Kognitif
Jurnal Riset HOTS Pendidikan Matematika
Volume - 6 No - 2 2026 Page 536 – 551
ISSN 2776-9704 P-ISSN 2776-9984
https://doi.org/10.51574/kognitif.v6i2.3986

A Video-Assisted Flipbook-Based E-Module to Enhance Mathematical Critical Thinking Skiils.

Thea Suci Wulandari, Rizki Wahyu Yunian Putra, Abi Fadila

How to cite: Wulandari, T. S., Putra, R. W. Y., & Fadila, A. (2026). A Video-Assisted Flipbook-Based E-Module to Enhance Mathematical Critical Thinking Skiils. *Kognitif: Jurnal Riset HOTS Pendidikan Matematika*, *6*(2), 536–551. https://doi.org/10.51574/kognitif.v6i2.3986

To link to this artcle: https://doi.org/10.51574/kognitif.v6i2.3986

Kognitif: Jurnal Riset HOTS Pendidikan Matematika
https://doi.org/10.51574/kognitif.v6i2.3986 Volume 6, No 2, April - June 2026, pp. 536 – 551

A Video-Assisted Flipbook-Based E-Module to Enhance Mathematical Critical Thinking Skiils.

Thea Suci Wulandari[1*], Rizki Wahyu Yunian Putra[1], Abi Fadila[1]

[1]Mathematics Education Study Program, Faculty of Tarbiyah and Teacher Training, Universitas Islam Negeri Raden Intan Lampung

Article Info

Article history:

Received Oct 21, 2026
Accepted Mar 31, 2026
Published Online May 10, 2026

Keywords:

E-Module
Flipbook
Critical Thinking Skiils
Videos

ABSTRACT

Mathematical critical thinking ability is one of the important competencies in mathematics learning that must be possessed by 21st-century students. However, the results of the study indicate that students' mathematical critical thinking ability is still low and the teaching materials used are less varied, so that learning is less than optimal. Therefore, this study aims to develop a video-assisted flipbook-based e-module to improve mathematical critical thinking ability. This study uses the Research and Development (R&D) method with the ADDIE model which includes the stages of Analysis, Design, Development, Implementation, and Evaluation. The subjects of the study were eighth-grade students at SMP Negeri 1 Sidomulyo, with classes selected using the Cluster random sampling technique. Data were collected through interviews, validation questionnaires, interestingness questionnaires and tests with a One Group Pretest-Posttest design. The test instrument was compiled based on indicators of critical thinking ability which include interpretation, analysis, evaluation, and inference. The results of the feasibility test by the material expert validator were 3.73, and the media expert validator were 3.37 with the criteria of "valid". The students' responses in the small group test were 3.39 and the large group 3.48 with the criteria of "very interesting". The N-Gain result of 0.72 with the category of "high" and the effect size of 0.74 with the category of "moderate" indicates that the e-module is effective and has a strong influence in improving mathematical critical thinking skills. Thus, the video-assisted flipbook-based e-module is feasible, interesting, and effective in improving mathematical critical thinking skills.

Corresponding Author:

Thea Suci Wulandari,
Mathematics Education Study Program,
Faculty of Tarbiyah and Teacher Training,
Universitas Islam Negeri Raden Intan Lampung
Letkol H Endro Suratmin, Sukarame, BandarLampung, 35131, Indonesia.
✉ theasw26@gmail.com

Introduction

The rapid development of science and technology encourages the world of education to continuously innovate to ensure learning remains relevant and improves its quality. Various studies confirm that education plays a strategic role in developing quality human resources, making improving the quality of learning a crucial necessity for national progress (Sri et al., 2024; Sari et al., 2018; Wahyuni et al., 2020). In this situation, educators are required to design conducive and effective learning to meet the demands of modern learning (Andriani & Putra, 2021). The challenges of the 21st century also require students to master higher-order thinking skills, particularly mathematical critical thinking skills that help students analyze information and solve problems logically (Fitaloka et al., 2022). This aligns with Johnson's view that critical thinking is the process of combining, analyzing, and evaluating information to gain a deeper understanding (Wilda et al., 2022).

Initial observations in class VIII of SMP Negeri 1 Sidomulyo showed that 83.4% of students experienced difficulties in completing critical thinking questions. One of the main causes was the use of less innovative learning resources. Educators only used printed textbooks as the main teaching material, so that learning was not able to optimally improve learning outcomes or critical thinking skills. Students were also less active in the learning process and had varying levels of difficulty in understanding the material. Digital learning resources such as e-modules had never been used in mathematics learning. In addition, assignments were still given conventionally through printed textbooks without the support of interactive media, so they were less able to attract students' attention and interest. Based on a needs questionnaire given to 30 students, 28 students preferred digital learning materials over printed ones. In line with this, educators also conveyed the need to develop innovative and interactive teaching materials to attract students' interest in learning. Therefore, innovations that utilize technology in presenting learning resources are needed.

One relevant innovation is the development of video-assisted flipbook-based e-modules, which provide a more interactive, flexible learning experience and support student independence. E-modules are non-printed digital teaching materials systematically designed to facilitate independent learning (Wedastuti et al., 2023). These digital teaching materials are attractively designed, easy to use, and accessible through various devices such as mobile phones, laptops, and computers (Amalia et al., 2025), thus meeting the needs of modern learning. Video-assisted flipbook-based e-modules are designed to make learning more practical because the presentation is structured to resemble the style of educators teaching in person. Flipbooks combine text, images, audio, and video into a single, dynamic visual display, making the material more engaging and easier to understand (Ramadhina & Pranata, 2022). Meanwhile, video integration has been shown to improve conceptual clarity, help students understand abstract material, and increase learning motivation (Mendofa et al., 2024).

