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# Development of Interactive E-Modules for Elementary Students: Enhancing Learning Outcomes

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**Abstract**

This study aims to develop an interactive e-module that can improve elementary school students' learning outcomes and provide a more interesting learning experience. The method used is research and development (R&D) with the ADDIE model. Data collection was carried out through questionnaires, interviews, tests, and document recording, which were analyzed using a Likert scale. The validation results showed that the e-module design scored 95%, the material scored 73%, and the language scored 92.5%. Responses from teachers (91.47%) and students (90%) showed that this e-module was interesting, effective, and could help students understand the material better. The effectiveness test showed a significant influence on student learning outcomes (significance value 0.000), which proves that this e-module is more effective than conventional learning methods. The implications of this study are that the e-module developed is proven to be valid, practical, and effective and can be used as an interactive and enjoyable learning medium to improve student learning outcomes and motivation, especially in overcoming monotonous learning challenges.



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## INTRODUCTION

Education has a significant part in a nation's growth since it is a key tool for advancing the next generation of citizens (BP et al., 2022; Normina, 2017; Cahyani et al., 2021). education is a deliberate endeavor that seeks to establish a learning environment and learning process that enable students to actively develop their potential (Dikta, 2020; Lestari & Handayani, 2023). According to Law Number 20 of 2003 governing the National Education System, this potential encompasses social, religious, and spiritual intelligence; self-control; personality; high morals; and the abilities required for the benefit of individuals, society, the country, and the state (Tambun et al., 2020). In the context of education, students are individuals who are growing towards adulthood, while teachers are people who are tasked with educating them (Fujiyanto et al., 2016). Therefore, education is closely related to the learning process.

Learning is a process by which someone tries to change their own behavior. Learning is essentially an organized activity that prepares or stimulates someone to learn effectively (Pane & Dasopang, 2017). Learning also plays a role in bringing students towards changes in their

knowledge, skills, attitudes, and behavior, which ultimately support the process of maturity (Herawati, 2018; Syukrianto, 2020). These changes are packaged in a series of actions that are carried out continuously (Jasuli, 2023). Responsibility in learning involves the roles of teachers, students, and educational resources such as curriculum, lesson plans, media, and open materials. All of these elements are very important in implementing learning in the classroom.

In designing teaching materials, the main focus is on how teachers can actively involve students in the learning process. This is supported by the multimedia learning theory proposed by Mayer (2001), which states that the use of various forms of digital media, such as images, videos, and interactive simulations, can improve student understanding by utilizing dual cognitive channels (verbal and visual). A thorough image of the abilities that students need to acquire is provided by the teaching materials themselves, which comprise a variety of informational, instructional, and text elements organized methodically (Magdalena et al., 2020). The learning process, planning, and organized, sequential learning activities all make use of these instructional resources (Nuryasana & Desiningrum, 2020). The learning process will be difficult without learning resources. Students must study the topic in an organized and methodical manner with the use of instructional resources if they are to fully comprehend it. A module is one type of instructional resource used in education.

A module is a type of teaching material that is arranged in a language that is easy for students to understand and is adjusted to their age level. This aims to increase students' learning independence so that they can learn independently without relying too much on teacher assistance (Prastowo, 2016). Modules are designed to meet the needs of both teachers and students. Basically, both teachers and students expect the teaching materials used to suit their needs and characteristics (Hamid & Alberida, 2021). To promote an efficient learning process at the elementary school level, the module must be modified to fit the learning model and the features of the subjects being taught.

Flexible, accessible modules are essential to support learning that allows interaction between students and materials. Elementary school pupils can learn independently at any time thanks to electronic modules, which are a great option for instructional resources because they are not time-limited. Additionally, interactive e-modules can support different learning styles, deliver materials in an engaging manner, and facilitate students' comprehension of the lessons (Rahmi et al., 2021). Compared to printed modules, electronic modules significantly enhance classroom instruction (Syahrial et al., 2021). They can also be used as teaching materials because they can increase students' interest in the lesson (Fatmianeri et al., 2021). Research conducted by Dermawan & Fahmi (2020), shows that the use of more effective electronic modules can help students understand topics better, increase their motivation to learn, and ultimately have an impact on improving learning outcomes.

Students' textbooks are the only source of information available during the learning process, and teachers do not use any other teaching resources, according to the findings of interviews with grade V teachers. This finding is in line with the results of observations, which show that grade V teachers have not fully utilized learning media, either in the form of printed modules or technology-based modules. Teachers are more dominant in using printed teaching materials such as government-published teacher books and student books. However, the textbooks used by students only contain brief explanations and are less innovative, causing students to be less enthusiastic about the subject matter. This has an impact on decreasing student interest and motivation in participating in learning.

