are correct according to the custom used in calculus. The material is presented in an actual manner that is in line with the area of shapes comprehension. The coherency of the material is presented in such a manner where the previous chapter of the video may help to understand the material in the next chapter. Problem questions or examples are provided to help the subsequent concept comprehension. These questions serve the purpose of training the ability to understand and apply the area of shapes.

This video which provides the concept to find the area of shapes may help the students to understand the concept itself by showing examples of finding the area of shapes in various representations. The steps or methods to find shape area, procedures, and presentation of a concept that can be applied in a contextual problem are included in this video.

The media assessment produces a mean score of 4.54 with the category of Very Good. Therefore, the media is feasible to use for the learning process. The mean score is 4.629 with the category of Very Good which shows that this video is feasible to use. The video is created with the proper standard of duration and audio that demonstrates a good center point. The font is easy to read because the style and size are appropriate, and there are few colours. The graphs within the video visualize the substance or the material of calculus. The delivery of the material is interactive, which aims to improve the students' motivation to study.

The procedure continues in a video trial with the subjects of this research. The video that is shown to the trial subjects consists of five video parts. Each of these parts has an introduction, problem examples, discussion, and conclusion.

Lastly, the evaluation process takes place by collecting the students' input about the video which stated that

1. Overall, the video is great, the volume and the intonation are apparent, the explanation is also understandable, complemented with the problem examples,
2. The learning video and the PowerPoint slides are interesting, and
3. The explanation is easy to comprehend, and the various problem examples also help the students to understand the material.

Based on the input from the subjects of the large class trial, the obtained mean score is 4.13 with the category Good. This goes to show that the learning video is practical to use.

According to the assessments of the material experts and the media experts, the learning video is feasible to use. Similarly, the students' questionnaire result shows that the video is practical to use. This learning video is up to date as it emphasizes the concept comprehension of the application of integral to find the area of shapes by presenting concepts through question examples. The first video highlights the concept comprehension about the method to partition an area that will be calculated. The area of the shape is bordered by the y axis, and a curve is above the x axis. The second video discusses a more complicated problem which is to calculate the area of a shape that is bordered by the x axis and a curve above the y axis. The students have to consider first how many partitions to make and then calculate the area. The third video is much harder to calculate the shape area bordered by the curve, two lines, and the x axis. For the fourth video, the shape area is calculated where its area is on the left and right side of the y axis, so both of the areas must be merged in calculating the area. The fifth video talks about the shape area where two curves and the x axis border its area.

The problem examples are presented based on their difficulty level, starting from the easiest to the most complex. One example of an easier problem is to calculate the area of a shape by understanding the concept of partition of the area of a shape. The given question is to find the area of a shape that is bordered by $x = 0, y = \frac{1}{3}x, and\ y = 4$. This particular

question stresses how to do partition of an area of a shape where the area can be partitioned parallel to the x axis and the y axis. In the second video, the given question is $y = 5x - x^2, y = 0, x = 1 \; and \; x = 3$. In this question, the students have to understand that the area above the x axis is going to be easier to calculate if the known area is partitioned parallel to the y axis.

Meanwhile, a more complex question asks the students to calculate an area of a shape that is bordered by $y = x^2 - x - 4, y = 0, x = 1 \; and \; x = 3$. This question seeks the area below the x axis. Additionally, the students must know that the obtained area should not be negative, they also have to draw the graph, to find the cut-off point of $y = x^2 - x - 4 \; and \; y = 0$, and to determine the partition that must be made. The fourth video presents a much more complex question where it asks for the area that is bordered by $y = \frac{1}{8}x^3, x = -3, x = 2$, and the x axis. This question requires the students to draw a function graph, even though it does not directly ask them to draw it. The obtained graph is on the left side of y axis, below x axis, and the right side of y axis, above x axis.

Consequently, the students have to think that two areas must be calculated, and to find the answer is to add up both the areas. Another difficult question in the video is $y = x^{\frac{1}{2,}} \; y = 6 - x$ and the x axis. To solve this question, the students are required to understand how to draw a graph, find the cut-off point, and determine the partition. An incorrect partitioning of the searched area will cause errors in calculating the area of the shape. The format of presenting the problems or questions based on their difficulty level has helped the students to understand the concept better.

According to previous studies, others also made learning videos, such as the studies by Brame (2016), Sulihin et al. (2020), Lailan (2019), where a feasible learning video was used to improve mathematical concept comprehension, and Kinnari-Korpela (2015), Sharma (2018) who developed a learning video also to improve concept comprehension. Chen and Chan (2022) held a professional development workshop for 54 mathematics teachers in Shanghai, China, to eliminate teacher-dominant discussion in the classroom by employing video as a medium in the teaching-learning process. The findings suggest that video increases student participation in learning while also meeting the needs of teachers. Austerschmidt et al. (2022) work in statistics indicates that students who viewed the video presentation greatly improved their skills compared to those who studied a textbook section about the identical themes. The video presentation was thought to be more engaging and educational than the text. Students' understanding and motivation to learn statistical subject have improved as a result of their efforts. However, these studies were not specifically about integral calculus.

The students responded that this learning video provided a better way to study the material during the pandemic than only downloading files through WhatsApp as it saves internet data and memory capacity. Besides, the video also helps students to understand the mathematical concepts more clearly because of its step-by-step guide on how to solve the questions. The variety of questions in the video makes the explanation of the mathematical concept more comprehensible. As a teacher, it is necessary to consider what types of learning tools are appropriate for our students' era (Chen et al., 2022), where technology is a critical factor in this pandemic situation, and how to enrich various types of lesson models to engage and enhance students' understanding of mathematics, particularly calculus topics. In general, the material is presented entertainingly and easy to follow, and thus encouraging the students to study calculus.

Conclusion

This learning video about the application of integral, which uses the ADDIE model, shows that the video is feasible and practical to use as a learning media for integral calculus. This is proven by mean score given by the material expert of 4.735 with the category Very Good and by the media expert with the mean score of 4.629 with the same category level. Similarly, the students' feedback also rated the video with the mean score of 4.13 with the category Good.

Recommendations

Based on the research results obtained, the following recommendations need to be considered for further studies:

1. Before developing a learning video media product, the teacher must assess the media students demand regarding time, material/content, and the type of video presentation that students want.
2. Students' difficulties are usually in drawing graphs of the calculated area; the teacher must have a strategy in presenting and explaining the depiction of the graph in detail step by step.
3. The resulting learning video products need to be tested in terms of their effectiveness.
4. It is recommended for future studies to further develop a concept video about the area of shapes and to study its effectiveness. In addition, questions with a High Order Thinking skill (HOTs) problem-solving method may also be added.

Limitations

This research still has some limitations, including:

1. Due to online classrooms during the COVID-19 pandemic situation, it is impossible to monitor whether small and big class trial subjects actually open the video product as a whole.
2. The material made in the learning video product is still limited to flat area material only.

Authorship Contribution Statement

Sumargiyani: Conceptualization, design, analysis, final approval. Suparman: Critical revision of manuscript and supervision, final approval. Nur: Drafting manuscript, technical or material support, editing and adding information on the introduction and literature review.

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