

## The Development of Geogebra Assisted E-Module on Integral Course Material

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### Abstrak

Penelitian ini bertujuan untuk menghasilkan e-modul pada materi Integral kelas XII SMA/MA yang memenuhi kriteria valid, praktis, dan untuk mengetahui efek potensial pengembangan e-modul terhadap hasil belajar siswa. Jenis Penelitian ini yaitu penelitian pengembangan dengan menggunakan model ADDIE (Analysis, Design, Development, Implementation, and Evaluation). Objek penelitian ini adalah kualitas e-modul berbantuan GeoGebra pada materi Integral kelas XII SMA/MA yang dikembangkan. Data dikumpulkan menggunakan angket validasi, angket respon, dan tes hasil belajar. Hasil penelitian menunjukkan bahwa e-modul yang dikembangkan telah memenuhi kriteria valid, penilaian kevalidan terlihat dari hasil validasi oleh expert review (validator) berdasarkan aspek isi, konstruk, dan bahasa dengan hasil penilaian kevalidan sebesar 97,3%. E-modul juga memenuhi kriteria sangat praktis berdasarkan angket respon siswa dengan persentase rata-rata 84,7% untuk kelompok kecil (small group) dan 85,3% untuk kelompok besar, dan e-modul dikatakan memiliki efek potensial terhadap hasil belajar siswa dengan rata-rata nilai sebesar 82,66 dengan memenuhi kriteria baik. Sehingga dapat dikatakan e-modul berbantuan geogebra pada materi integral dapat digunakan dalam proses pembelajaran.

**Kata kunci:** ADDIE, E-Modul, GeoGebra, Integral

### Abstract

*This study aims to produce e-modules on Integral material for class XII SMA/MA that meet the valid, practical criteria, and to determine the potential effects of developing e-modules on student learning outcomes. This type of research is development research using the ADDIE model (Analysis, Design, Development, Implementation, and Evaluation). The object of this research is the quality of the GeoGebra-assisted e-module on the material for Integral class XII SMA/MA which was developed. Data were collected using validation questionnaires, response questionnaires, and learning outcomes tests. The results show that the developed e-module has met the valid criteria, the validity assessment can be seen from the validation results by expert reviews (validators) based on content, construct, and language with a validity assessment of 97.3%. E-modules also meet the very practical criteria based on student response questionnaires with an average percentage of 84.7% for small groups and 85.3% for large groups, and e-modules are said to have a potential effect on student learning outcomes. Students with an average score of 82.66 by meeting the good criteria. So it can be said that GeoGebra-assisted e-modules on integral material can be used in the learning process.*

**Keywords:** ADDIE, E-Modul, GeoGebra Integral

## **1. INTRODUCTION**

Mathematics is a subject that is taught at all educational levels, and it is a part of every aspect of human life. Mathematics, in general, is a science that shapes a person's mindset and is a tool (Fathani, 2009). With this, it is intended that students will profit from mathematics in their daily lives.

To learn mathematics, students should be able to do the following, according to the Ministry of Education and Culture of Republic Indonesia (2006):

- 1) Understanding mathematical ideas, demonstrating how concepts relate to one another, and using concepts flexibly, accurately, efficiently, and precisely while addressing a problem.
- 2) Using logic to analyze patterns and properties, gather data, or derive the meaning of a mathematical concept or statement.
- 3) The capability to comprehend issues, create mathematical models, finish models, and analyze answers derived from a problem.
- 4) Using symbols, tables, graphs, or other visual aids to convey concepts and clarify an issue.
- 5) Have a positive outlook on the application of mathematics in life. This includes showing interest, care, and curiosity in learning the subject and being persistent and self-assured when it comes to problem-solving.

Teaching resources that encourage students to participate in studying mathematics actively are essential if learning objectives are to be met. According to Shaleha and Yus (2020), teaching materials are a collection of written and unwritten subject matter that can aid in achieving learning goals. It should be organized systematically and intact to foster a positive learning environment, make it easier for teachers to deliver a subject matter, and make it easier for students to learn study.

However, Turmudi (2008) asserts that students have not been actively involved in mathematics learning up to this point. Less time is spent engaging students in learning activities, and they only hear from the teacher for information. Due to this, students' memories of the material presented are not permanently ingrained (Siagian, 2016). In addition, they were developing student learning outcomes has not been possible using teaching resources like textbooks. Due to their monotony and complexity, the existing educational materials make students feel bored. Additionally, the information offered in the teaching materials is abstract and comprises many formulas, necessitating a high level of comprehension and thought to solve the issue. Integral is a good illustration of the material.

Satriadi (Wigati, Rahmawati, & Widodo, 2018) asserts that integral content is one of the subjects that students find challenging to comprehend, necessitating the use of accuracy, abilities, and quick thinking when studying it. Especially under the current circumstances, where schoolwork is not being done as usual. Due to the effects of the Covid-19 pandemic, students must study online from home.