Recent studies have shown that multimedia-based digital teaching materials, particularly flipbooks and videos, play a crucial role in enhancing higher-order thinking skills. Various studies over the past five years have reinforced these findings, including the development of e-modules using flipbook maker applications, which have proven valid, practical, and effective (Anggraini et al., 2022), interactive flipbooks based on the ADDIE model, which have been deemed feasible (A'inulkholifah & Sari, 2025), and flipbooks that integrate videos to support conceptual understanding (Khumairoh & Husnah, 2023). Case-based flipbooks have even been shown to enhance students' critical thinking skills (Landina & Agustiana, 2022). However, these findings indicate that flipbooks and videos are still being developed separately, resulting in a lack of research on integrating the two into a single e-module specifically designed to support mathematical critical thinking skills.

Kognitif: Jurnal Riset HOTS Pendidikan Matematika
https://doi.org/10.51574/kognitif.v6i2.3986 Volume 6, No 2, April - June 2026, pp. 536 – 551

In addition, several other studies also confirmed the effectiveness of e-modules in improving critical thinking skills, such as Danuri & Sundari (2023), as well as the feasibility of flipbook e-modules as shown by Rukmi & Diyana (2024). However, these studies have several weaknesses: (1) focusing only on feasibility or effectiveness without video integration; (2) there is no research that combines flipbooks and videos in one complete e-module; (3) not testing the direct impact on indicators of mathematical critical thinking skills; and (4) not implementing in-depth development designs related to multimedia learning. Therefore, there is a research gap that needs to be filled regarding how video-assisted flipbook-based e-module designs can specifically improve students' mathematical critical thinking skills.

The novelty of this research lies in the development of a video-assisted flipbook-based e-module on statistics material that is systematically designed using the ADDIE model and specifically aimed at improving students' mathematical critical thinking skills. This research not only assesses the feasibility and attractiveness of the e-module but also tests its effectiveness, thus providing a new contribution to the development of integrative digital teaching materials that focus on critical thinking skills. Based on this background, the formulation of the research problem is: (1) How is the process of developing a video-assisted flipbook-based e-module to improve mathematical critical thinking skills?; (2) How is the feasibility and attractiveness of the e-module?; (3) Is the video-assisted flipbook-based e-module effective in improving students' mathematical critical thinking skills? In line with this formulation, this study aims to develop an e-module, assess its feasibility and attractiveness, and test its effectiveness in improving students' critical mathematical thinking skills. The results are expected to contribute to innovation in digital teaching materials and serve as a reference in the development of learning resources for mathematics.

Method

Types of Research

The type of research used is Research and Development (R&D) which aims to produce a product in the form of a video-assisted flipbook-based e-module to improve mathematical critical thinking skills. This research approach is quantitative descriptive supported by qualitative data from interviews and student responses. The product trial design uses a One Group Pretest-Posttest Design to determine the effectiveness of the e-module in improving students' mathematical critical thinking skills. The development model used is the ADDIE model which consists of five stages: Analysis, Design, Development, Implementation, and Evaluation (Zef et al., 2022). ADDIE has advantages in each step that is systematically structured. Each stage is given the opportunity to be evaluated and revised based on the process that has been gone through before proceeding to the next stage, so that the final product is valid. The following is the ADDIE concept (Slamet, 2022):

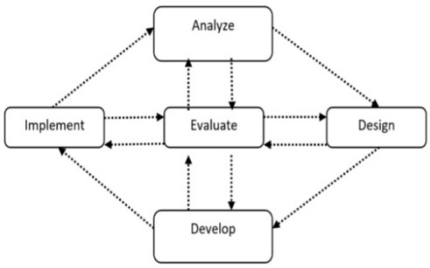

Figure 1. ADDIE Model Concept

Subject

The subjects in this study were eighth-grade students of SMP Negeri 1 Sidomulyo, consisting of a small group of 14 students and a large group of 30 students. Subject selection was carried out using purposive sampling and cluster sampling. Classes were selected purposively based on criteria, namely being at a level appropriate to the research material, students having heterogeneous characteristics, time availability according to the trial schedule, and relevance to developing a video-assisted flipbook-based e-module. Furthermore, all students in the selected classes were then sampled as clusters, so that the subjects represented a relevant population and in accordance with the research objectives.

Instrument

The data collection instruments in this study were interviews, validation questionnaires, an attractiveness questionnaire, and tests. Interviews were conducted to obtain important data or information related to the research implementation. The validation questionnaire was used to collect data from media and material experts. Validation was conducted to ensure that the developed e-module was valid and suitable for use in the learning process. Furthermore, an attractiveness questionnaire was conducted to determine the attractiveness of the developed e-module product. Scores were given using a Likert scale of 1-4. Meanwhile, the test was used to determine the effectiveness of the e-module in improving students' mathematical critical thinking skills. The test implementation included a pretest and a posttest in the form of essays totaling 5 questions. Each question has a maximum score of 16 points, so the total maximum score is 80 points. The critical thinking ability test is compiled based on four main indicators according to Karim & Normaya (2015), adapted from Facione (2015), namely:

Table 1. Critical Thinking Ability Indicators

Aspect	Indicator
Interpretation	Identifying problems and being able to write down known, asked and problems in questions
Analysis	Identifying relevant information, selecting the appropriate solution method, and performing calculations accurately and correctly
Evaluation	Write down the solution to the problem accurately and correctly, and be able to use other alternative answers
Inference	Make appropriate conclusions

Prior to use, all instruments were validated by experts to ensure content and construct suitability. Test reliability was analyzed using Cronbach's Alpha, while item validity was calculated using Pearson Product Moment correlation.

Research Procedures

Development of a video-assisted flipbook-based e-module to improve critical thinking skills in mathematics learning using the ADDIE model. The ADDIE model procedure is as follows Zef et al. (2022): First, the analysis stage, this stage is an activity of analyzing the needs of the teaching materials to be developed. The aim is to identify problems in the mathematics learning process at the school. The stages carried out in the analysis process are as follows: needs analysis, curriculum analysis, and analysis of student characteristics (Nisa et al., 2020). Second, the design stage, at this stage, the design is prepared through several steps before producing a learning device product in the form of a video-assisted flipbook-based e-module.