In addition, based on an interview with the homeroom teacher, it was conveyed that students sometimes do not pay attention to the teacher when the material is explained, and they tend not to actively participate in learning. This finding is also consistent with the observation results, which show that around 70% of students are not focused when the teacher gives an explanation. Many students were seen talking to friends or joking during the lesson. About 60%

of students looked bored and saturated, especially in learning that only focused on teacher explanations and reading student books. This condition causes students to tend to be passive in participating in learning, which ultimately has an impact on reducing their learning outcomes. The results of further interviews with the fifth-grade teacher showed that many students had not reached the Minimum Completion Criteria (KKM) set by the school, which is 75. Based on the average exam results, only 13 out of 28 students (46%) scored above the KKM, while 54% of other students had not reached the KKM. This reflects that less varied and interactive learning has a direct impact on the achievement of student learning outcomes.

Based on the description above, it is very important to develop an interesting e-learning module by including relevant images related to students' daily lives, as well as interactive features to increase their interest. This will help students stay engaged in learning, avoid boredom, and allow them to learn anytime and anywhere. This opinion is in line with the statement (Tsai et al., 2018), which states that e-modules, which are prepared by teachers and can be adjusted to the curriculum, give teachers more control over the material that students learn. With the availability of e-modules, students who have difficulty absorbing information can more easily understand the material. The module can create a more interesting and effective learning environment, according to the needs of students, thus helping them understand the material more deeply and making learning more meaningful (Inanna, 2018). As a result, researchers are trying to develop interactive online modules to support learning.

Although this e-module is similar to the Electronic Student Book (BSE), there are several additional innovations that distinguish it. First, this e-module is equipped with animated images and several commands to click on YouTube video links, which allow users to add material references while studying. In addition, this e-module also includes a QR code, which has a similar purpose to the link, namely that it can be scanned to access additional materials relevant to student learning. To create this e-module, the Kvisoft flipbook maker program and Ms. Word 2016 were used, with HTML format to save the final product. With this interactive and entertaining e-module, it is hoped that students can feel that learning does not have to be boring and can be a fun experience. This research aims to develop interactive e-modules to improve student learning outcomes and provide a more engaging learning experience for students.

## METHOD

This study uses a research and development (R&D) design by adopting the ADDIE design development model, which consists of five stages: analysis, design, development, implementation, and evaluation. The ADDIE model was chosen because of its ease of understanding and its initiality in developing learning methodologies, which allows for adjustments to various needs and changes that occur during the design process. The main advantage of the ADDIE model lies in its initiality, which allows researchers to adjust each phase to technological developments and specific needs that arise in the development of e-modules. Thus, this model is the right choice for developing interactive and effective e-modules.

In data collection, this study used four main methods: (1) questionnaires, (2) interviews, (3) tests, and (4) document recording. Questionnaires were used at the needs analysis stage to collect data related to expert views on material, learning design, and language. Interviews aimed to dig up in-depth information about problems in the learning process, especially in class V. Tests were used to measure student learning outcomes, while document recording was used to collect data related to the design of e-modules developed based on interviews with teachers. The following is a grid of the questionnaire sheet instrument used in this study:

Table 1 Instrument Grid for Material Experts

| No. | Assessment Aspect | Indicator | Item No. |
|---|---|---|---|
| 1. | Relevance of the material | a. Suitability of material with learning material | 1 |
| | | b. Suitability of material with learning objectives | 2 |
| | | c. Suitability of material with basic competencies | 3,4 |
| | | d. Completeness of material | 5 |
| | | e. Sequence of material | 6,7 |
| | | f. Writing format | 8 |
| | | g. Accuracy of image selection | 9,10,11 |
| | | h. Easy-to-understand component images | 12 |
| | | i. Accuracy of animation in explaining material | 13 |
| | | j. Sequence of material | 14 |
| | | k. Suitability of questions with material | 15 |
| 2 | Benefits | a. Easy to understand material | 16 |

Source: Agustania (2014) modified

Table 2 Instrument Grid for Design Experts

| No. | Assessment Aspect | Indicator | Item No. |
|---|---|---|---|
| 1. | Making | a. Writing form | 1 |
| | | b. Writing color | 2 |
| | | c. Writing size | 3 |
| | | d. Writing color composition | 4 |
| | | e. Image shape | 5 |
| | | f. Image selection | 6 |
| | | g. Color with background writing | 7,8 |
| | | h. E-module appearance | 9 |
| | | i. Efficiency of e-module | 10 |
| 2 | Procedure | a. Ease of use of e-module | 11 |
| 3 | Making | a. Learning process is more interesting | 12 |
| | | b. The content of e-module material is easy to understand | 13 |
| | | c. Questions in e-module are easy to understand | 14 |
| | | d. Ease of learning process | 15 |

Source: Agustania (2014) modified

Table 3. Instrument Grid for Linguists

| No. | Assessment Aspect | Indicator | Item No. |
|---|---|---|---|
| 1 | Straightforward | The language used is straightforward | 1,2 |
| 2 | Compliance with language rules | Language accuracy | 3,4 |
| 3 | Use of terms | Use of terms that are in accordance with the concept of the subject matter | 5 |
| 4 | Communicative | Understanding of the message or information | 6,7 |
| 5 | Compliance with student development | Suitability to students' intellectual development | 8 |
| 6 | Coherence and integration of thought flow | Sequence and integration between learning activities | 9 |
| 7 | Dialogical and interactive | Ability to encourage critical thinking | 10 |

Source: Agustania (2014) modified.

