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THE DEVELOPMENT OF STATISTICS E-MODUL USING FLIPBOOK ON JUNIOR HIGH SCHOOL

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ABSTRACT

Conventional learning methods tend to be monotonous, often making junior high school students less interested and difficult to understand the material, especially in statistics. Therefore, it is necessary to develop more interactive and interesting teaching materials to increase students' interest in learning and understanding. This research aims to develop of statistics e-modul valid and practical teaching using the flipbook on junior high school. This study is classified as Research & Development using Thiagarajan's 4D model. The 4D stages of Thiagarajan include Define, Design, Develop, and Disseminate. The data collected using the instruments employed in this study include a validation questionnaire consisting of subject matter experts and media experts, a readability test questionnaire, and student response questionnaires, as well as teacher response questionnaires used to measure the practicality of the developed e-module. The results of the the development of e-modul using the flipbook application falls under the criteria of validity and practicality. The level of validity can be seen from the validity scores of 74% for content validation and 78% for media validation, which fall within the valid category, as well as practicality scores were obtained from the student response questionnaire with a score of 85% and the teacher response questionnaire with a score of 98%. It can be concluded that the development of e-modules using the flipbook application for statistics material for eighth grade, as produced by this research, is valid and practical, and therefore considered suitable for use in learning.

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INTRODUCTION

The rapid development of technology has indirectly influenced all aspects of human life, both in the fields of politics, economics, culture, and even in the field of education (Akbar & Noviani, 2019). The rapid advancement of Science and Technology demands creative and innovative adaptation to find effective solutions in various fields, including education (Wungguli & Yahya, 2020). The use of technology in the teaching and learning process in the classroom will help students in learning with the teacher acting as a facilitator (Kobandaha et al., 2022). Education

that utilizes technology is not just about replacing traditional methods, but also about creating a learning environment that is responsive, inclusive, and prepares learners to face future challenges with confidence (Fakhri, 2023).

Technological developments have had a significant impact on the development of the learning process, especially in terms of teaching materials. Teaching materials used during the learning process have an important role in improving the quality of learning, because they are the main media in delivering material to students (Millah et al., 2025). Education encourages the development of more interactive and dynamic teaching materials, such as electronic modules commonly called e-modules. Accouding to (Elvarita et al., 2020) an electronic module is an electronic version of a previously printed module that can be read on a computer or other gadget and is designed with supporting software. According to (Harahap, 2021), his research found that e-modules can serve as an alternative teaching material that enriches the learning experience of junior high school students. This is also supported by (Laraphaty et al., 2021) who found that the use of electronic modules enables effective learning, as they can assist students who are experiencing learning difficulties, facilitate students in studying subjects in a structured and systematic manner, and present materials in a sequential format.

Mathematics, particularly statistics, is an important part of every junior high school mathematics curriculum, serving as the foundation for understanding more advanced mathematical concepts. Statistics is the science of collecting, managing, presenting, and analyzing data, as well as drawing conclusions (Fitriatien, 2017). However, However, statistics is often considered difficult and boring by some students because of its abstract nature and the need for in-depth understanding (Kusnadi & Mardiani, 2022). A many students struggle with determining which principles or formulas to use, as well as with academic skills such as understanding the concepts behind the problems presented, which are more focused on numbers and logic (Mediyani & Mahtuum, 2020). This is due to the abstract, monotonous, and contextual nature of the material presentation. Yet statistics is beneficial in daily life and is used in all fields of science, such as economics, sociology, health, and even in the office world (Vahlia et al., 2022). Therefore, a learning medium is needed that can present material with a visual, interactive, and engaging approach.

A similar situation was also found in the schools that were the subject of this study, where learning media were not being used optimally. The teaching materials used were still uninteresting, making it difficult for students to understand them. As a result, students felt bored because the material presented tended to be monotonous and difficult to understand. Therefore, various innovations are needed in the mathematics learning process to make students more interested and able to understand the material better during learning activities. There is a distinct difference when learning uses innovative teaching materials or learning media (Bungsu et al., 2024).