The context of current events and technology advancements not only affects teachers and students but also has the potential to enhance the value of the learning process (Abdurrahman, Ariyani, Maulina, & Nurulsari, 2019). According to Ramadhani, Umam, Abdurrahman, and Syazali (2019), using technology to conduct a learning process can impact the improvement of learning quality and make it simpler, more efficient, and boost students' and teachers' access to extra knowledge and skills. So that current technology advancements, teaching resources, and learning media, notably online distance learning (PJJ) at home, can have a good impact on the learning process.

Consequently, it is essential to empower and use teaching materials to support learning activities and positively impact student learning outcomes throughout the learning process, specifically by developing teaching materials in the form of e-modules (e-modules; electronic modules).

E-modules deliver independent teaching resources organized into specific learning units and provided electronically, according to the Ministry of Education and Culture (2017). Each learning activity contains a link as a pathway that encourages students to participate and interact with the application, which comes with the ability to integrate audio, animations, and video presentations into the learning process. For example, an electronic book-shaped display of information is called an "e-module" (Wijayanto & Zuhri, 2014).

The use of e-module teaching resources that effectively display content during the learning process serves to improve students' abilities to advance independently of the teacher's presence. In addition, with the use of e-modules, students are required to measure and assess their mastery of the material that has been studied (Prastowo, 2015). The use of e-modules as learning support must therefore be implemented by the current circumstances that call for distance learning (PJJ) online. So it can be used independently at home and can be a solution to current issues to improve understanding of the material for both teachers and students (Satriawati, 2015).

The e-modules has several advantages compared to the print modules, namely the e-modules is more interactive, making it easier for students and teachers to navigate, allows displaying / loading images, audio, video, and animation and is equipped with formative tests / quizzes that allow automatic feedback immediately (Rochsun & Agustin, 2020). Learning using teaching materials (e-modules) must also be supplemented by suitable learning media to achieve learning objectives. Hidayatulloh (2016) defined a learning medium as anything physically used to transmit information. Regarding alternate educational tools that are suitable for the present and can help teachers communicate abstract content, particularly on the integral subject, one such tool is the GeoGebra application.

GeoGebra is a piece of software that can be used, following Arbain (Mimbadri, Suharto, & Oktavianingtyas, 2019), to aid in the learning of mathematics. With the free app GeoGebra, students of all ages and academic levels may learn algebra, calculus, and geometry. Furthermore, according to Hohenwarter (Syahbana A., 2017), GeoGebra can be utilized as a tool to help students more easily visualize geometric concepts, particularly in integral material, making it very valuable for teachers and students.

The researchers' observations show that more study still needs to be done on using electronic modules and the GeoGebra application to promote arithmetic learning. Essentially, the present modules only take into account the teacher's wants and preferences and do not consider the reality of the workplace or the challenges pupils face. Therefore, in light of the current circumstances that demand online learning, the use of e-modules as learning support is necessary. Furthermore, due to the benefits of having this electronic module, students can use it independently at home, and it can be a solution to current issues, which can help improve mastery of the material both teachers and students can benefit from (Satriawati, 2015). The novelty of this study lies in the types of electronic instructional materials and the use of software or programs for material visualization. Therefore, the researcher aims to create an electronic-based module (e-module) that is intended as a simple and appealing mathematics teaching material on integral material. This will allow all students to utilize it online whenever they want and autonomously add interest.

Researchers created instructional materials in the form of e-modules (electronic modules) with the aid of learning media in the GeoGebra application to assist the learning process evolves to be more

effective and provide excellent learning results for students. This project aims to construct GeoGebra-assisted e-modules on reliable and simple integral resources and to investigate potential effects on student learning outcomes from the development of GeoGebra-assisted e-module teaching on integral materials.

## 2. METHOD

This study is a research and development (R&D) study that focuses on teaching resources in the form of electronic modules or electronic modules with GeoGebra support. The development model created by Dick and Carry, ADDIE (Sugiyono, 2019), which has five stages of development, was applied in this study's research methodology. These stages are listed in Table 1 below.

**Table 1.** Stages of the ADDIE Development Model

<b>Stages</b>	<b>Description</b>
<i>Analysis</i>	Three components comprise the analysis stage: a needs analysis, a curriculum analysis, and a media analysis. To create e-modules that meet the expectations and needs of students, a needs analysis is conducted to identify the issues that arise in the sector. Curriculum analysis is used to determine the (Core Competency, Based Competency) and indications that students must meet after studying the subject matter. Finally, with media analysis, e-modules will be created to better fulfill the needs of students during the teaching and learning process.
<i>Design</i>	In this design phase, the researcher gathered references, put together an assessment tool in the form of a validation questionnaire, and created a storyboard for the e-module using GeoGebra on Integral content that was generated based on the findings of the previous study (e-module design).
<i>Development</i>	The e-module begins to develop shape per the preliminary design from the earlier stage. The three validators—material specialists, media experts, and subject teachers—validate the created items after the e-module has been designed.
<i>Implementation</i>	After the e-Module has been built and deemed practical, the implementation step is feasible. After the e-Module has been created and deemed appropriate for use by experts (materials, media, and subject teachers), the implementation stage is carried out. First, a trial is conducted in schools, followed by distributing student answer questionnaires in small groups and groups. It is good to learn how beneficial the developed e-module is. Following the use of e-modules for learning, information about learning outcomes will be sent to the students.
<i>Evaluation</i>	At this step of evaluation, it is examined to determine whether the e-quality modules comprise validity, applicability, and a potential impact on student learning outcomes.