Kognitif: Jurnal Riset HOTS Pendidikan Matematika
https://doi.org/10.51574/kognitif.v6i2.3986 Volume 6, No 2, April - June 2026, pp. 536 – 551

This design stage is still a basic concept that will be the basis for product development in the next stage (Titis et al., 2025). The process of preparing the e-module design includes the e-module cover, concept maps, learning achievements according to the curriculum used, collecting references, compiling material in the e-module and including videos and images (Putra et al., 2024). The third stage of development, this development stage involves the creation of a video-assisted flipbook-based e-module to improve critical thinking skills, as well as the preparation of pretest-posttest question instruments. After the e-module and instrument are completed, the next step is validation by validators to identify deficiencies. The fourth stage of implementation, at this stage the e-module is applied to students and a series of product trials are conducted to determine the effectiveness and student responses to the product being developed. The fifth stage of evaluation, the evaluation stage can be carried out at each stage that has been carried out. This evaluation aims to assess the extent to which the development objectives have been achieved.

Data Analysis

This study employed qualitative and quantitative analysis. The qualitative analysis presented the results of interviews, suggestions, and criticisms from media experts, material experts, and mathematics educators, analyzed descriptively through the stages of reduction, presentation, and conclusion drawing. Meanwhile, the quantitative analysis presented numerical data using a Likert scale. The data were obtained from the presentation of the results of the development of video-assisted flipbook-based e-module teaching materials and tests to measure critical thinking skills. The results of both analyses were used in an integrated manner to assess the feasibility, attractiveness, and effectiveness of the video-assisted flipbook-based e-module. The results were then calculated using the following formula: (Syafnuri et al., 2019)

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

With,

$$x_i = \frac{total\ score}{maximum\ total\ score} \times 4$$

The assessment scores for each answer in the expert validation questionnaire can be seen in Table 2 (Wibowo et al., 2018)

Table 2. Expert Validation Assessment Score

Category	Score
Very Good	4
Good	3
Not Good	2
Not Good	1

The score data obtained can be categorized according to the criteria in the Table 3

Table 3. Validator Criteria

Score	Eligibility Criteria
$3{,}26 < \bar{x} \leq 4{,}00$	Valid
$2{,}51 < \bar{x} \leq 3{,}26$	Quite Valid

$1{,}76 < \bar{x} \leq 2{,}51$	Less Valid
$1{,}00 < \bar{x} \leq 1{,}76$	Invalid

The assessment scores for each answer in the student response questionnaire for the video-assisted flipbook-based e-module can be seen in the Table 4 (Aini et al., 2018)

Table 4. Respondent Trial Assessment Score

Category	Score
Very Good	4
Good	3
Not Good	2
Not Good	1

With the score results categorized as follows:

Table 5. Attractiveness Test Criteria

Score	Criteria
$3{,}26 < \bar{x} \leq 4{,}00$	Very Interesting
$2{,}51 < \bar{x} \leq 3{,}26$	Interesting
$1{,}76 < \bar{x} \leq 2{,}51$	Less Attractive
$1{,}00 < \bar{x} \leq 1{,}76$	Not Attractive

The next stage measured the effectiveness of the video-assisted Flipbook-based e-module by providing pre-test and post-test essay questions, which were then analyzed using N-Gain. The trial design used was a One Group Pretest-Posttest Design (Sugiyono, 2017). The following is the effectiveness test formula used: (Supriadi, 2021)

$$\langle g \rangle = \frac{Postest\ Score - Pretest\ Score}{Maximum\ Score - \ Pretest\ Score}$$

The N-Gain results obtained are then grouped into the following Hake N-Gain score distribution categories.

Table 6. N-Gain Score Category

N-Gain Score ⟨g⟩	Criteria
$g > 0{,}7$	High
$0{,}3 \leq g \leq 0{,}7$	Currently
$g < 0{,}3$	Low

Furthermore, to determine the level of effectiveness of video-assisted flipbook-based e-modules to improve mathematical critical thinking skills, this can be seen in the Table 7

Table 7. Criteria for Determining the Level of Effectiveness

Persentase (%)	Criteria
$g < 40$	Ineffective
$40 \leq g < 56$	Less Effective
$56 \leq \mathrm{g} < 76$	Quite Effective
$g \geq 76$	Effective

Furthermore, to strengthen the interpretation of effectiveness, this study also calculated the magnitude of the influence of the video-assisted flipbook-based e-module on improving mathematical critical thinking skills using effect size. The following is the effect size formula:

Kognitif: Jurnal Riset HOTS Pendidikan Matematika
https://doi.org/10.51574/kognitif.v6i2.3986 Volume 6, No 2, April - June 2026, pp. 536 – 551

$$d = \frac{(X_2 - X_1)}{SD_{Polled}} \text{ with, } SD_{polled} = \sqrt{\frac{SD_1^2 + SD_2^2}{2}}$$

Research Findings

The development research resulted in a video-assisted flipbook-based e-module product to improve mathematical critical thinking skills. The following is an explanation of the results of the development research from each stage:

Analysis Stage

The analysis stage involves analyzing student needs, curriculum analysis, and student characteristics. The needs analysis was based on data from student interviews and questionnaires, which showed that the mathematics learning process is still limited to the use of printed textbooks without the support of interactive media such as flipbooks or learning videos. Digital learning resources such as e-modules have never been used in mathematics learning, so students tend to be less interested and less active in participating in learning. The questionnaire results showed that 30 students preferred digital-based learning materials, because they were more flexible and engaging. In addition, 28 students chose the option of strongly agreeing with the development of learning materials in the form of flipbook-based e-modules with video support to make it easier for students to understand mathematics learning materials. Educators also expressed the need for innovative and interactive learning materials to increase learning interest. These findings align with the demands of the independent curriculum, which encourages the use of digital media as a flexible, interactive, and student-centered learning tool. Therefore, the development of flipbook-based e-modules with video support is a relevant solution and in line with current developments in educational technology. Curriculum analysis shows that the curriculum used at SMP Negeri 1 Sidomulyo is the independent curriculum. The independent curriculum emphasizes interactive, flexible learning and supports the development of higher-order thinking skills. Statistics material was chosen because it demands analytical skills, data interpretation, and reasoning, making it an appropriate context for developing critical thinking skills. The questionnaire results showed that students' learning styles were diverse: 35% visual, 32% auditory, and 33% kinesthetic. This diversity underscores the need for media that combines text, visuals, video, and interactive activities, all of which can be facilitated by video-assisted flipbooks.

