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Research paper

Development of Flipbook-Based E-Modules on Class XI Construction Cost Estimation Subjects

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ABSTRACT

Background: This research is motivated by the problems faced by grade XI DPIB students at SMK Negeri 3 Boyolangu. The problems include the lack of available learning media and students' difficulties in determining the basic formula for calculating building construction volume. This research and development aim to produce flipbook-based e-module media in the Construction Cost Estimation Subject class XI; to analyze the feasibility and practicality of media as an innovative solution to address these difficulties; and to determine the effectiveness of the use of flipbook-based e-modules in improving students' understanding of the material.
Methods: The method used research and development (R&D) by applying the ADDIE model (Analysis, Design, Development, Implementation, and Evaluation). Data collection instruments employed preliminary instruments (interviews and observations), while validation questionnaires included media experts and material experts, student response questionnaires, and cognitive test questions (pre-test and post-test).
Results: The results of flipbook-based e-module products have advantages in ease of use and a variety of features, including interactive buttons, back sound for flipping, image pop-ups, YouTube video pop-ups, web hyperlinks, and quiz games, to present a clearer visualization of the material and encourage student enthusiasm for learning. Media eligibility obtained a score from media experts of 96% and from material experts of 93%. This score is included in the very feasible category. The practicality of the media was obtained from the user response questionnaire, receiving an average percentage of 88% with very practical criteria. Moreover, the effectiveness of the use of media in learning obtained an N-Gain Score of 0,63 with the "moderate" criterion.
Conclusion: Based on the test results, it is concluded that the developed flipbook-based e-module media is effectively used to improve student understanding.

INTRODUCTION

The development of technology has a significant impact on education, creating demands to maximize technology in the learning and teaching process (Fadilah *et al.,* 2021). However, facts in the field show that most schools predominantly used printed modules as their main medium of learning (Sidiq & Najuah, 2020). The printed module is considered not to be able to build an atmosphere of learning to count to be fun and easy to understand. A teacher or facilitator should be required to master technology to innovate in developing more sophisticated and applicable modules (Lestari & Suryaman, 2022).

The importance of using the right modules is also felt by vocational school students, especially in the Subject of Construction Cost Estimation (Elviana, 2021). The subject of Construction Cost Estimation often called EBK is one of the subjects that studies the planning and calculation of the cost needs needed to complete construction work (Sumardjo et al., 2020). This subject must be studied by students in grades XI and XII of the Building Department, one of which is the Concentration on Building Modelling and Information Design Expertise (DPIB). A problem that is often found during the learning of the Construction Cost Estimation Subject is that the average student lacks understanding of the basic formula material which results in difficulties in calculating the volume of work, so they find this subject difficult to learn (Adila, 2022). According to Desmawati & Abdullah (2021), the breadth of material in the volume of building construction work requires high understanding because the material contained is quite complex. Students are required to be able to understand and master the basics of calculations so that the implementation of work practices can be maximized.

Based on initial field observations at SMK Negeri 3 Boyolangu class XI, the DPIB Expertise Concentration shows that learning has not been carried out optimally on the calculation material for building construction volume due to the lack of available learning media. In the teaching process, educators only use printed teacher handbook modules and are assisted by whiteboard media and lecture methods. So that when students feel bored during learning, they are more interested in doing other things, such as chatting with friends or doing other activities with their smartphones. The results of interviews with EBK subject teachers stated that there are still many students who cannot determine the basic formula for calculating the volume of building construction. In addition, the demands of school fieldwork practice schedules (PKL) also affect the learning period of students to be shorter. This condition results in students who tend to have difficulty understanding formulas in a relatively short time. Considering the percentage of temporary test results by researchers regarding the material volume of building construction work, it showed that 37,14% (13 students) received a > Criteria for achieving learning objectives (KKTP) while 62,86% (22 students) scored < KKTP. These results show that students' learning achievement of the material has not been satisfactory.

Research that has relevance about the importance of developing an e-module for Construction Cost Estimation, namely a study conducted by Dewi (2023) with the title "Development of Vocational Literacy-Based E-Module for Calculating Building Construction Work Volume Materials at Vocational Schools". The results of the research and development are said to be very feasible to be used to improve the learning outcomes of the EBK Subject on the material for calculating the volume of building construction work in the concentration of DPIB expertise. However, from the research conducted previously, no one has researched the

development of flipbook-based e-module learning media in overcoming problems during the learning of the Construction Cost Estimation Subject.