This study used student learning outcomes assessments, student answer questionnaires, and expert/validator validation sheets for data collection. A questionnaire or questionnaires were utilized as the validation sheet in this investigation. Three specialists, or validators, carry out the validation process. Table 2 contains the indicators for the validation questionnaire.

**Table 2.** Grid for Expert Validation Questions

<b>Aspect</b>	<b>Indicator</b>	<b>Number</b>
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Contents	a. Compliance with the indicators of student achievement, essential competencies, and competency requirements (Competency Standards and Based Competency) b. Meeting requirements c. Adequacy of the teaching resources	1-6
Construct	a. Material arrangement b. Presentation of interesting content c. Clarity of display	1-4
Language	a. Clarity of information b. Compliance with Indonesian laws c. Legibility	1-5

Source: (Akbar, 2017, hal. 39)

GeoGebra-assisted e-module trials were also piloted by giving response questionnaires to students. The grid of student response questionnaires has been presented in Table 3.

**Table 3.** Grid for the Student Response Questionnaire

Indicator	Number
The suitability of the educational materials	1, 15
Information clarity	4, 9
Providing motivation	2, 11, 14
Letter usage, letter type, and letter size	6
E-module useability	5, 13
Animation clarity	7, 12
E-module display design	3, 10
Conformity with Indonesian language rules	8

Source: (Akbar, 2017, hal. 39)

A trial test of student learning outcomes is the final strategy for gathering data. In this study, the test is required to determine the extent of student learning completion. How comprehensive the student learning results are determined by the viability of the e-module or the standards for efficiency. Learning outcomes tests were carried out to determine whether the produced e-module could alter learning outcomes and perhaps have an impact on student learning outcomes.

The data analysis used in this study is a qualitative descriptive analysis technique that shows the results of the developed teaching materials in the form of GeoGebra-assisted e-modules on integral materials. The information gathered from the validation sheet of media professionals, subject matter experts, and teachers was then used to group the questions according to the metrics. Then, using the validity and validity criteria in Tables 4 and 5, find the average value of each expert/validator and convert it to assess the level of validity and feasibility of the GeoGebra-assisted e-module on integral content.

**Table 4.** Validity Criteria

Value	Criteria
81%-100%	Very Valid
61%-80%	Valid
41%-60%	Reasonably Valid
21%-40%	Less Valid
0%-20%	Not Valid

Source: Riduwan (Purnamasari & Rochmawati, 2015)

**Table 5.** Practical Criteria

Value	Criteria
81%-100%	Very Practical
61%-80%	Practical
41%-60%	Reasonably Practical
21%-40%	Less Practical
0%-20%	Not Practical

Source: Riduwan (Purnamasari & Rochmawati, 2015)

An evaluation of student learning outcomes in the form of a question exam is utilized as the data source to assess the possible impact of the e-module. If students have fulfilled or exceeded the Minimum Completeness Classification (KKM) criteria set by the school, they are considered to have completed their studies and learning scores. This test data analysis used descriptive data analysis to find the average value. Then, the average student scores are transformed into qualitative data to ascertain student learning outcomes. Table 6 lists the standards for student learning outcomes.

**Table 6.** Criteria for Academic Proficiency

Value	Criteria
85,01-100,00	Very Good
75,01-85,00	Good
60,00-75,00	Enough
40,00-60,00	Not Good
00,00-40,00	Not Very Good

Source: Arikunto (Adha & Refianti, 2019)

### 3. RESULT AND DISCUSSION

The produced e-module teaching resources must be of high caliber. Validity, practicality, and possible consequences are standards that must be met for teaching materials to live up to their standard of quality. These standards can be used as a benchmark for the caliber of the expected teaching materials for e-modules. To satisfy these three requirements, this study's production of GeoGebra-assisted e-module teaching materials uses the ADDIE paradigm, which comprises five stages: analysis, design, development, implementation, and evaluation.

#### A. Analysis

Three stages of analysis were used to build this e-module at the analysis stage, including media analysis, curriculum analysis, and needs analysis. At the needs analysis stage, it was discovered by the teacher that studying mathematics utilizing e-modules for integral topics has never been utilized in the learning process and that students also frequently do not actively engage in learning activities.

The researcher then moves on to the stage of curriculum analysis, where she examines the 2013 curriculum employed. The 2013 curriculum's Core Competencies (KI), Basic Competencies (KD), Competency Achievement Indicators (GPA), Learning Objectives, and Integral Materials are the subject of this analysis.