One technology that is expected to create interactive teaching materials (electronic modules) is by utilizing a flipbook application, specifically the Flip PDF Professional application. Flip PDF Professional has the advantage of being easy to use and operate, as it can be published offline so that it can be run on a computer and uploaded online so that it can be run on a smartphone. This is why Flip PDF Professional can be used by those who do not know HTML programming language (Seruni et al., 2019). According to (Cahyani Agustin et al., 2021), Flip PDF Professional is software that can convert PDF files into digital flipbook publications, allowing them to be flipped through like a book when opened. In Flip PDF Professional, users can also add images, audio, video, animations, quizzes, buttons, and more, making the final product visually appealing and interactive.

The development of e-modules with the help of flipbooks is excellent and suitable for use in the learning process. This is evidenced by research conducted by (Bungsu et al., 2024), which yielded valid and practical results in their study on the development of digital instructional materials using the Flip PDF Professional application based on differentiated processes in circle-related content. This demonstrates that digital instructional materials are highly suitable for use as digital instructional materials and can be widely disseminated for classroom learning processes. Additionally, research conducted by (Wibowo & Pratiwi, 2018) found that e-modul using the Kvisoft flipbook maker application meet the criteria of validity, practicality, and effectiveness and are suitable for use in mathematics learning on set theory material.

Referring to previous research, this study aims to produce an e-modul development product that is valid and practical. Based on the above description, the researcher is interested in conducting research on the development of electronic modules using the flipbook application for eighth-grade statistics material.

METHOD

This development research was conducted to produce a valid and practical electronic module (e-modul) for use in mathematics learning in the classroom, particularly for statistics material. The research was conducted at SMP Negeri 3 Telaga. The development model used in this study is the 4D development model from Thiagarajan. This development model also involves expert validity testing so that the resulting product output will be more valid. The sample consisted of 5 students for readability testing and 26 students for large group testing. The data collected using the instruments used in this study are validation questionnaires consisting of material and media experts, readability test questionnaires, and student response questionnaires and teacher responses used to measure the practicality of the developed e-modul. The steps of the 4D model consist of four stages: define, design, develop, and disseminate (Afriansyah et al., 2020). The development steps in this study are explained as follows:

Define

In this stage, the requirements for development are determined and defined based on the objectives and problems, commonly referred to as needs analysis, namely: (1) Initial-final analysis, this stage is carried out to establish or determine the basic problems in the development of teaching materials. At this stage, an analysis of the statistics material is carried out to determine alternatives regarding real problems in education so that a description of the learning pattern that is in line with the learning objectives can be obtained, which can then be used as a supporting factor in the development of these teaching materials. In other words, the initial-final analysis aims to identify the fundamental issues that will be faced. (2) Student analysis, this stage is conducted to understand the characteristics of students. Since each student has different characteristics, the researcher feels it necessary to analyze the characteristics of these students, including their thinking abilities, learning motivation, learning background, and so on. This analysis aims to review the suitability between the media design to be developed and the conditions or characteristics of the students. (3) Concept/material analysis is used to identify the main concepts/materials compiled in the selected e-modul material, which is statistics. (4) Task analysis is conducted to find learning materials to be delivered to students. This analysis is conducted according to the Learning Outcomes that cover statistics material. (5) Specification of Learning Objectives: At this stage, the learning objectives to be achieved by the students will be formulated based on the learning outcomes in the Merdeka Curriculum. These will then be developed into an electronic module to be used in accordance with the material and task analysis.

Design

The design stage aims to design an electronic module with the final result being a prototype (initial product) of an e-module using a flipbook application for statistics material. The steps involved include determining the main topic to be covered in the e-modul. The e-modul is designed to be engaging for students and easy to understand. The e-modul will include text, images, videos, and quizzes managed using the flipbook application.

Develop

In this activity, experts in their respective fields conducted validation to test the validity of the e-modul. The suggestions provided were used to improve the material and design of the e-modul that had been created. The product validation process by validators was carried out using validation tools with the aim of providing an assessment of the e-modul that had been developed. The results of the expert validation and suggestions from the validators were then used to make further improvements.

The formula used to test data validity is as follows:

$$Validity\ (Kv) = \frac{Total\ value\ given\ by\ the\ validator}{Total\ maximum\ value} \times 100\%$$

The analysis was continued by using a combined validation calculation with the following formula:

$$Total\ Kv\ presentation = \frac{number\ of\ presentations\ Kv}{number\ of\ validators}$$

The validity of the e-modul in terms of material and media was assessed using a four-point Likert scale, with the lowest score of 1 indicating very poor, 2 indicating poor, 3 indicating good, and 4 indicating very good (Sugiyono, 2017). The final score calculation based on the formula, the validity criteria refer to (Wicaksono et al., 2020) which has been modified as shown in Table 1.