To ascertain the viability of the teaching material development product, the values gathered from the evaluation by specialists in language, learning design, and learning materials will be descriptively examined. A Likert scale with the following alternative responses is used to examine product validation data: Very Good (5), Good (4), Sufficient (3), Less (2), and Very Less (1). The generated e-module's level of validity is assessed using this assessment scale. Following the calculation of the validity percentage, the product validity level will be classified according to the range of percentages, as indicated in Table 4 below:

Table 4. Product Validity and Revision Levels

| Percentage (%) | Valid Criteria |
|---|---|
| 0-20 | Not Valid |
| 21-40 | Less Valid |
| 41-60 | Quite Valid |
| 61-80 | Valid |
| 81-100 | Very Valid |

Source: Riduwan (2019)

Based on this category, researchers can determine whether the e-module development product is valid or needs further revision. Then, a response questionnaire was used to collect data on student and teacher responses to the interactive e-module developed, using the Guttman Scale.

Furthermore, to analyze the effectiveness of the interactive e-module, two data analysis techniques were used, namely the paired sample t-test and the independent sample t-test. 1) The paired sample t-test was used to see the effect of the independent variable on the dependent variable. The significance level used was 5%. The data were analyzed using SPSS version 24, with the criteria that if the significance value (p-value) < 0.05, then Ho (null hypothesis) is rejected and Hi (alternative hypothesis) is accepted. 2) The independent sample t-test was used to test the differences in the dependent variable between groups of students who were treated. The significance level used was also 5%, and the data were processed with SPSS version 24. The same testing criteria were applied, namely, if the significance value < 0.05, then Ho was rejected and Hi was accepted. Before conducting a hypothesis test, prerequisite tests are first carried out, such as a normality test to ensure that the data is normally distributed and a homogeneity test to check for equality of variance between groups.

## RESULTS AND DISCUSSION

### Results

The development of e-modules in this study refers to three stages of the ADDIE model, namely Analysis, Design, and Development.

1. The first stage is the Analysis Stage.

   At this stage, data collection is carried out through interview and observation instruments that aim to explore, find out, and analyze the needs of students. Interviews and observations are used to identify student characteristics as well as existing learning facilities and environments. The results of this needs analysis show several important findings. In terms of student characteristics, it was found that students need more interesting and innovative teaching materials to support their understanding of the subject matter. In addition, the results of the analysis of learning facilities and environments also revealed that there were shortcomings in the provision of teaching materials that could increase student engagement and interest in learning.

   The current condition is that the textbooks used by students only contain brief explanations without any interactive or innovative learning elements. This causes students to be less

enthusiastic and less excited in following the learning material. Therefore, the development of e-modules aims to overcome these shortcomings by presenting teaching materials that are more interesting, interactive, and in accordance with student needs.

2. The second stage in the development of this e-module is the Design Stage.

   At this stage, a series of steps are taken to design and prepare the elements needed in the e-module, which include content planning and visual design. The following are the steps taken at the design stage:

   a. Determining Learning Objectives

      The first step in design is to determine the learning objectives to be achieved in learning. This objective is a reference in developing the material presented in the e-module.

   b. Making an e-Module Design

      Based on the needs analysis that has been carried out in the first stage, the researcher created an e-module design that suits the needs of the students. This design includes content arrangement, color selection, fonts, and other graphic elements that support the learning process. At this stage, the researcher used applications that support the design process, such as Microsoft Word 2016, KVISoft Flipbook Maker, and QR Code Generator.

   c. Steps in Designing an e-Module

      Here are the detailed steps in designing an e-module:

      1. Preparing Materials

         The materials included in the e-module are arranged clearly, structured, and in accordance with the learning objectives and needs of students. The material raised in this e-module is Chapter 4, "Let's Get to Know Our Earth."

      2. Making a Cover

         The e-module cover design is made attractive and representative by considering the theme of the material to be studied.

      3. Making a Background Layout

         The e-module layout uses A4 paper size with the right color combination. The background is made attractive but slightly blurred to avoid visual disturbances that can distract students from the text.

      4. Determining the Type and Color of the Font

         The selection of the type and color of the font is a very important aspect in the design of the e-module because it can affect the comfort and ease of students in reading the text. To ensure that the e-module is easy to read and not confusing, the font used in this e-module is Cambria, which was chosen because it has a clear, neat, and easy-to-read shape. In addition to the type of font, the selection of the font color is also considered so that it contrasts with the background and is comfortable for the eyes. The font color used is black for the main text because this color has good contrast with the white background.

      5. Creating a Separator Design Between Learning Materials

         The design of the separator between sections or chapters in the e-module aims to provide a clear boundary between different topics. This design helps students navigate the material and understand the learning structure.