The researcher then moves on to the curriculum analysis stage, where she examines the used 2013 curriculum. This research focuses on the Core Competencies (KI), Fundamental Competencies (KD), Competency Achievement Indicators (GPA), Learning Objectives, and Integral Materials of the 2013 curriculum.

### B. Design

The researcher's work at this stage is to create an e-module by gathering the elements of teaching material requirements. It is based on Core Competencies (KI), Basic Competencies (KD), Competency Achievement Indicators (GPA), Learning Objectives and materials, collecting references, and developing research instruments to assess the validity, viability, and potential effects of newly developed teaching materials. The front and back covers, introduction, student learning activities, summary, competency test, bibliography, and glossary make up the storyboard section of this e-module.

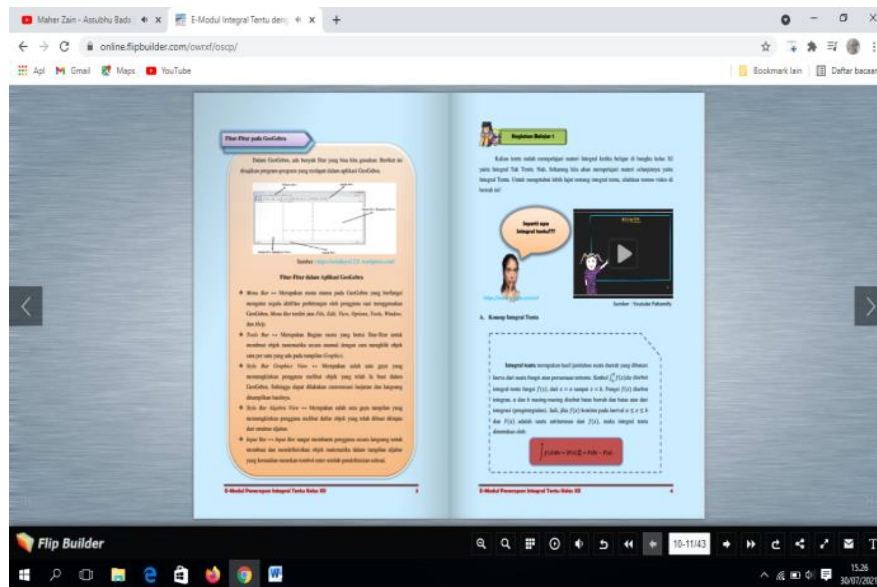
### C. Development

According to the initial design at the design stage, researchers create e-modules. To create this e-module, the researcher first gathered all required materials, including background information, photographs, videos, animations, text, and aphorisms. These materials were then combined using Microsoft Word 2010. they are steadily working their way through the glossary after the front and rear covers. Figure 1 displays the results of the e-module products that have been created.



Figure 1. Display for E-Module Cover

The researcher utilized Microsoft Word 2010 to create the e-module component and then converted it to a pdf file before using the Flip PDF Professional (Flip Builder) application to make the e-module appear like a book but in electronic form. The Flip PDF Professional (Flip Builder) tool also allows you to include instructional videos as needed. Once all the videos have been added, the e-module is released as a link. Figure 2 displays the outcomes of instructional materials created as electronic modules (e-modules) using the Flip PDF Professional program (Flip Builder).



**Figure 2. E-Module Display with Flip PDF Professional (Flip Builder) application**

The validity test process comes next after the e-module creation process is finished. At this point, the experts will determine whether the content is appropriate and whether the built e-module is genuine. There are two lecturers and one educator among the experts/experts who become validators (math teachers). Based on the quality of the findings from the validation sheet's expert evaluation of the e-module teaching materials' development from the perspectives of content, construction, and language. Table 7 details data calculation information of validator calculation for the e-module developed.

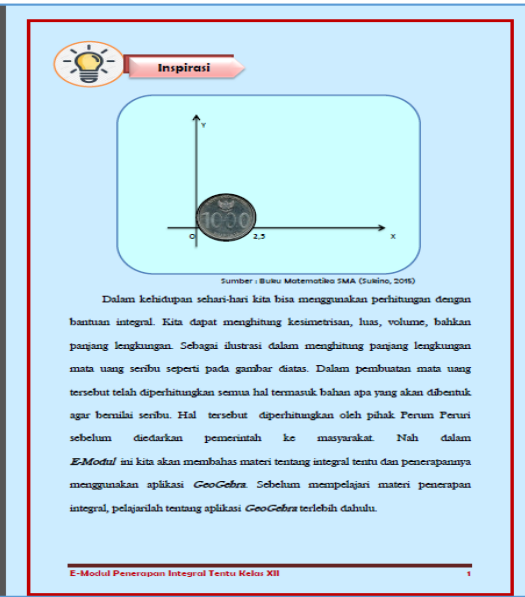
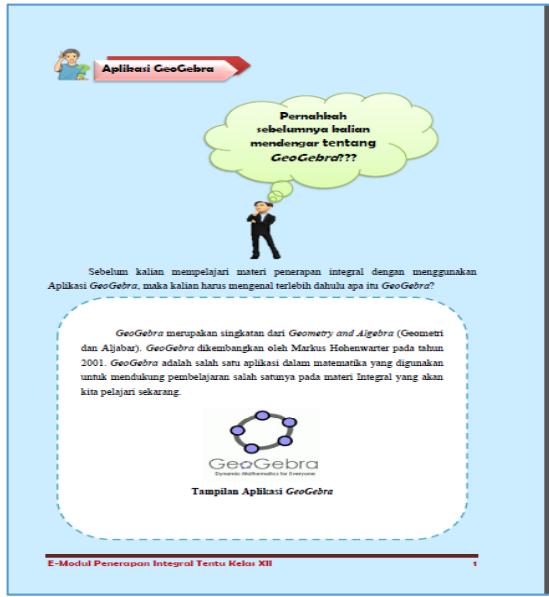
**Table 7. Validation Questionnaire Assessment by Validator**