Design Stage

The design stage includes creating e-module covers, e-module instructions, concept maps, learning objectives, compiling statistical materials, learning videos, and designing instruments to assess feasibility, attractiveness, and effectiveness.

Development Stage

The development phase involved developing a video-assisted flipbook-based e-module to enhance critical mathematical thinking skills. After the e-module was developed, it was validated by subject matter and media experts to improve the product and declare it suitable for use. The following is a screenshot of the e-module cover, concept map, statistics materials, learning videos, practice questions, glossary, and bibliography:

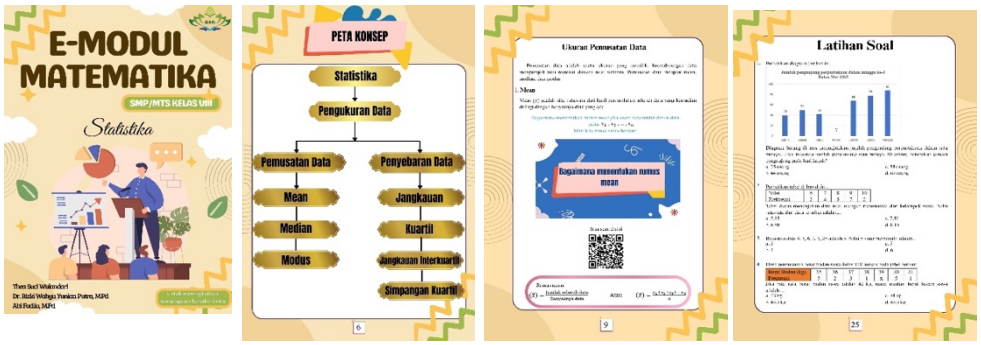

Figure 2. Cover E-module, concept map, statistics materials, learning videos, practice questions, glossary, and bibliography

Learning videos are created to support students' understanding of the material through audio-visual explanations. An example of a developed learning video is shown in the following image:

Figure 3. Learning Videos

Figure 3 displays a video clip illustrating the presentation of data in the form of a bar chart regarding the number of library visitors over five days. The video shows an illustration of a teacher explaining the material, a digital whiteboard containing the context of the problem, a bar chart as visual data, and questions to encourage students to analyze the data. Information in the video indicates that visitor data for five days is available, but the number of visitors on Wednesday is not clearly visible. Students are then asked to determine the number of visitors on Wednesday based on other data and the average value. This calculation activity is part of a critical thinking skill exercise.

The combination of visuals, narratives, and illustrations is designed to support visual and verbal information processing and the use of various learning media, thereby helping students understand statistical concepts and practice critical thinking skills through data interpretation, information evaluation, and conclusion drawing. The e-modules presented in flipbooks allow students to easily navigate pages, play videos directly on the page, access questions and discussions interactively, and repeat certain sections as needed for independent learning. The flipbook's layout is designed to be attractive and user-friendly, using soft colors, educational illustrations, and a consistent layout.

Next, product validation testing was conducted by experts, including material experts and media experts. The validation testing was conducted to identify deficiencies in the e-module so that the author could obtain advice and input from the experts for revisions until the product was deemed suitable for use. The following are the results of the material expert validation:

Kognitif: Jurnal Riset HOTS Pendidikan Matematika
https://doi.org/10.51574/kognitif.v6i2.3986 Volume 6, No 2, April - June 2026, pp. 536 – 551

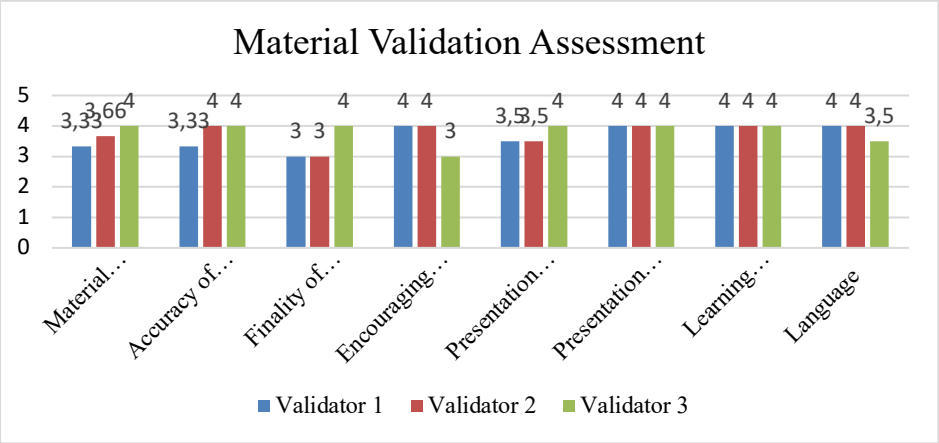

Figure 4. Subject Matter Expert Validation Chart

Figure 4 shows the validation graph of the material experts assessed by two mathematics education lecturers from UIN Raden Intan Lampung and one mathematics teacher from SMP Negeri 1 Sidomulyo. The assessment above covers aspects of the suitability of the material to the CP, material accuracy, material up-to-dateness, encouraging curiosity, presentation techniques, presentation support, learning presentation, and language. The average score for all aspects was 3.73 with the criteria of "valid". Therefore, it can be concluded that the video-assisted flipbook-based e-module is very valid and suitable for use. The following are the results of the media experts:

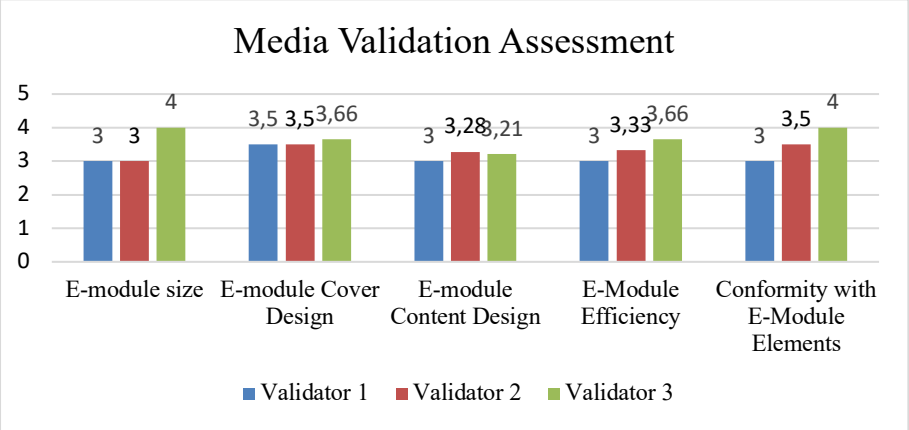

Figure 5. Media Expert Validation Graph

Figure 5 shows the media expert validation graph conducted by two mathematics education lecturers from UIN Raden Intan Lampung and one mathematics teacher from SMP Negeri 1 Sidomulyo. The assessment above includes aspects of e-module size, e-module cover design, e-module content design, e-module efficiency, and suitability with e-module elements. The average score for all aspects is 3.37 with the criteria of "valid", so it can be concluded that the video-assisted flipbook-based e-module is very valid and suitable for use.

Implementation Stage

The implementation phase was conducted to determine student response to the e-module and measure its effectiveness. The product's appeal test consisted of small-group and large-

group trials. The appeal test was obtained from a student response questionnaire regarding the video-assisted flipbook-based e-module to improve mathematical critical thinking skills. Meanwhile, the product's effectiveness test was determined using test results (pretest-posttest) to determine the e-module's effectiveness. The following are the comparative results of the student appeal test:

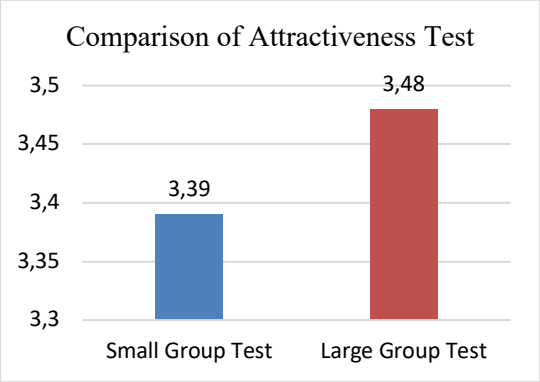

Figure 6. Comparison of Attractiveness Test

Figure 6 displays the results of the small-group and large-group engagement tests. The small-group test, involving 14 students, yielded an average engagement score of 3.39, categorized as "very engaging." Meanwhile, the large-group test, involving 30 students, yielded an average engagement score of 3.48, categorized as "very engaging." Students assessed that this e-module increased learning motivation, facilitated understanding of the material, and provided a pleasant learning experience. These findings were reinforced by comments in the open-ended questionnaire, where students stated that the flipbook's interactive visual display, simple navigation, and the presence of instructional videos made the learning process more enjoyable and easier to follow. These features enabled students to review the material independently, increasing their confidence and adjusting their learning pace to suit their individual needs. This consistency between the questionnaire data and student comments aligns with research by Waliulu & Palembang (2022), which found that using flipbooks accompanied by instructional videos can increase student interest and engagement. Furthermore, the effectiveness of the e-module was measured using a One Group Pretest-Posttest design. The analysis showed an increase in students' critical mathematical thinking skills after using the video-assisted flipbook-based e-module.

Table 8. N-Gain Data on Students' Mathematical Critical Thinking Ability

Mean			
Pretest	**Posttest**	***N-Gain Score***	**Information**
35,17	81,97	0,72	Tall

Based on the results of the N-Gain Score calculation, a value of 0.72 was obtained in the "high" category and for the N-Gain Score in percentage form, the result was 72% with the criteria of "quite effective". This indicates that the developed e-module is able to provide a significant increase in students' mathematical critical thinking skills. This high increase not only indicates students' success in understanding the material, but also reflects that the features in the e-module, such as the visual display of flipbooks, the integration of explanatory videos, and systematic presentation of materials, are able to help students build a deeper conceptual understanding. Videos provide reinforcement for difficult concepts, while the flipbook format makes it easier for students to explore the material flexibly according to their respective learning

Kognitif: Jurnal Riset HOTS Pendidikan Matematika
https://doi.org/10.51574/kognitif.v6i2.3986 Volume 6, No 2, April - June 2026, pp. 536 – 551

pace. The combination of the two media creates a more interesting, directed, and meaningful learning experience, thus supporting the development of critical thinking indicators such as interpretation, analysis, evaluation, and inference. To strengthen these results, an effect size analysis was conducted. The results are presented in Table 9

Table 9. Data Effect Size of Students' Mathematical Critical Thinking Ability

Category	N	$M_{1,2}$	$SD_{1,2}$	SD_{polled}	*Effect Size*
Pretest Score	30	35,17	35,92	62,57	0,74
Posttes Score	30	81,97	80,88		

Based on the calculations, the effect size was 0.74, which falls into the "moderate" category. These results indicate that the use of video-assisted flipbook-based e-modules has a significant impact on improving students' critical thinking skills in statistics. The difference in categories between N-Gain and effect size indicates that although the improvement in learning outcomes is relatively high, the strength of the treatment's influence is influenced by variations in student scores, so the effect size is in the medium category. Thus, the results of the N-Gain and effect size analysis indicate that the developed e-module is effective for use in mathematics learning, particularly in improving students' critical thinking skills in mathematics learning.