Related to these problems, the researcher wants to develop learning media in the form of flipbook-based e-modules using Flip PDF Corporate software. While conventional e-modules are typically presented in PDF format, these e-modules are structured as applications, complete with engaging learning features. Flipbook is a digital module technology system designed to convert PDF e-modules into multi-product e-modules capable of loading moving illustrations (Afwan *et al.,* 2020). The advantages of features available on flipbook-based e-modules include interactive buttons, back sound flipping, image pop-ups, YouTube video pop-ups, web hyperlinks, and quiz games. These features can present clearer visualizations in helping students understand the calculation material (Putri & Slamet, 2021). In addition, the emergence of Android smartphones also supports the operation of flipbook-based e-module applications to become increasingly practical. This is supported by research conducted from Zahid (2018), which states that the existence of internet services on smartphones makes it easier for students to access features in the e-module so that it is effectively used to browse certain information about a wider range of subject matter.

This development is expected to answer the research and development objectives consisting of 1) producing flipbook-based e-module media in the Construction Cost Estimation Subject class XI; 2) analyzing the feasibility and practicality of flipbook-based e-modules as an innovative solution to overcome the difficulty of determining the basic formula for volume calculation; 3) to determine the effectiveness of the use of flipbook-based e-modules in improving students' understanding during the learning of the Construction Cost Estimation Subject in grade XI.

METHODS

The type of method used in this research is the type of research and development (R&D). The development model used the ADDIE model. Aulia & Masniladevi (2021) stated that the ADDIE stage consists of five steps, including the stages of analysis, design, development, implementation, and evaluation. The subjects of this study involved 38 students of grade XI DPIB 2 SMK Negeri 3 Boyolangu, with details of individual trials totaling 3 student respondents with different levels of learning achievement and field trials totaling 35 student respondents.

Research data collection used several instruments in the form of, preliminary instruments (interviews and observations), validation questionnaires including media and material experts (feasibility of flipbook-based e-modules), student response questionnaires (practicality of flipbook-based e-modules), pre-test and post-test questions (effectiveness of flipbook-based e-modules). The measurement used in the student validation and response questionnaire uses the Likert Scale with four answer choices, which were then converted into a score (Sugiyono, 2017).

The data results in the study were processed using data analysis techniques, including the validity of media feasibility, media practicality, and N-gain score. The results of the validation questionnaire and student responses were calculated using the following formula:

$$Percentage = \frac{Number\ of\ score\ obtained}{Maximum\ number\ of\ score} \times 100\% \quad (1)$$

The results of the values from the pre-test and post-test that have been analyzed using the index formula N (Gain) show the level of media effectiveness based on the criteria in Table 1 as follows:

Table 1.
Effectiveness Criteria Gain *Index*

N(gain)	Category
g > 0,70	High Score
0,30 ≤ g ≤ 0,70	Medium Score
g < 0,30	Low Score

Source: (Riduwan & Sunarto, 2013)

The ADDIE development model was chosen by the researcher because it is more effective in testing learning media products, especially for tests that use a sample that is not too broad, besides that this development model has simple stages that must be passed.

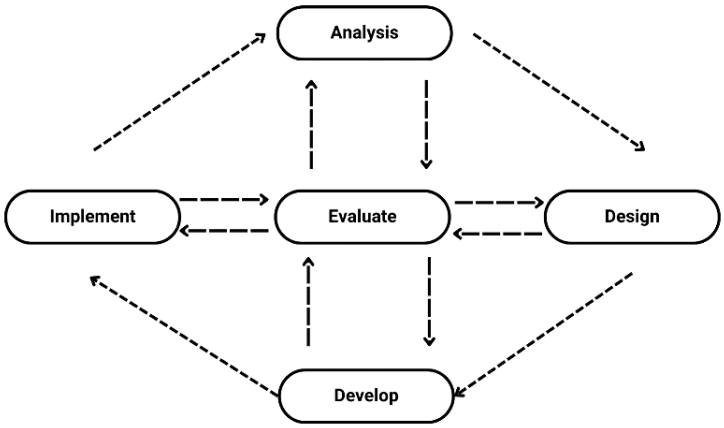

Figure 1. ADDIE Stages

1. Analysis

The Analysis Stage is related to analytical activities on the work situation and the environment so that it can be determined what products need to be developed. At this stage, the researcher analyzes needs and materials.