Validator	Percentage	Description
Ali Syahbana, S.Si., M.Pd.	96,0%	Very Valid
Asnurul Isroqmi, S.T., M.Kom.	97,3%	Very Valid
Dian Mardiana, S.Pd	98,6%	Very Valid
Rata-rata	97,3%	Very Valid

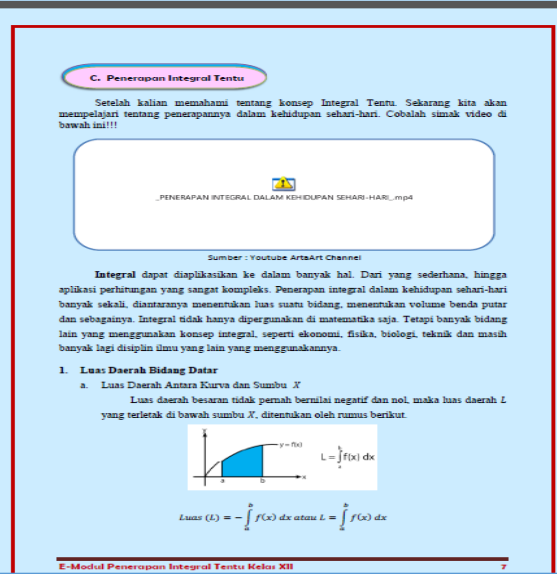
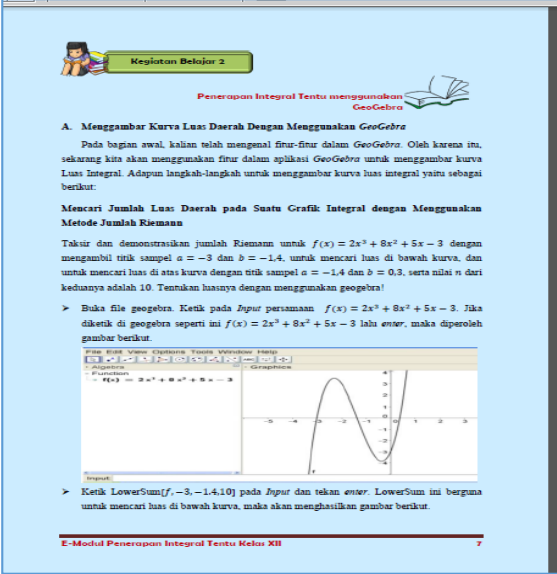
The researcher does the enhancement stage or revises the product once the expert/expert validates the e-module. The e-module was enhanced throughout the product revision stage in response to comments and advice from the validator. Table 8 below shows the outcomes of the product revision.



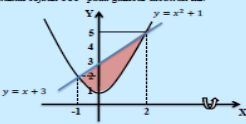
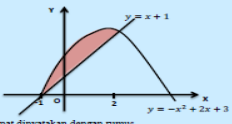
Table 8. Product Updates for E-Module Teaching Resources

Before	After
 <p><b>Inspirasi</b></p> <p>Dalam kehidupan sehari-hari kita bisa menggunakan perhitungan dengan bantuan integral. Kita dapat menghitung kesimetrisan, luas, volume, bahkan panjang lengkungannya. Sebagai ilustrasi dalam menghitung panjang lengkungannya mata uang seribu seperti pada gambar diatas. Dalam pembuatan mata uang tersebut telah diperhitungkan semua hal termasuk bahan apa yang akan dibentuk agar bernilai seribu. Hal tersebut diperhitungkan oleh pihak Perum Peruri sebelum diadarkan pemerintah ke masyarakat. Nah dalam EModul ini kita akan membahas materi tentang integral tentu dan penerapannya menggunakan aplikasi GeoGebra. Sebelum mempelajari materi penerapan integral, pelajarilah tentang aplikasi GeoGebra terlebih dahulu.</p> <p>E-Modul Penerapan Integral Tentu Kelas XII</p>	 <p><b>Aplikasi GeoGebra</b></p> <p>Pernahkah sebelumnya kalian mendengar tentang GeoGebra??</p> <p>Sebelum kalian mempelajari materi penerapan integral dengan menggunakan Aplikasi GeoGebra, maka kalian harus mengenal terlebih dahulu apa itu GeoGebra?</p> <p>GeoGebra merupakan singkatan dari Geometry and Algebra (Geometri dan Aljabar). GeoGebra dikembangkan oleh Markus Hohenwarter pada tahun 2001. GeoGebra adalah salah satu aplikasi dalam matematika yang digunakan untuk mendukung pembelajaran salah satunya pada materi Integral yang akan kita pelajari sekarang.</p> <p>Tampilan Aplikasi GeoGebra</p> <p>E-Modul Penerapan Integral Tentu Kelas XII</p>