      6. Creating a QR Code

         QR Code is used to direct students to additional materials available on the internet. In this e-module, students can scan the barcode to access the learning video. This barcode is created using the QR Code Generator application.

      7. Creating User Guides

         Students can use the e-module more easily if they follow the instructions provided. These guidelines describe how to utilize the e-module, access its features, and get the most out of the available resources.

8. Determining Images
   The e-module's visuals are chosen to enhance students' comprehension of the subject matter. Images are made relevant, high quality, and placed proportionally so as not to interfere with the text.
9. Creating Evaluation Questions
   To evaluate students' understanding of the material being studied, the researcher created evaluation questions that were in accordance with the predetermined learning objectives. These questions are designed to measure students' level of mastery of the e-module material.
10. Transforming Design into Digital Format
    After the e-module design is complete, the next step is to convert the design into a format that can be accessed digitally. The researcher used KVISoft Flipbook Maker to convert the e-module into HTML format, which makes the e-module display on the web or blog. With this format, the e-module can be accessed by students online and interactively.

This e-module is designed to encourage student interaction by utilizing various interesting and interactive multimedia elements. One of its features is an interactive assessment included at the end of each sub-chapter to measure their understanding. In addition, animations are used to explain more complex concepts. The images used are also of high quality and are selected to support student understanding, placed proportionally so as not to interfere with the text and make the e-module display more attractive.

This e-module also includes other innovative elements that enrich the student learning experience. One of them is the QR code, which directs students to additional materials, such as learning videos or other external references that can be scanned directly to deepen their understanding. These videos provide a more in-depth explanation of certain topics, making the learning process more dynamic and interactive. All of these elements are designed so that the e-module is not only informative but also fun, keeping students engaged and motivated in learning. By combining these features, the e-module provides a more interesting, interactive, and easily accessible learning experience for students online.

The following are some visualizations of the results of making the e-module for chapter IV for grade V elementary school:


Figure 1. Cover


Figure 2. Foreword

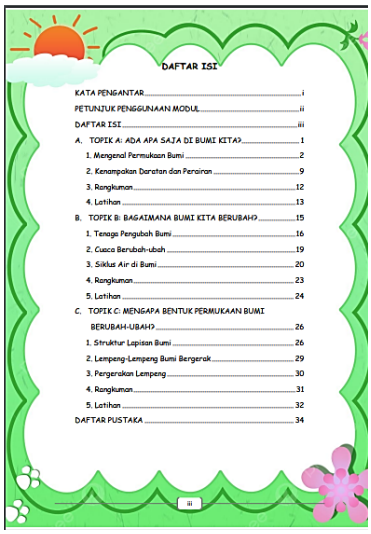


Figure 3. Table of Contents

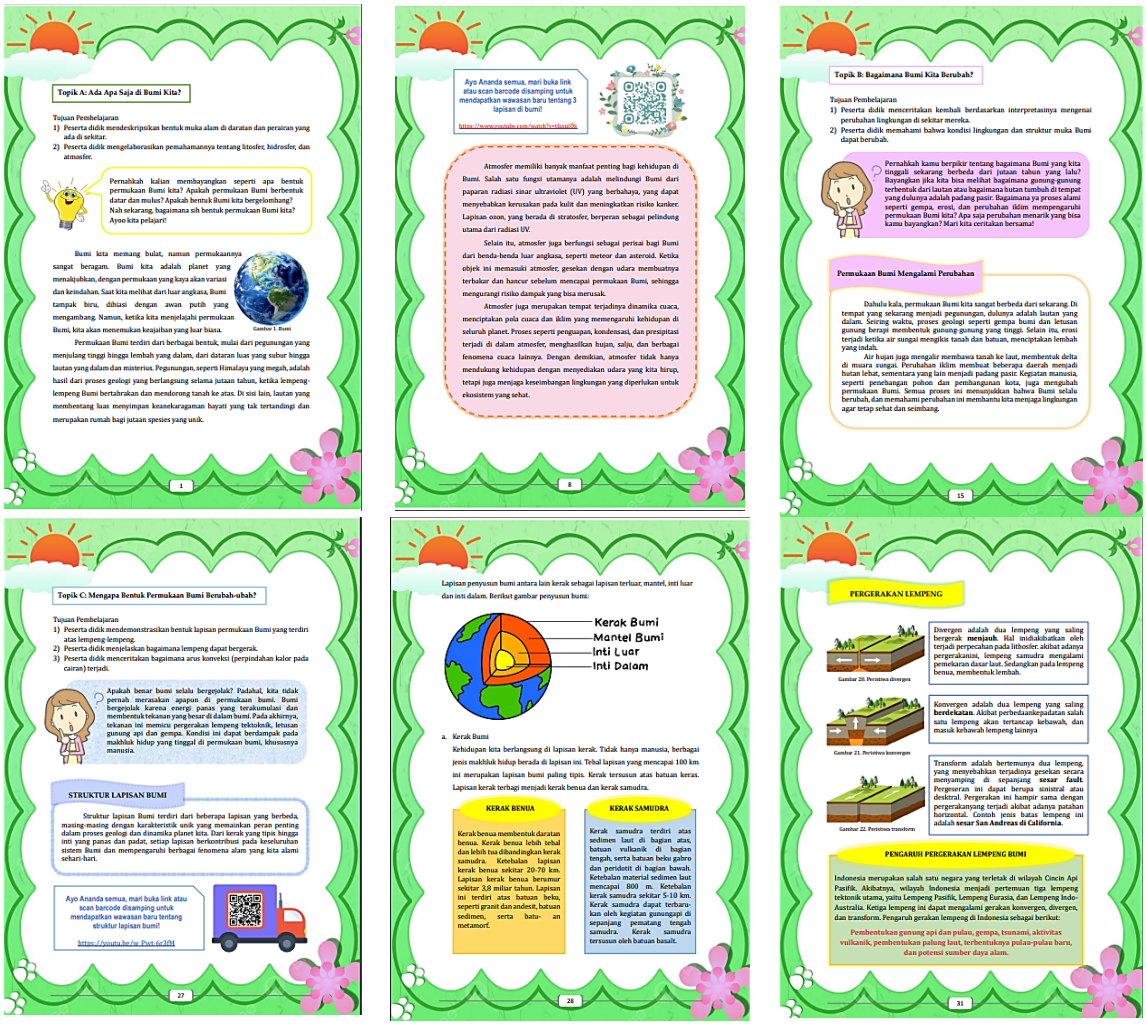


Figure 4. Some of the E-Module Material Content

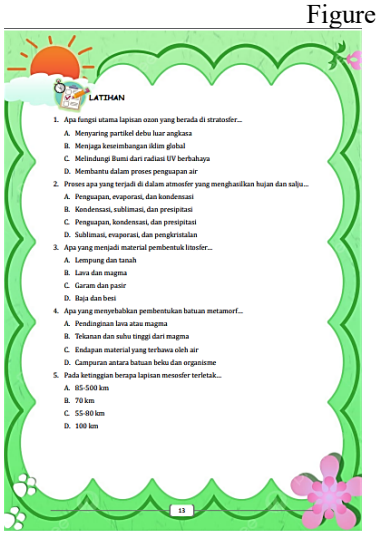


Figure 5. E-Module Practice Questions

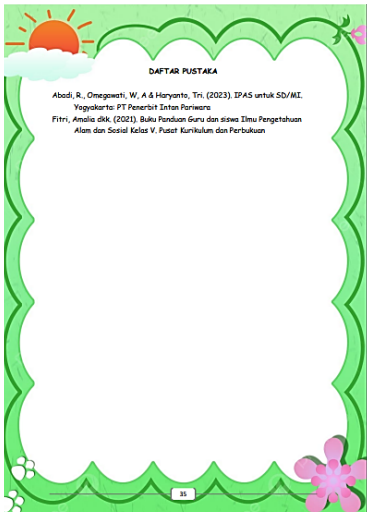


Figure 6. Bibliography

3. Development Stage

The outcomes of e-module validation by specialists including design, material, and language experts are included in the development of data acquired for this study. The following is a description of the e-module design validation results:

*Design Expert Validation*

The purpose of design validation by design experts is to test the feasibility of the e-module in terms of visual appearance. The results of the assessment of the media aspect can be seen in Table 5

Table 5. Design Validation Results

| Validator | Validation to | Empirical Score | Maximum Score | Percentage | Categori |
|---|---|---|---|---|---|
| Validator Design | 1 | 46 | 60 | 77% | Valid |
| | 2 | 57 | 60 | 95% | Very Valid |

Table 5 shows the results of the design validation. In the first validation, the validator's score was 46 out of a possible 60 total, which translates to a 77% percentage. The e-module design is classified as valid with this %, indicating that while the e-module display has largely satisfied the eligibility requirements, there are still certain aspects that require improvement.

In the second validation, after improvements or refinements were made based on feedback from the first validation, the score given increased to 57 out of 60, with a percentage of 95%. With this higher percentage, the e-module design is considered very valid, which indicates that most aspects of the e-module display are very good and meet the expected eligibility standards.

Thus, it can be concluded that there is a significant increase between the first and second validations, indicating that the revisions and improvements made after the first validation have succeeded in improving the quality of the e-module design.

Table 6. Material Validation Results

| Validator | Empirical Score | Maximum Score | Percentage | Categori |
|---|---|---|---|---|
| Validator Materi | 47 | 64 | 73% | Valid |

It is evident from Table 6 that the material validator awarded a score of 47 out of a possible 64, yielding a 73% percentage. The content in the e-module is classified as valid with this percentage. This means that the material presented has met most of the eligibility criteria and is ready to be used in learning, although there may be some parts that can still be improved. However, overall, the material is considered feasible and relevant to use without requiring further revision.