a. Needs Analysis

The needs analysis was carried out by observing and interviewing teachers for Construction Cost Estimation class XI of SMK Negeri 3 Boyolangu. At this stage, facts, problems, and alternative problem-solving are obtained so that it is easier to determine the initial steps in the development of learning media in the form of flipbook-based e-modules that are suitable for development.

b. Material Analysis

At this stage, information was found about the number of students who still had difficulty determining the basic formula for calculating volume, so the researcher decided to develop a learning medium with material for calculating the volume of building construction work.

2. Design

After completing the analysis data, the researcher began to design an initial version of the flipbook-based e-module media to be developed. The design stage includes collecting sources and materials, planning design concepts, making storyboards, preparing validity

instruments and student response questionnaires, and preparing cognitive test questions (pre-test and post-test).

3. Development

The development stage aims to realize the concept of the product design carried out previously.

a. Creation of Flipbook-Based E-Module Media

Researchers will create a flipbook-based e-module product by stringing together all components including materials, questions, images, videos, and hyperlinks using Flip PDF Corporate software. The final product design is in the form of an application that can be operated on Android smartphones.

b. Flipbook-Based E-Module Validation

The stage carried out by the researcher after making the e-module media is validation. This validation aims to determine the feasibility of the flipbook-based e-module that will be tested.

4. Implementation

The final product of the flipbook-based e-module that has been valid and feasible will be tested (implemented) directly to the research subject. The trial was carried out by working on pre-test and post-test questions. At the trial stage, a student response questionnaire was also distributed to measure and determine their opinions on learning media in the form of flipbook-based e-modules. The data from the student response questionnaire was processed and analyzed by the researcher so that a conclusion was obtained about the practicality of the e-module that had been developed.

5. Evaluation

The evaluation stage aims to assess whether each step and product made is following the specifications or not. The evaluation stage includes formative and summative external evaluations based on the results of the validation of media experts, material experts, student response questionnaires, and test results (Tegeh & Kirna, 2013).

RESULTS AND DISCUSSION

1. Analysis

a. Results of Needs Analysis

In the activities that have been carried out, some information has been obtained as follows:

1) There is a lack of availability of learning media on building construction volume calculation materials, be it in the form of modules, e-modules, or other media. On the other hand, educators only use the printed module of the teacher's handbook when teaching.
2) The method used in teaching is still conventional, namely using the lecture method assisted by a blackboard.
3) Students who feel bored when learning will be more interested in doing other things such as chatting with friends or doing other activities with their smartphones.

b. Results of Material Analysis

The following are the material indicators used in developing flipbook-based e-module learning media:

1) Identify types of work by unit.
2) Determining the basic formula for calculating the volume of construction work based on units.
3) Solve contextual problems related to the calculation of construction volume based on units.
4) Identify the types of construction cost analysis in building construction work.
5) Explain the definition of each building construction work.
6) Determining the volume calculation formula in the analysis of building construction costs.
7) Solving contextual problems related to building construction cost analysis.

2. Design

The results of the design stage include 1) Collection of sources and materials, materials collected from various references including BSE EBK and Property SMK Class XI by Juni Damajanti, Building Construction Work Volume Teaching Module by Emma Massaadah, BSE EBK Class XI by Udin Samsudin and Budi Saepulyadi; 2) Design concept planning, themed construction environment in dark mode. In addition, the selection of text letters (fonts), type, size, and color of fonts are adjusted to make them readable; 3) Making a storyboard, in the form of initial sketches on the media to be developed; 4) Preparation of validity instruments and student response questionnaires, adapted from BSNP which has been modified by Savera (2022); 5) Preparation of cognitive test questions (pre-test and post-test), multiple-choice questions with a total of 10 questions.

3. Development

a. Results of Flipbook-Based E-Module Media

The resulting product is a flipbook-based e-module on Construction Cost Estimation Subjects. This media has several features in Flipbook, including interactive buttons, back sound for flipping, image pop-ups, YouTube video pop-ups, web hyperlinks, and quiz games. The total number of pages is 56 pages. In the context of its creation, flipbook-based e-modules involved several software, such as Canva, Flip PDF Corporate, and Website 2 Apk. The material in the e-module was classified into two main discussions, namely the basic formula for volume based on units and the calculation of the cost analysis of building construction work. In addition, the material was also supported by image pop-up features, YouTube video pop-ups, and web hyperlinks.