Evaluation Stage

The evaluation phase in the ADDIE development model is conducted at each stage, stopping once the final assessment results meet the criteria of being valid/feasible, engaging, and effective, allowing them to be used in learning. Based on the development results, the five stages yielded a final product that is feasible, engaging, and effective in the learning process. Furthermore, triangulation between quantitative and qualitative data was conducted to strengthen the findings regarding the feasibility and effectiveness of the video-assisted flipbook-based e-module to improve students' mathematical critical thinking skills. Quantitative data showed a significant increase in critical thinking skills with an N-Gain of 0.72 in the high category and an effect size of 0.74 in the medium category, while questionnaire data showed an average interest value of 3.39 for the small group and an average interest value of 3.48 for the large group with a very interesting category. This finding was reinforced by student comments in the open column of the questionnaire, which stated that the interactive flipbook display and the presence of learning videos helped students understand the statistical material clearly and made the learning process more interesting. The alignment between the interest assessment, the increase in test scores, and these open comments indicates that the positive learning experience through the e-module contributed directly to the improvement of critical thinking skills. Thus, the triangulation of quantitative and qualitative data provides strong evidence that the developed e-module is not only feasible in terms of appearance and media, but also effective in supporting the learning process..

Discussion

This study produced a video-assisted flipbook-based e-module to improve students' mathematical critical thinking skills in statistics. The validation results from material experts and media experts showed that the developed e-module met the feasibility criteria, while the results of student responses showed that the e-module was considered very interesting for use in learning. In addition, the results of the effectiveness test showed an increase in students' mathematical critical thinking skills with an n-gain value of 0.72, which is in the high category.

These findings indicate that the e-module is not only suitable as a learning medium, but also has contributed to improving the quality of students' thinking processes in understanding and solving statistical problems. This improvement can be explained through the characteristics of e-modules that combine flipbook displays, step-by-step presentation of material, learning videos, problem-solving examples, and exercises that guide students in understanding, analyzing, evaluating, and drawing conclusions. In statistics, critical thinking skills are essential because students cannot simply calculate the average, median, mode, or measure of data distribution. Students also need to read the data, interpret its meaning, choose the appropriate procedure, check the reasonableness of the results, and draw conclusions based on the available information (Sri et al., 2024; Sari et al., 2018; Wahyuni et al., 2020).. Therefore, the use of video-assisted e-modules is relevant because it can help students follow a more structured mathematical thought process.

The learning videos in the e-module serve as audiovisual media that simultaneously present the relationships between concepts, procedures, and problem-solving examples. This presentation helps students see how information in the problem is identified, how a solution strategy is selected, how calculations are performed, and how conclusions are drawn (Wedastuti et al., 2023). However, the power of the video lies not solely in the visual and audio elements, but in how it is integrated with the learning activities in the e-module (Waliulu & Palembang, 2022). If the video is only watched passively, its contribution to critical thinking will be limited (Wedastuti et al., 2023). In this study, the video became more meaningful because it was combined with materials, questions, exercises, and activities that required students to provide reasons, evaluate answers, and draw mathematical conclusions.

These findings align with multimedia learning theory, which explains that learning can be more effective when information is presented through an integrated combination of text, images, audio, and visuals. This integration can help students process information through verbal and visual channels, thus strengthening their understanding of concepts (Amalia et al., 2025). In the context of this research, multimedia principles not only support understanding of statistical concepts but also help students develop the foundations of thinking necessary for analysis and evaluation. Therefore, the use of video in e-modules needs to be understood as part of a learning design that encourages thinking processes, not simply as a supplementary media.

The results of this study also strengthen the findings of Darmansyah et al. (2024) who showed that flipbook-assisted e-modules are effective in mathematics learning. These findings also support the research of Gulo & Mendrofa (2024) who showed that flipbook-based e-modules are valid, practical, and effective for use in mathematics learning. However, this study has a more specific focus because it developed a video-assisted flipbook-based e-module on statistics material with a primary orientation towards improving mathematical critical thinking skills (Khumairoh & Husnah, 2023). Thus, the contribution of this study lies in strengthening the design of e-modules that not only present material in an interesting way but also direct students to engage in high-level cognitive activities.

Theoretically, this study reinforces the view that digital learning media will be more meaningful if designed based on the principle of integration between visual and verbal representations, and thinking activities. Video-assisted flipbook-based e-modules can be a means to connect concept presentations, solution examples, and reflective exercises in a single learning flow. Practically, the results of this study indicate that teachers can use this type of e-module as an alternative, more interactive and directed statistics learning medium. However, the effectiveness of e-modules still depends on the quality of the assignments, the clarity of the instructions, the appropriateness of the videos, and the presence of activities that encourage students to analyze, evaluate, and provide mathematical reasoning (Landina & Agustiana, 2022). Therefore, the development of video-based e-modules should not only emphasize the

Kognitif: Jurnal Riset HOTS Pendidikan Matematika
https://doi.org/10.51574/kognitif.v6i2.3986 Volume 6, No 2, April - June 2026, pp. 536 – 551

appearance and appeal of the media, but also ensure that each component within it supports the process of mathematical critical thinking.