Table 7. Language Validation Results

| Validator | Empirical Score | Maximum Score | Percentage | Categori |
|---|---|---|---|---|
| Validator Language | 37 | 40 | 92.5% | Very Valid |

It is evident from Table 7 that the language validator awarded a score of 37 out of a possible 40, yielding a 92.5% percentage. The e-module's language component is classified as highly valid at this %. This indicates that the e-module's language quality is excellent and satisfies the required eligibility requirements, making the content deemed very appropriate for use without the need for additional development.

4. Implementation Stage

After validation by design experts, material experts, and language experts, validation of teacher and student responses was carried out, consisting of two teachers and six fifth-grade students. The responses given by teachers and students can be seen in Tables 8 and 9, including:

Table 8. Teacher Response Class IV

| No | Assessment Aspects | Teacher I | Teacher II |
|---|---|---|---|
| 1 | Material Presentation | 90% | 92,4% |
| 2 | Evaluation and Exercise | 95% | 91% |
| 3 | E-Module Products | 90% | 100% |
| 4 | Impact on Users | 83,4% | 90% |
| **Average** | | **89,6%** | **93,35%** |
| | | **91,47%** | |
| **Criterion** | | **Very Interesting** | |

Table 8 shows that the validation results of the two teachers on the e-module showed positive responses in various aspects. In the aspect of material presentation, teacher I gave a score of 90%, while teacher II gave 92.4%, indicating that the material was delivered quite clearly. For the evaluation and exercise aspect, teacher I gave a score of 95%, and teacher II 91%, indicating effective exercises in measuring student understanding. In the e-module product, teacher I gave a score of 90%, and teacher II gave a perfect score, 100%, indicating good acceptance of the design and functionality of the e-module. On the other hand, for the impact on users, teacher I gave 83.4%, while teacher II gave 90%, indicating a positive impact even though there was a slight difference in assessment. Then, the average assessment of teacher I was 89.6%, teacher II 93.35%, and the overall average reached 91.47%, indicating that this e-module was considered very interesting by the teachers.

This is also supported by the results of interviews conducted with the two teachers, who said that this e-module has helped students be more active in following lessons and made it easier for them to understand the material. Both teachers also revealed that the e-module provides variation in learning, which makes students more interested and less bored. Overall, this e-module is considered very effective in supporting the learning process. The e-module provides well-structured and easily accessible material, as well as exercises that can help students understand and master the concepts taught. In addition, the attractive and interactive appearance of the e-module provides a more enjoyable learning atmosphere so that students do not get bored quickly. Teachers also feel that this e-module is very helpful in providing a variety of teaching methods, which ultimately increases student involvement in the teaching and learning process.

Furthermore, the researcher also conducted an assessment to obtain student responses to this interactive e-module. The results of the responses given by students are shown in Table 9 as follows:

Table 9. Response of Class IV Learners

| No | Name | Presentatiton | Criterion |
|---|---|---|---|
| 1 | Student 1 | 80% | Interesting |
| 2 | Student 2 | 100% | Very Interesting |
| 3 | Student 3 | 90% | Very Interesting |
| 4 | Student 4 | 80% | Very Interesting |
| 5 | Student 5 | 90% | Very Interesting |
| 6 | Student 6 | 100% | Very Interesting |
| **Number of Scores** | | **90%** | **Very Interesting** |

Table 9 shows the results of students' responses to the interactive e-module provided. In the table, it can be seen that most students gave a very positive assessment of the e-module. Overall, the scores given by students range from 80% to 100%, with an average score of 90%, indicating that the e-module was considered very interesting by the majority of students. Specifically, there were two students who gave an 80% rating, namely student 1 and student 4, who rated the e-module as interesting. Meanwhile, five other students gave an assessment of 90% to 100% and considered the e-module as very interesting. This shows that most students feel enthusiastic and actively involved in learning using this e-module.

This is also supported by the results of interviews with students, which show that they feel the e-module makes it easier for them to understand the material. Students expressed that the interactive features in the e-module provide a more enjoyable learning experience and make them more interested in learning. In addition, they find it easier to access materials and exercises at any time, allowing them to learn in a more flexible way and at their own pace. Overall, the students' response to this e-module was very interesting.

5. Evaluation Stage

The data in this study are grouped into two categories, namely (1) student learning outcomes taught using interactive e-modules (experimental class) and (2) student learning outcomes taught without using interactive e-modules (control class). After the data is collected, the next step is to analyze the data. The data description can be seen in Table 10:

Table 10. Data Description

| Variable | Class | N | Mean | Standard Deviation |
|---|---|---|---|---|
| Learning outcomes | Experimental Pretest | 20 | 55.20 | 7.40981 |
| | Experimental Posttest | 20 | 82.70 | 9.80387 |
| | Control Pretest | 21 | 54.28 | 8.34951 |
| | Control Posttest | 21 | 68.09 | 13.45327 |

Based on table 10 above, it can be seen that in the experimental class, the average pretest score was 55.20, while after being given treatment, the average posttest score increased to 82.70. This shows a significant increase in understanding the material after using the e-module. On the other hand, in the control class, the average pretest score was 54.28, and the average posttest score only increased to 68.09. Although there was an increase, the change was not as large as that seen in the experimental class. This difference indicates that the use of e-modules in the experimental class has a greater impact on improving student learning outcomes compared to the learning methods used in the control class.