Table 1. Validity Criteria

Validity Presentation	Criteria
$85{,}01\% \leq Kv \leq 100\%$	Very Valid
$70{,}01\% \leq Kv \leq 85\%$	Valid
$50{,}01\% \leq Kv \leq 70$	Invalid
$0\% \leq Kv \leq 50\%$	Very Invalid

In addition to validity testing by experts, the product needs to undergo readability testing by students, represented by five students for this readability test. The final score was calculated using the formula, and the eligibility criteria are shown in Table 2.

Table 2. Media Eligibility Criteria

Presentation	Scale	Criteria
$85\% - 100\%$	4	Very suitable
$75\% - 84\%$	3	Suitable
$56\% - 74\%$	2	Less suitable
$0\% - 55\%$	1	Not suitable

After making improvements, developmental testing was conducted, which involved testing the e-modul with eighth-grade students in class VIII B and mathematics teachers at SMP Negeri 3 Telaga, Gorontalo Regency. After the testing, students were given a questionnaire to fill out to obtain data on student and teacher responses. This response data was analyzed to obtain practicality scores. In the questionnaire, students' responses were measured using a Likert scale ranging from 1 to 4. The practicality criteria can be seen in Table 3.

Table 3. Practicality Criteria

Interval %	Criteria
$81\% - 100\%$	Very practical
$61\% - 80\%$	Practical
$41\% - 60\%$	Quite practical
$21\% - 40\%$	Not very practical
$0\% - 20\%$	Not practical

The developed media can be considered practical if the results of the analysis of the responses of teachers and students show a minimum presentation of $\geq 61\%$.

Disseminate

In developing e-modul using flipbook applications for eighth-grade statistics material, the scope of the research was limited to SMP Negeri 3 Telaga, which means that the problems and results of the research may differ if conducted in other schools. The research was limited to the development stage only due to time constraints. Therefore, further research is needed to test the effectiveness of the developed e-modul.

RESULTS AND DISCUSSION

Results

The process and results of developing e-modules using flipbook applications in eighth-grade statistics material with the 4D model are explained as follows:

a. Define

The initial stage in e-module development is the definition stage, which consists of initial-final analysis, student analysis, concept/material analysis, task analysis, and specification of objectives. The initial-final analysis conducted revealed that the dominant methods used in mathematics instruction are lectures, discussions, and games, while instructional materials remain monotonous, such as printed textbooks and worksheets. Based on the results of the student analysis, it was found that students have varying abilities. In the learning process, some students are still less involved in the learning process, both in discussions and in providing feedback when the teacher asks questions and exchanging information with their peers. This requires interactive teaching materials that support the learning process to be more active, such as electronically designed module teaching materials. Furthermore, a concept/material analysis was conducted to identify the content related to single data statistics. The material in this study was aligned with the Merdeka Curriculum, specifically in the data analysis and probability elements, with sub-materials on data centralization (mean, median, mode) and data dispersion (range, quartile, and quartile deviation). The results of the statistical material analysis indicate that understanding and mastering this material is crucial in developing an e-modul. Based on the concept analysis results, the researcher then conducted an analysis of the tasks faced by students, with the primary focus on conceptual understanding. Finally, learning objectives were established, aligned with available resources to meet the Learning Outcomes for Phase D.

b. Design

The objective at this stage is to prepare the initial product. The steps taken are media selection, format selection, and initial design creation. An example of a flipbook-based e-modul display can be seen in Figure 1. The result of this design is referred to as draft I.