It is best to just eliminate the money context and move on to the description of the GeoGebra program if it does not match the content.

Before	After
 <p><b>C. Penerapan Integral Tentu</b></p> <p>Setelah kalian memahami tentang konsep Integral Tentu. Sekarang kita akan mempelajari tentang penerapannya dalam kehidupan sehari-hari. Cobalah simak video di bawah ini!!!</p> <p>PENERAPAN INTEGRAL DALAM KEHIDUPAN SEHARI-HARI.mp4</p> <p>Sumber : Youtube ArtsArt Channel</p> <p>Integral dapat diaplikasikan ke dalam banyak hal. Dari yang sederhana, hingga aplikasi perhitungan yang sangat kompleks. Penerapan integral dalam kehidupan sehari-hari banyak sekali, diantaranya menentukan luas suatu bidang, menentukan volume benda putar dan sebagainya. Integral tidak hanya dipergunakan di matematika saja. Tetapi banyak bidang lain yang menggunakan konsep integral, seperti ekonomi, fisika, biologi, teknik dan masih banyak lagi disiplin ilmu yang menggunakannya.</p> <p>1. Luas Daerah Bidang Datar</p> <p>a. Luas Daerah Antara Kurva dan Sumbu X</p> <p>Luas daerah tersebut tidak pernah bernilai negatif dan nol, maka luas daerah <math>L</math> yang terletak di bawah sumbu <math>X</math>, ditentukan oleh rumus berikut.</p> $L = \int_a^b f(x) dx$ $\text{Luas } (L) = - \int_a^b f(x) dx \text{ atau } L = \int_a^b f(x) dx$ <p>E-Modul Penerapan Integral Tentu Kelas XII</p>	 <p><b>Kegiatan Belajar 2</b></p> <p><b>Penerapan Integral Tentu menggunakan GeoGebra</b></p> <p>A. Menggambar Kurva Luas Daerah Dengan Menggunakan GeoGebra</p> <p>Pada bagian awal, kalian telah mengenal fitur-fitur dalam GeoGebra. Oleh karena itu, sekarang kita akan menggunakan fitur dalam aplikasi GeoGebra untuk menggambar kurva Luas Integral. Adapun langkah-langkah untuk menggambar kurva luas integral yaitu sebagai berikut:</p> <p>Mencari Jumlah Luas Daerah pada Suatu Grafik Integral dengan Menggunakan Metode Jumlah Riemann</p> <p>Takdir dan demonstrasikan jumlah Riemann untuk <math>f(x) = 2x^3 + 8x^2 + 5x - 3</math> dengan mengambil titik sampel <math>a = -3</math> dan <math>b = -1.4</math>, untuk mencari luas di bawah kurva, dan untuk mencari luas di atas kurva dengan titik sampel <math>a = -1.4</math> dan <math>b = 0.3</math>, serta nilai <math>n</math> dari keduanya adalah 10. Tentukan hasilnya dengan menggunakan geogebra!</p> <p>&gt; Buka file geogebra. Ketik pada <i>Jupur</i> persamaan <math>f(x) = 2x^3 + 8x^2 + 5x - 3</math>. Jika diketik di geogebra seperti ini <math>f(x) = 2x^3 + 8x^2 + 5x - 3</math> lalu <i>enter</i>, maka diperoleh gambar berikut.</p> <p>&gt; Ketik <i>LowerSum</i>[<math>f, -3, -1.4, 10</math>] pada <i>Jupur</i> dan tekan <i>enter</i>. <i>LowerSum</i> ini berguna untuk mencari luas di bawah kurva, maka akan menghasilkan gambar berikut.</p> <p>E-Modul Penerapan Integral Tentu Kelas XII</p>

Which learning level, the location of the information, and the utilization of educational media for the GeoGebra application are more important? Explain the content first, then how to use the new GeoGebra application.