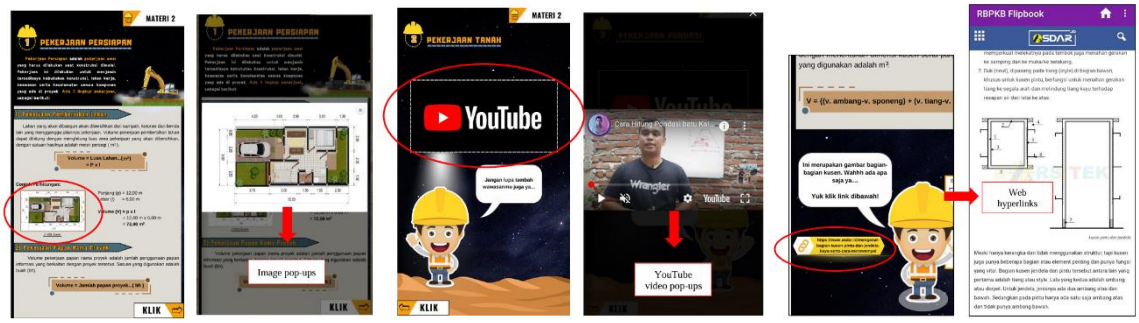

Figure 2. Flipbook Features

After completing changing the format of the e-module into an apk (application), then the media is shared via WhatsApp so that students can install and operate it on their respective Android smartphones.

Figure 3. Final Look of Flipbook-Based E-Module Application

The flipbook-based e-module application can be operated via Android smartphones with at least version 8.0 (output in the 2017s) with a minimum memory capacity of 120 MB (Megabyte).

b. Flipbook-Based E-Module Validation Results

1) Media Member-Based Eligibility

Based on the evaluation by media experts, across 22 e-module media indicators, the materials scored 84,00 out of a maximum value of 88,00. When calculated as a percentage, get a score of 96,00%. So, flipbook-based e-module products are categorized as very feasible to use.

Table 2.
Validation Results by Media Experts

Aspects	Percentage	Criterion
Media Design Display	92%	Highly Worthy
User Convenience	100%	Highly Worthy
Consistency	92%	Highly Worthy
Graphics	95%	Highly Worthy
Functions and Benefits	100%	Highly Worthy
Average Overall Percentage of Aspects	**96%**	**Highly Worthy**

In the aspect of design display, there are six assessment indicators and the percentage obtained is 92%, so this aspect is categorized as very feasible. From the analysis results, two indicators get a score that has not been fully maximized, namely the background color composition and the attractiveness of the design. From these indicators, the researchers have suggested increasing the contrast of background colors and the appearance of the design. Winatha *et al*. (2018), stated that the use of color compositions that contrast with the background (background) and the appearance of a minimalist design will make it easier for the users to read. If these indicators are successfully optimized, it will trigger user interest to see the contents of the flipbook-based e-module.

In the consistency aspect, there are three assessment indicators and the percentage obtained is 92%, so this aspect is categorized as very feasible. The analysis results reveal that

there is still one indicator regarding the consistency of selecting the type and size of text, which has not achieved a score that has not been maximized. Researchers get comments and suggestions to revise the section to make it more comfortable to read. In line with the theory of Logan *et al.* (2021), the selection of text on media should use a typeface that does not have horizontal or vertical lines at its angles, such as the type "Calibri". It is intended to provide learners comfort in reading e-modules.

In the graphic aspect, there are five assessment indicators and the percentage obtained is 95%. Therefore, this aspect is categorized as very feasible. From the analysis results, there is still one indicator with the not optimal score, namely the suitability of visual and audio-visual elements. Regarding this occasion, the researchers can look for animated images that are more relevant to the calculation material of building construction in order to balance the visual elements in the media and to maximize the score on the graphic aspect. An animated image in the media can facilitate learning when the animation successfully focuses students' attention visually and is relevant to the content of the material (Winatha *et al.,* 2018).

2) Materialist-Based Eligibility

The feasibility of the e-module is based on the assessment by material experts, in 15 (fifteen) media indicators, the e-module gets a score of 55,00 from a maximum score of 60,00 and if calculated with a percentage, it gets a value of 93,00%. From these results, flipbook-based e-module products can be categorized as feasible for use.