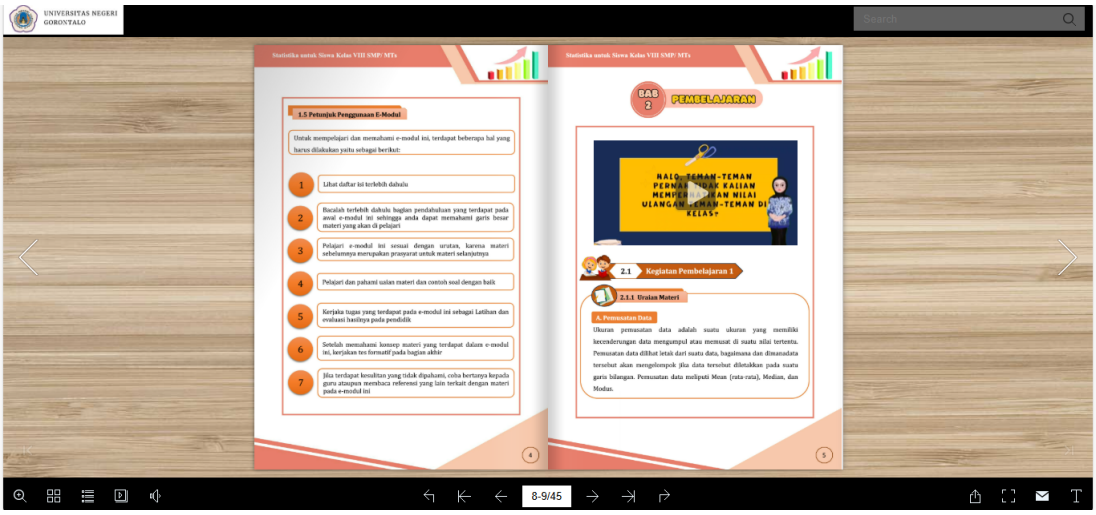

Figure 1. Example of e-modul display using flipbook application

c. Develop

The development stage resulted in the production of electronic modules (e-modul) for statistics material. In this activity, experts in the field conducted an assessment to test the validity of the e-modul before field trials were conducted. Several notes/suggestions were provided by the experts, and Table 4 presents the results of the validation of the developed e-learning modules.

Table 4. Results of e-module validation

Assessment Aspects	Validator 1	Validator 2	Validator 3
Materials	85%	45%	93%
Media	63%	83%	88%

Based on the data in Table 4, the average material validation score was 74% (valid) and the average media validation score was 78% (valid). Although the results obtained were valid, there were still some notes and suggestions for improvement from the validators that must be considered as material for revision of the e-module developed before field testing.

In addition to validity testing by experts, the product needs to undergo readability testing by students, represented by five students for this readability test. The results of the e-module readability test are presented in Table 5.

Table 5. Readability Test Results

No	Responden	Percentage
1	Responden 1	89%
2	Responden 2	73%

No	Responden	Percentage
3	Responden 3	98%
4	Responden 4	75%
5	Responden 4	93%

Based on the data obtained, the e-module using the flipbook application for the eighth grade statistics material was deemed very suitable for use, with an average score of 85% in accordance with the established criteria.

After making improvements, a field trial was conducted, which involved testing the e-modul using the flipbook application for the eighth-grade statistics material on eighth-grade students and mathematics teachers at SMP Negeri 3 Telaga, with a sample size of 26 students and 2 teachers. This trial was conducted to assess the practicality of the developed e-modul. The results of the analysis from the distributed questionnaire are presented in Table 6 below.

Table 6. Practicality test results

No	Aspect	Average
1	Teachers	98%
2	Students	86%

Based on the data obtained, the e-module using the flipbook application for eighth-grade statistics material was found to be very practical to use in the learning process, with an average score of 98% from teachers and 86% from students according to the established criteria.

d. Disseminate

This stage is the final stage, which involves distributing e-modul using the flipbook application for eighth-grade statistics material. The researchers distributed the modules to mathematics teachers and all eighth-grade students at SMP Negeri 3 Telaga, which has three classes.

Discussions

This study aims to develop valid and practical electronic teaching materials (e-modul) for mathematics for eighth grade junior high school students. The product development in this study involves enhancing the educational materials for use by students, teachers, and schools. The study produced an e-modul using a flipbook application for statistics material in eighth grade, developed using the 4D development model, which consists of four stages: define, design, develop, and disseminate.

Based on the research results, there are four stages involved in developing this e-modul teaching material, beginning with the Define stage. In this stage, the researcher conducted observations to obtain information related to the obstacles faced by teachers and students in the learning process, and analyzed the curriculum, which is the Merdeka curriculum used at SMP Negeri 3 Telaga. In this analysis, the researchers also analyzed the teaching materials used at the school. The school uses printed teaching materials and minimizes the use of electronic teaching materials. Next, the researchers analyzed the students, identifying their characteristics and finding that they are accustomed to using mobile phones.