Before	After
<p style="text-align: center;"><b>Uji Kompetensi</b></p> <p><i>Petunjuk: Jawablah soal dibawah ini dengan teliti!</i></p> <ol style="list-style-type: none"> <li>1. Tentukan luas daerah tertutup yang dibatasi oleh kurva <math>y = 2x</math>, sumbu <math>X</math>, dan garis-garis <math>x = 1</math> dan <math>x = 4</math>.</li> <li>2. Tentukan luas daerah yang dibatasi oleh kurva <math>x = 1 - y^2</math> dan sumbu <math>Y</math>.</li> <li>3. Tentukan luas daerah yang dibatasi oleh kurva <math>y = x^2</math>, sumbu <math>X</math>, dan garis <math>x = -1</math> dan <math>x = 1</math>.</li> <li>4. Hitunglah isi benda putar yang terjadi jika daerah yang dibatasi oleh kurva <math>x = y^2</math> dan <math>y = 4</math> diputar mengelilingi sumbu <math>Y</math> sejauh <math>360^\circ</math>.</li> <li>5. Hitunglah volume benda putar pada daerah yang diarsir yang diputar pada sumbu yang ditunjukkan sejauh <math>360^\circ</math> pada gambar dibawah ini.</li> </ol>  <ol style="list-style-type: none"> <li>6. Tentukan volume benda putar yang dibatasi oleh <math>y = x^2 - 2x</math> dan sumbu <math>Y</math> diputar <math>360^\circ</math> mengelilingi sumbu <math>X</math>.</li> <li>7. Lukislah luas daerah terarsir yang dinyatakan oleh bentuk integral tentu berikut. <math>L = \int_{-1}^2 [(x+1) - (-x^2 + 2x + 3)] dx</math>.</li> <li>8. Tentukan volume benda putar yang terjadi bila daerah yang dibatasi kurva <math>y = 4x - x^2</math> dan <math>y = -2x + 8</math> dan diputar <math>360^\circ</math> mengelilingi sumbu-<math>Y</math>.</li> <li>9. Gambarkan grafik berikut dengan menggunakan GeoGebra dan tentukan hasilnya. Simpan hasil pekerjaannya pada folder masing-masing.             <ol style="list-style-type: none"> <li>a. Luas daerah dibatasi oleh kurva <math>y = -x^2 + 2x</math> dan sumbu <math>X</math>.</li> <li>b. Volume benda putar yang dibatasi kurva <math>y = 3, y = x^2</math> dan sumbu <math>X</math>.</li> </ol> </li> <li>10. Buatlah suatu grafik yang menggambarkan hubungan kecepatan dengan waktu. Kecepatan <math>v</math> pada sumbu-<math>y</math> sedangkan waktu <math>t</math> pada sumbu-<math>x</math>. Diketahui suatu fungsi <math>v(t) = 3t^2 + 2</math> m/s. Hitunglah perubahan posisi pada selang waktu <math>t = 1</math> hingga <math>t = 3</math>.</li> </ol> <p style="text-align: center;"><small>E-Modul Penerapan Integral Tentu Kelas XII 25</small></p>	<p style="text-align: center;"><b>UJI KOMPETENSI</b></p> <p><i>Petunjuk : Kerjakanlah dengan teliti dan pilihlah satu jawaban yang paling benar.</i></p> <ol style="list-style-type: none"> <li>1. Luas daerah tertutup yang dibatasi oleh kurva <math>y = 2x</math>, sumbu <math>X</math>, dan garis-garis <math>x = 1</math> dan <math>x = 4</math> adalah...             <ol style="list-style-type: none"> <li>a. 10 satuan luas</li> <li>b. 12 satuan luas</li> <li>c. 15 satuan luas</li> <li>d. 17 satuan luas</li> <li>e. 8 satuan luas</li> </ol> </li> <li>2. Luas daerah terarsir seperti tampak pada gambar berikut.</li> </ol>  <p>Dapat dinyatakan dengan rumus...</p> <ol style="list-style-type: none"> <li>a. <math>L = \int_{-1}^2 [(x+1) - (-x^2 + 2x + 3)] dx</math></li> <li>b. <math>L = \int_{-1}^2 [(-x^2 + 2x + 3) - (x+1)] dx</math></li> <li>c. <math>L = \int_{-1}^2 [(-x^2 + 2x + 3) - (x+1)] dx</math></li> <li>d. <math>L = \int_{-1}^2 [(x+1) - (-x^2 + 2x + 3)] dx</math></li> <li>e. <math>L = \int_{-1}^2 [(-x^2 + 2x + 3) + (x+1)] dx</math></li> </ol> <ol style="list-style-type: none"> <li>3. Luas daerah yang dibatasi oleh kurva <math>x = 1 - y^2</math> dan sumbu <math>Y</math> adalah...             <ol style="list-style-type: none"> <li>a. <math>\frac{1}{2}</math> satuan luas</li> <li>b. <math>\frac{2}{3}</math> satuan luas</li> <li>c. <math>\frac{1}{3}</math> satuan luas</li> <li>d. <math>1\frac{1}{2}</math> satuan luas</li> <li>e. <math>\frac{2}{5}</math> satuan luas</li> </ol> </li> </ol> <p style="text-align: center;"><small>E-Modul Penerapan Integral Tentu Kelas XII 26</small></p>
<p>The questions on the competency test have been transformed into multiple-choice ones.</p>	

The instructional material in an e-module is deemed extremely valid when the validator has validated the e-module product. This supports the hypothesis by Yuniarti et al. (2020). They contend that the constructed e-module is in line with the indicators of learning achievement, making the e-module teaching material valid for use in learning activities.