Table 3.
Validation Results by Media Experts

Aspects	Percentage	Criterion
Content Feasibility	90%	Highly Worthy
Linguistics	100%	Highly Worthy
Feasibility	88%	Highly Worthy
Average Overall Percentage of Aspects	**93%**	**Highly Worthy**

In the aspect of content feasibility, there are five assessment indicators and the percentage obtained is 90%, so this aspect is categorized as very feasible. From the analysis results, it shows that there are still two indicators that get a score that has not been maximized, namely the accuracy and completeness of the content as well as consistency of the material with the learning objectives. From these indicators, the researchers received revisions from material experts to add material content and evaluation questions regarding Bouwplank measurements. Then, the researchers can find and add more diverse Bouwplank measurement materials and of course have been adjusted to CP & TP EBK subjects.

In the feasibility aspect of the presentation, there are six assessment indicators and the percentage obtained is 88%, so this aspect is categorized as very feasible. The analysis results show that there are still three indicators that get a score that is not optimal, including the practicality of media, completeness of instructions, and completeness of features that can create a pleasant learning atmosphere. In line with research conducted by Tanner (in Winatha, 2018), the success of the feasibility aspect of the presentation lies in the presentation of practical and systematic content because it can invite students to learn gradually to the end.

4. Implementation

a. Individual Trial Results

The individual trial was carried out by distributing a flipbook-based e-module application to respondents and then asking for their opinions through a questionnaire that had been given.

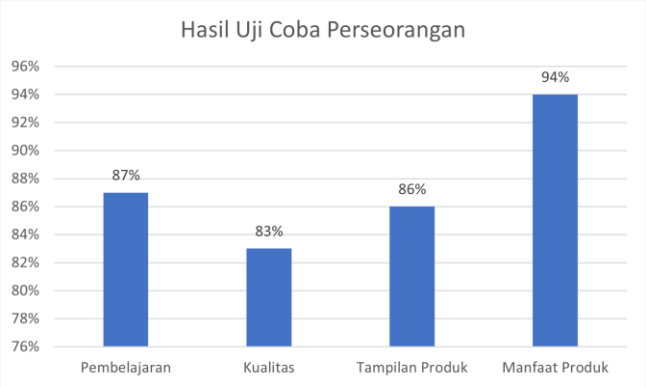

Figure 4. Graph of Individual Trial Results

Based on Figure 4, the average response result in the individual trial is 88%, which means that the respondents strongly agree that *the e-module* based on *the Construction* Cost Estimation flipbook is used as a medium of learning. These results will later be used as a revised benchmark before being applied to field trials.

b. Field Trial Results (Class)

1) Cognitive Test (Pre-Test and Post-Test)

The effectiveness of using the e-module can be known from the results of cognitive test scores (pre-test and post-test). The provision of this test aims to determine the level of increased understanding of students after using flipbook-based e-modules.

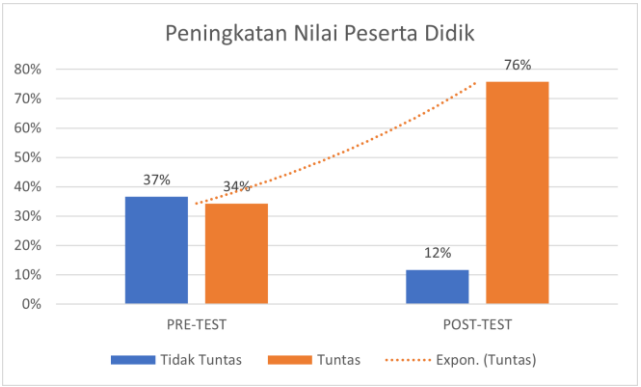

Figure 5. Student Grade Increase Graph

Based on Figure 5 above, it is known that the overall post-test results have increased by 43% compared to the previous pre-test assessment. This proves that the ability to increase material understanding can be achieved by familiarizing students with using practical flipbook media during the learning process (Angriani *et al.*, 2020).