Conclusion

This study concludes that the developed video-assisted flipbook-based e-module is feasible, engaging, and effective for improving students' mathematical critical thinking skills in statistics. The feasibility of the product is demonstrated through valida tion results from material experts and media experts, while the product's appeal is evident from students' positive responses to the use of the e-module in learning. The effectiveness test results indicate an increase in mathematical critical thinking skills with an n-gain value of 0.72, which is in the high category. These improvements demonstrate that the integration of flipbooks and learning videos can help students understand statistical concepts in a more focused manner. Videos help clarify problem-solving pathways, while e-modules provide a learning structure that allows students to read, observe, analyze, evaluate, and draw conclusions. Thus, video-assisted flipbook-based e-modules serve not only as a medium for delivering material but also as a tool to support critical mathematical thinking. The main contribution of this research lies in the development of digital learning media that combines flipbook displays, learning videos, and learning activities in statistics. However, the effectiveness of e-modules is not solely determined by the audiovisual elements, but rather by the integration of material, examples, videos, exercises, and questions that encourage students to reason critically. Therefore, this e-module can be used as an alternative learning medium for mathematics, particularly in statistics, while still paying attention to the quality of the content, activity design, and the appropriateness of the videos to the learning objectives.

Conflict of Interest

The authors declare no conflict of interest.

Author Contributions

T.S.W. conceived the research idea presented and collected the data. The other two authors (R.W.Y.P. and A.F.) actively participated in the development of theory, methodology, organization and analysis of data, discussion of results, and approval of the final version of the work. All authors declare that the final version of this paper has been read and approved. The total percentage of contributions to the conceptualization, preparation, and correction of this paper is as follows: T.S.W.: 40%, R.W.Y.P.: 30%, and A.F.: 30%

Data Availability Statement

The authors declare that data sharing is not possible, as no new data was created or analyzed in this study.

References

Aini, A., Anggoro, B. S., & Putra, F. G. (2018). Pengembangan Media Pembelajaran Matematika Pada Materi Transportasi Program Linier Berbantuan Sparkol. *UNION: Jurnal Ilmiah Pendidikan Matematika* *6*(3), 289–96. https://doi.org/10.30738/union.v6i3.2986

A'inulkholifah, I., & Sari, Y. (2015). *Math Interactive Flipbook*: Pengembangan Media Berbasis Digital Konsep Matematika Peserta Didik Kelas V Sekolah Dasar. *Pendas: Jurnal Ilmiah Pendidikan Dasar, 10*(1), 213–24. https://doi.org/10.23969/jp.v10i01.23518

Amalia, N., Winarni, S., & Marlina. (2025). Pengembangan E-Modul Ajar Berbasis *Understanding by Design* untuk Meningkatkan Kemampuan Numerasi. *Kognitif: Jurnal Riset HOTS Pendidikan Matematika, 5*(3), 994–1004. https://doi.org/10.51574/kognitif.v5i3.3498

Andriani, S., & Putra, R. W. Y. (2021). Pengembangan Modul Matematika SMP/MTS Berintegrasi Nilai-Nilai Islam. *Delta: Jurnal Ilmiah Pendidikan Matematika, 9*(1), 37. https://doi.org/10.31941/delta.v9i1.1254

Anggraini, R. S., Sustipa, W., & Erita, S. (2022). Pengembangan E-Modul Pembelajaran Matematika Menggunakan Aplikasi Flipbook Maker. *Journal On Teacher Education, 4*(2), 745–56.

Danuri, & Sundari, E. (2023). Pengembangan E-Modul Matematika Model Flipped Classroom Pada Pembelajaran untuk Meningkatkan Kemampuan Berpikir Kritis Siswa Sekolah Dasar. *Jurnal Pendidikan Dasar 4*(2), 2746–1211. http://jurnal.umpwr.ac.id/index.php/jpd

Darmansyah, M. R., Refianti, R., & Elly, E. (2024). Pengembangan E-Modul Berbantuan Flipbook Pada Materi Aplikasi Turunan Fungsi Aljabar Kelas Xi Sman 8 Lubuklinggau. *JP2M (Jurnal Pendidikan Dan Pembelajaran Matematika)*, *10*(2), 604–14. https://doi.org/10.29100/jp2m.v10i2.5601

Fitaloka, R. D., Netriwati, & Fadila, A. (2022). Pengaruh Model Pembelajaran Problem Based Learning Dengan Pendekatan Metakognitif Terhadap Kemampuan Berpikir Kritis Dan Pemahaman Konsep Matematis. *Hipotenusa Journal of Research Mathematics Education (HJRME)*, *5*(2), 74–89, https://doi.org/10.36269/hjrme.v5i2.847

Gulo, K., & Mendrofa, N. K. (2024). Pengembangan E-Modul Dalam Bentuk Flipbook Berbasis Discovery Learning Terhadap Kemampuan Metakognitif Siswa Di UPTD SMP Negeri 1 Gunungsitoli. *Jurnal Cendekia : Jurnal Pendidikan Matematika, 8* (2), 1007–20. https://doi.org/10.31004/cendekia.v8i2.2956

Karim, & Normaya. (2015). Kemampuan Berpikir Kritis Siswa Dalam Pembelajaran Dalam Pembelajaran Matematika Dengan Menggunakan Model Jucama Di Sekolah Menengah Pertama. *EDU-MAT: Jurnal Pendidikan Matematika, 3*(1). https://doi.org/10.20527/edumat.v3i1.634

Khumairoh, P., & Husnah, T. (2023). Pengembangan E-Modul Berbasis Flipbook Muatan Matematika Materi Pecahan Dan Pengubahan Bentuk Pecahan Di Kelas IV SD. *Journal Research and Education Studies, 4*(3), 17–23. https://doi.org/10.51178/invention.v4i3.1631

Landina, I. A. P. L., & Agustiana, I. G. A. T. (2022). Meningkatkan Berpikir Kritis Siswa Melalui Media Pembelajaran Flipbook Berbasis Kasus Pada Muatan IPA Kelas V SD." *Jurnal Mimbar Ilmu*, *27*(3), 443–52. https://doi.org/10.23887/mi.v27i3.52555

Mayer, R. E. (2002). Multimedia Learning. 85–134.