The next stage in this analysis is the normality test, which aims to measure whether the data obtained is normally distributed so that it can be analyzed using parametric statistics. The

normality test was carried out using the Shapiro-Wilk test, with reference to the significance value (Asymp. Sig). The criteria for determining the normality of the distribution are as follows: if the significance value (Asymp.Sig) is greater than α = 0.05, then the data is considered to be normally distributed; conversely, if the significance value is less than α = 0.05, then the data is considered not normally distributed. A summary of the results of the normality test for the pretest and posttest data in the control and experimental classes can be seen in Table 11 below:

Table 11. Normality Test

| Variable | Class | Shapiro-Wilk | | |
|---|---|---|---|---|
| | | Statistic | df | Sig. |
| Learning outcomes | Experimental Pretest | .945 | 20 | .298 |
| | Experimental Posttest | .922 | 20 | .107 |
| | Control Pretest | .946 | 21 | .288 |
| | Control Posttest | .928 | 21 | .123 |

Based on the results of the normality test using the Shapiro-Wilk test in Table 11 above, it can be concluded that all data on the pretest and posttest in the experimental class and control class are normally distributed. This can be seen from the significance value (Sig.), which is greater than 0.05 in each group. In the experimental class, the significance value for the pretest is 0.298 and the posttest is 0.107, while in the control class, the significance value for the pretest is 0.288 and the posttest is 0.123. Because all significance values are greater than 0.05, these data can be considered normally distributed.

In this study, a homogeneity test of variance was conducted on the variance between the experimental group and the control group. The test used is the homogeneity test with the criteria that if the significance value (sig) is based on the mean > 0.05, then the data is homogeneous. Meanwhile, if the significance value (sig) is based on the mean <0.05, then the research data is not homogeneous. The calculation of the complete data distribution homogeneity test is presented in Table 12.

Table 12. Homogeneity Test

| | | Levene Statistic | df1 | df2 | Sig. |
|---|---|---|---|---|---|
| Learning Outcomes | Based on Mean | .796 | 1 | 39 | .378 |
| | Based on Median | .686 | 1 | 39 | .413 |
| | Based on Median and with adjusted df | .686 | 1 | 32.321 | .414 |
| | Based on trimmed mean | .823 | 1 | 39 | .370 |

Based on the results of the homogeneity of variance test shown in Table 12, the significance value (Sig.) is 0.378, which is greater than 0.05. This indicates that the variance between groups (experimental class and control class) is homogeneous, or in other words, there is no significant difference in variance between the two groups. Thus, the assumption of homogeneity of variance is met for further analysis.

After the data is confirmed to be normally distributed and homogeneous, the next step is to conduct a parametric statistical test, a paired t-test, to determine whether the interactive e-module used in the control class and experimental class is effective in improving student learning outcomes. The basis for decision-making in the paired t-test is if the Sig. (2-tailed) < alpha (0.05), then the interactive e-module used is considered effective in improving student learning outcomes. The results of the paired t-test can be seen in Table 13 below:

Table 13. Paired t-test

| | Paired Differences | | t | df | Sig. (2-tailed) |
|---|---|---|---|---|---|
| | Mean | Std. Deviation | | | |
| Pretest - Posttest | -27.50000 | 10.17479 | -12.087 | 19 | .000 |

Based on the results of the paired sample t-test shown in Table 13, the significance value (Sig.) is 0.000, which is smaller than 0.05. This shows that there is a significant difference between the pretest and posttest scores in the experimental class. In other words, the use of interactive e-modules has a significant effect on improving student learning outcomes.

The next stage is hypothesis testing using an independent sample t-test to determine whether there is a difference in the average between the control class and the experimental class. The results of the independent sample t-test analysis can be seen in Table 14 below:

Table 14. Independent t-test

| | | t-test for Equality of Means | | | | |
|---|---|---|---|---|---|---|
| | | t | df | Sig. (2-tailed) | Mean Difference | Std. Error Difference |
| Learning Outcomes | Equal variances assumed | 3.956 | 39 | .000 | 14.60476 | 3.69211 |
| | Equal variances not assumed | 3.986 | 36.558 | .000 | 14.60476 | 3.66393 |

Based on the results of the independent sample t-test shown in Table 14, the significance value (Sig. 2-tailed) is 0.000, which is smaller than 0.05. This shows that there is a significant difference between student learning outcomes in the experimental class and the control class. Thus, it can be concluded that the use of interactive e-modules in the experimental class has a different and more significant effect compared to the learning method used in the control class.

## Discussion

At the analysis stage, data collection was conducted through interviews and observations to explore the needs and characteristics of students as well as the conditions of existing facilities and learning environments. The results of the analysis showed that students needed more interesting and innovative teaching materials to support their understanding. In addition, the textbooks currently used tend to be monotonous, only containing brief explanations without interactive elements. This causes students to be less enthusiastic in following the learning materials. Therefore, e-modules were developed to provide more interesting, interactive teaching materials that are in accordance with students' needs soo that they can increase their involvement and motivation to learn.