Table 4.
Gain Score Descriptive Results on the SPSS Application

Descriptive Statistics					
	N	*Minimum*	*Maximum*	*Mean*	*Std. Deviation*
Ngain	35	0.00	1.00	0.6329	0.34602
Valid N (listwise)	35				

The results of the N-Gain Score calculation data conducted by the researchers show that the effectiveness of media use was obtained at 0.63 or medium category. Evawani (in Ayub *et al.,* 2020) said that effective learning media can be seen from increasing mastery of learning outcomes after the use of developed learning media and obtaining an N-gain value in the "medium" category.

2) Student Response Questionnaire

The practicality of Flipbook-based e-modules was obtained from student response questionnaires, receiving a total percentage of all aspects of 88% with very practical criteria.

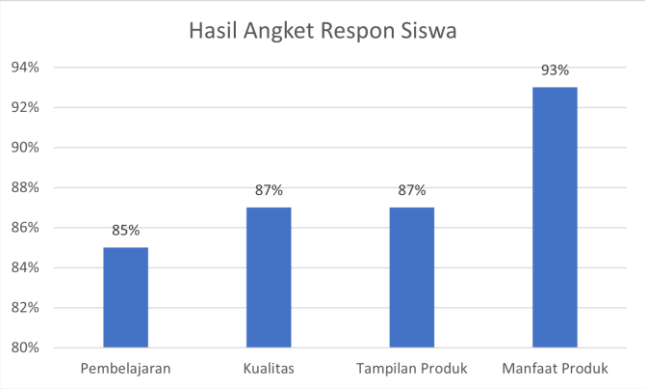

Figure 6. Graph of Student Response Questionnaire Results

In the learning aspect, results were obtained by 85% (very practical). Based on the analysis results, it shows that there are still two indicators with a score below the average, namely the conciseness of the material and the variety of evaluation questions. In response to this, the researchers can make points of discussion of the material and add more variations of questions that have different levels of difficulty. According to research from Ng *et al.* (2021), the existence of varied questions in e-modules can encourage challenging learning and improve problem-solving skills.

In the quality aspect, the results were obtained by 87% (very practical). The result of the analysis shows that there is still one indicator regarding the completeness of the clue, which gets a score below the average. According to Susanti & Sholihah (2021), besides the completeness, the basic thing that must be considered in the e-module instructions is its simple design so that it is easy for users to remember.

In the aspect of product display, the results were obtained by 87% (very practical). From the results of the analysis, shows that there are still four indicators that get a score below average, including text type and size; color composition; interactive video; and the back sound that is not distracting. In terms of layout, the selection of text types and colors, as well as the flipbook feature on the media can interest the students (Septiana *et al.,* 2018).

In the aspect of product benefits, the results were obtained by 93% (very practical). The result of the analysis shows that there is still one indicator that gets a score below average,

namely the ability to overcome difficulties in understanding the material. Wibowo & Pratiwi (2018) said the use of flipbook media can affect the mentality of students, so they will be motivated and interested in understanding the material.

5. Evaluation

This evaluation stage was carried out after the previous four stages were completed. The results of the formative evaluation in this study are the results of several comments and suggestions by validators, these comments, and suggestions function as instructions to improve or revise the e-module media produced. Meanwhile, the results of the summative evaluation in this study were in the form of cognitive tests (pre-test and post-test) and student response questionnaires. The results of the cognitive tests that have been carried out have found an increase in scores in the medium category. Meanwhile, the results of the student response questionnaire obtained the practicality of flipbook-based e-module media in the category of very practical to use.

CONCLUSION

The results of flipbook-based e-module media products have advantages in ease of use and a variety of features, including interactive buttons, back sound for flipping, image pop-ups, YouTube video pop-ups, web hyperlinks, and quiz games. The flipbook feature can present a clearer visualization of the material so that it can encourage student enthusiasm for learning.

The feasibility of flipbook-based e-modules is obtained from the validation results of media experts and material experts. From all aspects, the product feasibility of media expert validators obtained a percentage of 96% with very feasible criteria. Meanwhile, material expert validators obtained a percentage of 93% with very feasible criteria. From this data, flipbook-based e-module learning media can be categorized as feasible to be applied in the classroom. The practicality of flipbook-based e-modules is obtained from user response questionnaires, obtaining a total percentage of all aspects of 88% with very practical criteria. Post-test scores increased by 43% compared to the previous pre-test assessment. The effectiveness of using flipbook-based e-modules is included in the effective category with the acquisition of an N-Gain Score test value of 0,63 or medium category.

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