Mendofa, S. J. P. Y., Mendofa, T. N., Telambanua Yakin, N., & Zega, Y. (2024). Pengembangan Video Pembelajaran untuk Meningkatkan Motivasi Belajar Peserta Didik Di SMP Swasta Bunga Mawar. *Jurnal Cendikia: Jurnal Pendidikan Matematika, 8*(1),591–607. https://doi.org/10.31004/cendekia.v8i1.2946

Putra, R. W. Y., Azmi, N. N. N., Ambarwati, R., Leni, N., Fadila, A., & Riskiana Dewi, N. (2024). Pengembangan E-Modul Matematika Berbasis Nilai Keislaman Dan Situation Based Learning. *SIGMA: Jurnal Pendidikan Matematika*, *16*(1), 209–20.

https://doi.org/10.26618/sigma.v16i1.14977

Ramadhina, S. R., & Pranata, K. (2022). Pengembangan E-Modul Berbasis Aplikasi Flipbook Di Sekolah Dasar. *Jurnal Basicedu*, *6*(4), 7265–74, https://doi.org/10.31004/basicedu.v6i4.3470

Rukmi, I. P., & Diyana, T. N. (2024). Pengembangan E-Modul Flipbook Hukum Hukum Newton Berbasis Discovery Learning untuk Meningkatkan Kemampuan Berpikir Kritis Siswa. *DIFFRACTION: Journal for Physics Education and Applied Physics*, *5*(2), 62–72, https://doi.org/10.37058/diffraction.v5i2.6751

Sari, R. S. P., Fadila, A., & Fiteriani, I. (2018). Pengembangan Bahan Ajar Matematika Pada Materi Bangun Ruang Sisi Datar Menggunakan Software Adobe Flash untuk Kelas VIII SMP. *Prosiding Seminar Nasional Matematika Dan Pendidikan Matematika*, 565–72. https://repository.radenintan.ac.id/3780/

Slamet, F. A. (2022). *Model Penelitian Pengembangan (R&D)*. Malang: Institut Agama Islam Sunan Kalijogo Malang.

Sri, K. M, J., Kariani, M. N., Otoni, H. A., & Niat, T. Y. (2024). Pengembangan E-Modul Menggunakan Anyflip untuk Meningkatkan Kemampuan Penalaran Matematis Siswa. *Kognitif: Jurnal Riset HOTS Pendidikan Matematika, 4*(4), 1798–1811. https://doi.org/10.51574/kognitif.v4i4.2230

Sugiyono. (2017). *Metode Penelitian Pendidikan (Pendekatan Kuantitatif, Kualitatif, R&D)*. Alfabeta, CV.

Supriadi, G. (2021). *Statistik Penelitian Pendidikan*. Yogyakarta.

Syafnuri, A. R., Netriwati, & Pratiwi, D. D. (2019). Pengembangan Bahan Ajar Aljabar Linear Dengan Menggunakan Model Pembelajaran Matematika Knisley. *NUMERICAL: Jurnal Matematika Dan Pendidikan Matematika, 3*(1), 43–62. https://doi.org/10.25217/numerical.v3i1.417

Titis Prayitno, A., Nurhayati N., & Suci Damayanti A. (2025). Pengembangan E-Modul Berbasis Problem Based Learning untuk Memfasilitasi Berpikir Komputasional Matematis Siswa." *Kognitif: Jurnal Riset HOTS Pendidikan Matematika, 5*(2), 864–81. https://doi.org/10.51574/kognitif.v5i2.3126

Wahyuni, S., Yati, M., & Fadila, A. (2020). Pengembangan Modul Matematika Berbasis REACT Terhadap Kemampuan Komunikasi Matematis Peserta Didik. *Jambura Journal of Mathematics Education*, *1*(1), 1–12, https://doi.org/10.34312/jmathedu.v1i1.4542

Waliulu, Y. S., & Palembang, C. F. (2022). Penerapan Perangkat Pembelajaran E-Modul Berbasis Flipbook Teori Komunikasi Terhadap Minat Belajar Mahasiswa. *Aksiologi: Jurnal Pendidikan Dan Ilmu Sosial*, *2*(2), 2747–52. https://doi.org/10.47134/aksiologi.v2i2.84

Wedastuti, N. K., Sunismi, & Fuady, A. (2023). Pengembangan E-Modul Berbasis Literasi Model Pisa. *Kwangsan: Jurnal Teknologi Pendidikan*, *11*(1), 459, https://doi.org/10.31800/jtp.kw.v11n1.p459--471

Wibowo, E., & Dinda Pratiwi, D. (2018). Pengembangan Bahan Ajar Menggunakan Aplikasi Kvisoft Flipbook Maker Materi Himpunan. *Desimal: Jurnal Matematika, 1*(2), 147. https://doi.org/10.24042/djm.v1i2.2279

Wilda S., Linda F. S., Nurhabibah, Agustina B. G., Gazi S., Theofilus A. N., Tatan S., et al. (2022). *Pemikiran Kritis Dan Kreatif*. Bandung: CV. Media Sains Indonesia.

Zef, R., Hakmi, R., & Rosid Adbullah, A. (2022). *Metode Penelitian Dan Pengembangan*. Malang: CV. Literasi Nusantara Abadi.

Authors Biography

	**Thea Suci Wulandari,** is a student in the Mathematics Education Study Program, Faculty of Education and Teacher Training, Raden Intan State Islamic University, Lampung. ✉ theasw26@gmail.com
	**Rizki Wahyu Yunian Putra,** is a lecturer and secretary of the Mathematics Education Study Program, Faculty of Education and Teacher Training, Raden Intan State Islamic University, Lampung. He completed his doctoral studies in Mathematics Education at the University of Lampung. ✉ rizkiwahyuyp@radenintan.ac.id
	**Abi Fadila,** is a lecturer in the Mathematics Education Study Program, Faculty of Tarbiyah and Teacher Training, Raden Intan State Islamic University, Lampung. He completed his master's degree in mathematics education at Sebelas Maret University. ✉ fadilaabi@radenintan.ac.id