#### D. Implementation

E-modules can then be used as teaching resources in student learning activities at the implementation stage. In addition, the implementation's outcomes can serve as a benchmark for enhancing the e-module. Thirty students from class XII IPA A and 15 from XII IPA B served as the research subjects for this e-module trial, conducted at SMA Muhammadiyah 6 Palembang. The e-module teaching materials are put into practice using a distance learning process (PJJ) in a network (Online), and they will first be tested on a small group (small group) in class XII IPA B, followed by a field test (field test) on a large group, before being given out to students in large groups and having them take learning outcomes tests in class XII IPA A.

The three stages of learning activities used in the e-module trial were core activities, opening activities, and closing activities. The educational process is conducted online via a zoom meeting that is shared with a WhatsApp group. Students are advised to complete a response questionnaire provided in the form of a google form link after receiving brief instructions about the introduction of the distributed e-modules in small groups. The findings will be used to assess the usefulness of the e-module.

Additionally, three sessions of learning activities utilizing e-modules were conducted for field trials in big groups. In the last meeting, the researchers gave students learning outcomes test questions to determine learning outcomes after using the e-module. The researchers also distributed student response questionnaires after students had a chance to discuss the subject matter studied and taught

based on the developed e-module teaching materials. It helps determine how realistic or feasible e-modules are.

#### **E. Evaluation**

Evaluating the e-module generated based on student assessments of the usefulness of e-modules and student learning outcomes tests collected from the deployment phase is the final step in developing e-module teaching materials. According to the student response survey results, the e-module is rated as extremely practical by students, who gave it scores of 84.7 percent for the small group and 85.3 percent for the big group.

According to the development process, it was also discovered that 26 out of 30 students had test results for student learning outcomes that met the Minimum Completeness Criteria (KKM) 70. With this, students' average score of 82.66, which is in line with the requirements, was reached for the e-module teaching materials to potentially affect student learning outcomes assessments that prove that students receive a complete score after using e-modules.

The teaching materials created for the e-modules aim to enhance students' critical thinking abilities and make it simpler for students to understand the material, especially integral material. This research is based on the needs of students and the demands of learning during the COVID-19 pandemic. The GeoGebra application, which can assist students in better visualizing the information, was used in the design of the e-module.

Overall, the study's findings suggest that the generated GeoGebra-assisted e-module teaching materials on integral topics are highly reliable, beneficial, and may impact students' learning outcomes. According to Hidayatulloh's research, the created GeoGebra-assisted e-module is valid and practical; hence it is appropriate for usage in the educational process (Hidayatulloh, 2016).

Implementing teaching and learning activities with GeoGebra-assisted e-modules can train students to study independently, teach activeness in learning, and increase student interest in learning. These activities are based on learning activities using the applicable curriculum and conducted online. Therefore, these findings demonstrate how useful e-modules are as a learning tool. Furthermore, according to research by Sari, Farida, and Syazali (2016), learning media (e-modules) aided by GeoGebra can boost student interest in learning and are deserving of being used as learning media. This is consistent with the findings of Octaria et al. (2013) study, which indicates that students can use the designed learning material more efficiently.

Additionally, animated visuals and instructional films are used to display the topics in this e-module. The children appear engaged and enthusiastic during the learning exercises. This demonstrates that employing e-modules increases students' enthusiasm for learning mathematics (Maryam, Masykur, & Andriani, 2019). The GeoGebra program was employed as this study's learning tool, making it new. This is consistent with the study by Rhilmadinar, Ramli, and Ansari (2020), which demonstrates that using GeoGebra software in the classroom can enhance students' learning results and raise their grasp of mathematics. I concur with Nurlaini (2017) that using software-assisted learning modules can boost students' engagement in their academic work.

#### **4. CONCLUSION**

This research has produced an e-module teaching material product (electronic module) assisted by GeoGebra on integral material. The study's findings led to the conclusion that the e-module teaching materials created in this study were extremely practical, very valid, and might impact students'

learning outcomes. Based on the results of the validity assessment of 97.3 percent and the results of the practicality assessment by students with a percentage of 84.7 percent for small groups and 85.3 percent for large groups, the quality of the e-module developed based on the ADDIE development model can be declared very valid and very practical. Furthermore, according to studies of student learning outcomes, which reveal that 26 out of 30 students fulfill the Minimum Completeness Criteria (KKM) 70, e-modules may also have an impact. In light of this, the pupils' average score is 82.66 and meets the criteria for Good, which is acceptable. For the e-module to be acknowledged as being of high quality and practical for use in the learning process. This e-module is intended to sharpen students' analytical abilities and serve as home study material for independent study.

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