From this stage, the researcher developed modules using a flipbook application, specifically Flip Pdf Professional, which the researcher chose because it supports the use of e-modul,

student learning motivation, and concept understanding through the content and sample questions contained in the e-module. As in the study conducted by (Bungsu et al., 2024) the digital teaching materials developed using Flip PDF Professional demonstrated high validity and practicality. Based on this analysis, the researcher believes that further research can be conducted to develop electronic-based learning modules as printed teaching materials for use in schools. The subject matter used is statistics for eighth grade.

Next is the Design stage, which includes the selection of media. Based on the initial and final analyses, it was determined that the media to be developed is an e-modul. The e-module will consist of learning objectives to be achieved, key topics, the position and function of the module, learning activities to be carried out and understood by students in sequence, and practice questions. In addition, other components such as instructional videos and quizzes can also increase students' interest in learning using the e-modul. This is in line with research (Fazila & Khatimah, 2024) which states that the use of instructional videos is an effective means of increasing students' motivation to learn mathematics. In addition, quizzes are also intended to assess the extent of each student's understanding and mastery of the material. The subtopics discussed are divided into two learning activities: Learning Activity 1 Data Centralization, which includes Mode, Median, and Mean; Learning Activity 2 Data Dispersion, which includes Range, Quartile, and Quartile Deviation.

The next stage is Development, which consists of the creation of e-modul and the assessment or validity testing and product testing stages. During the evaluation phase, expert validation is conducted, and the suitability of the e-modul learning product is measured using the flipbook application on the statistics material for eighth grade that was developed, as well as based on student feedback. The results of the validation analysis indicate that the e-module is valid and suitable for use in learning.

The development stage includes the dissemination of product results to a group of students, in this case conducting a trial with 26 students in class VIII B of SMP Negeri 3 Telaga. From the results of the trial, the average response of the students was that the E-modul using the flipbook application for the statistics material in class VIII was very interesting and practical to use. Based on the calculations, the average score was 86%, which falls into the “very practical” category. Similarly, the average response from subject teachers was 98%, indicating that the use of the E-module for learning statistics using the flipbook application in Grade VIII is highly practical.

Next, the Disseminate stage carried out by the researcher was observed from the results of the development test. Dissemination was carried out with all eighth grade classes at SMP Negeri 3 Telaga as the target of the researcher. Thus, all three classes with an average of 26 students felt the positive impact of the developed product.

The above statement reinforces several previous studies, such as the study conducted by (Atikah et al., 2020), which states that the developed mathematics e-module is considered highly valid in terms of content (independent learning, mastery learning, self-contained, adaptive, user-friendly, and e-modul components) as well as linguistic and design aspects (graphic quality, language appropriateness, module cover/cover, module content, and module suitability as teaching material). Based on the evaluators' assessment, the e-module is now ready for field testing.

In addition, this study also reinforces previous research (Ramadhina & Pranata, 2022) stating that the implementation test of the media on a small group yielded very feasible results, so a large group trial was conducted. The large group trial included 12 students. From the students' assessment of the digital flipbook-based electronic module (e-modul), the results showed that 86.90% fell into the very feasible category. The results of the trials conducted by the students

were good, both on a small and large scale. Both fell into the very feasible category. This indicates a positive response to the development of the digital flipbook-based electronic module (e-modul). Students expressed that the electronic module (e-modul) is highly effective when used in both classroom and out-of-classroom learning processes.

It can be concluded that the results of this study are consistent with previous studies in terms of the percentages obtained by the researchers. In this study, the expert material validation assessment yielded a percentage of 74%, which falls into the good/valid category. The assessment by media or design experts yielded a percentage of 78%, which also falls into the good/valid category, with the same criteria of being good and valid for field testing.

Next, after testing to see how easy it was to read, the researcher got feedback from 5 students, who gave it an 85% rating, which is really good. Then, after limited testing to see how easy it was to read, the researcher tested it in class VIII B at SMP Negeri 3 Telaga and also with 2 teachers at the school. where each evaluation used teacher and student response questionnaires. For teacher respondents, the percentage was 98%, meeting the criteria for highly practical, while according to the student response questionnaire evaluation, the percentage was 86% and also met the criteria for highly practical. Therefore, the developed product is deemed suitable for dissemination.

CONCLUSION

Based on the results of research on the development of statistics e-modul using flipbook on junior high school, the modules were found to be valid and practical, making them suitable for use in classroom and independent mathematics learning. Other researchers are encouraged to conduct further research to determine the effectiveness of these E-modul as a medium for mathematics learning in the classroom.

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