At the design stage, the first step taken was to determine the learning objectives to be achieved. This objective is the basis for planning the content of the e-module material. The visual design of the e-module is designed to be attractive and easy for students to understand. The elements prepared include a representative cover, a selectionon of easy-to-read fonts, and the use of a neat layout with appropriate colors. In addition, interactive features are also included in the form of QR codes to access additional materials on the internet, as well as evaluation questions to measure students' understanding of the material being studied. All of these design elements are designed with students' comfort and ease in using the e-module in mind.

The development stage involved validation of the e-module by design experts, material experts, and language experts to ensure its feasibility. The validation results showed that the e-

module design scored 77% in the first validation, which was categorized as "valid," and increased to 95% after revision, indicating that the e-module design was very valid. Improvements made to the design included arranging more proportional images, adding animations, and illustrations that support the learning material. In addition, the navigation aspect was also improved to make it more intuitive and easy for students to use. The material validation scored 73%, also categorized as "valid," indicating that the material was in accordance with the learning objectives, although there were still some parts that could be improved, such as adding more in-depth content and clearer explanations in certain sections. Material revisions included simplifying sentences and sharpening the focus on the learning objectives to be achieved. Meanwhile, language validation scored 92.5%, which was categorized as "very valid," indicating that the language used in the e-module was very good and easy for students to understand. Language revisions were also carried out to ensure that the sentences used were more communicative and appropriate to the students' level of understanding, as well as to avoid ambiguity in conveying information.

After validation by design, material, and language experts, the next stage was validation by teachers and students. This process involved two teachers and six fifth-grade students, with very positive results. Responses from teachers showed the quality of the e-module was very good, especially in terms of material presentation, evaluation and exercises, e-module products, and their impact on users. Overall, teachers considered this e-module to be very effective in helping students become more active and understand the material well. One teacher said, *"This e-module really helps students understand the material and makes them more interested in learning."* The e-module also provides variation in learning that keeps students from getting bored, with structured, easily accessible material and in-depth exercises to strengthen students' understanding.

Furthermore, researchers obtained responses from students who were also very positive about this interactive e-module. The results of student assessments showed that the majority gave scores between 80% and 100%, with most giving scores of more than 90%. Interviews with students also supported these findings. One student said, *"I prefer to learn with the e-module because the appearance is attractive and the exercises allow me to learn in a fun way."* Another student also said, *"This e-module makes it easier for me to understand the material, and I can access it anytime if I need additional practice."* They felt flexible in accessing the material and exercises according to their own learning pace, which increased their motivation to continue learning. Overall, this e-module was very well received by students and was considered effective in increasing their engagement, understanding, and motivation to learn.

At the evaluation stage, the results of the statistical test showed a significance value (Sig. 2-tailed) of 0.000, which is smaller than 0.05. This indicates that there is a significant difference between student learning outcomes in the experimental class using interactive e-modules and the control class using traditional learning methods. The use of interactive e-modules has a more significant effect on improving student learning outcomes.

The development of this e-module provides various benefits, both for students and teachers. E-modules are innovative media that can increase students' interest in learning (Laili et al., 2019; Laraphaty et al., 2021). E-modules are compilations of materials designed as effective and efficient teaching materials for students' independent learning because they contain guidelines that facilitate the independent learning process (Widiana & Rosy, 2021). This means that students can carry out learning activities independently even though they are not accompanied by a teacher. Each learning activity in the e-module is equipped with a navigation link that allows students to interact more actively with the material. In addition, this e-module also presents videos and images related to everyday life to enrich students' learning experiences (Hafizah et al., 2024). Interactive features such as QR codes and evaluation questions facilitate more active and enjoyable learning. This e-module also provides a more innovative learning experience, which can increase students' motivation and understanding of the subject matter. In addition, digital-based e-modules provide easy access for students, who can access materials anytime and anywhere, thus supporting more

flexible learning. With this e-module, it is hoped that it can improve the quality and learning outcomes and motivate students to be more active and involved in the learning process.

## CONCLUSION

Based on the research results, it can be concluded that the interactive e-module developed for learning in grade V has met the criteria for good validity and effectiveness. The validation results show that this e-module received a "Valid" rating with a high score in the design (95%), material (73%), and language (92.5%). The response from teachers was also very positive, with an average of 91.47%, indicating that this e-module was considered interesting and effective in helping students understand the material. Students also gave a very good rating, with an average of 90%, indicating that they felt more interested and involved in learning using this e-module. The effectiveness test showed that this interactive e-module had a significant effect on improving student learning outcomes, with a significance value of 0.000, which is less than 0.05. This proves that interactive e-modules can improve student understanding more effectively compared to conventional learning methods. Thus, this interactive e-module is proven to be valid, practical, and effective and can be used as an innovative learning tool to improve student learning outcomes.

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