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Development of Computer Based Learning Media with A Scientific Approach to Probability Materials

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This study aims to produce computer-based learning media with a scientific approach to probability material. The development model used is the 4D model which consists of the stages of define, design, develop, and disseminate. The instrument used was a validity instrument in the form of a validation sheet and a practicality instrument in the form of a student response questionnaire. The data collection techniques used were validation sheets and student response questionnaires. The data analysis technique used in this research is quantitative data analysis and qualitative data analysis. Validation is carried out by four validators who are experts in their fields. A limited trial was conducted on 16 students of SMP Mutiara Harapan Pangkalan Kerinci. Students are divided into two groups, consisting of students with high, medium, and low abilities. Each group tries two learning media. From the results of data processing, it was found that the average validation of learning media on the media aspect was 3.47 with very valid criteria and the material aspect was 3.53 with very valid criteria. This means that all aspects of the device in the learning media developed are related consistently. While the average percentage obtained from the student response questionnaire in the limited trial was 90.59% with very practical criteria. This means that the learning media developed can be used in learning activities. It can be concluded that the learning media developed are valid and practical.

1. Introduction

Currently, information and communication technology (ICT) has developed very rapidly, so that it affects all aspects of life. The role of technology which is so prominent in supporting renewal efforts is no exception for the world of education. The government has realized that the role of technology is

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indispensable in the world of education. The government has also regulated the need for technology in the world of education in the laws and regulations. One of them is listed in Permendikbud No. 22/2016 on Process Standards. In the sections of Graduate Competency Standards and Content Standards, it is explained that one of the learning principles that needs to be applied is the use of information and communication technology to increase the efficiency and effectiveness of learning.

An ICT product that is designed and properly can be used and utilized to improve the quality of learning both in terms of results and processes. The existence of technology is a great resource for teachers to support the teaching and learning process. The use of technology in learning activities can provide wider learning opportunities and reduce learning gaps caused by socio-economic factors. The use of technology in learning can shape teachers into professional teachers so that it has an impact on improving the quality of learning (Skryabin, 2015).

One of the uses of technology in education is the use of computers in classroom learning activities. According to Malik & Agarwal (2012), the ability of computers to present learning material is better than the presentation of subject matter in books. Computers can run multimedia. Through this ability, the presentation of teaching material on the computer becomes clearer and more interesting. Thus the use of computers in learning activities can make it easier for students to understand the teaching material delivered. Vaughan (2011) explains that multimedia is a computer-based system that can combine various contents such as text, video, graphics, animation, and interactivity. With this multimedia capability, the presentation of learning concepts using computer-based media can be done flexibly.

Learning media can help the mathematics learning process at the junior high school level. Cognitively, junior high school students are in a transition period from the concrete operational cognitive stage to the formal operational cognitive stage. According to Piaget's cognitive theory, at this stage, students have begun to be able to think abstractly and logically. Students already can draw conclusions, interpret, and develop hypotheses. The existence of media can help teachers to convey messages in learning to students (Naz et al, 2014).

Computer-based learning media deserves to be chosen to support the implementation of learning activities. Computer-based learning media has various advantages, including visualizing abstract concepts, making it easier to understand difficult materials, simulating processes that are difficult to do manually, displaying learning material in various formats (multimedia) so that it becomes more interesting, and the latest (up to date) from various sources, allows interaction between learners and learning materials, accommodates differences in student learning speed and styles, overcomes limitations of space, time, and energy, supports changes in the role of teachers in a positive direction as facilitators and mediators, from their original position as the only source of knowledge, enhancing the individual skills of its users.

In the process of developing computer-based learning media, it must consider the learning approach used. Permendikbud No. 22/2016 mandates teachers as educators to apply a scientific learning approach in learning activities. Learning with a scientific approach is a learning process designed in such a way that students actively construct concepts, laws, or principles through the stages of observing, formulating problems, proposing or formulating hypotheses, collecting data with various techniques, analyzing data, drawing conclusions, and communicating concepts, laws or found principles (Daryanto, 2014).

The application of the scientific approach to learning involves process skills, such as observing, measuring, predicting, explaining, and concluding. In implementing these processes, teacher assistance is needed, but the teacher's assistance is decreasing as the students mature or the class of students increases (M. Hosnan, 2014). In applying the scientific approach in learning activities, learning media based on a scientific approach is needed. Learning media based on a scientific approach can help the learning process take place and build students' understanding of the material they are learning.

The results of a preliminary study of the use of computers in learning conducted through interviews with nine mathematics teachers from several junior high schools in Singingi Hilir sub-district, Kuantan Singingi Regency, obtained information that six out of nine teachers never used a computer during class learning. The rest stated that they had used computers as a medium to deliver learning materials. This data shows the low use of computers and technology in learning.

Continuing the results of interviews that researchers conducted, there are several reasons why teachers have not used technology in learning activities. First, the teacher's lack of understanding of computer use. In the current era of information and communication technology development, there are still many teachers who do not understand how to use computers, even though mastery of ICT skills is needed to be able to adapt to the development of 21st-century learning.

Second, the time for teaching preparation is limited. To produce technology-based learning media that is following the demands of the approach and learning model in the 2013 curriculum requires a long time to manufacture. Making technology-based learning media requires stages and development to produce valid and practical learning media for use in learning activities. Teaching preparation time is relatively limited, making it impossible for teachers to create and develop technology-based learning media.

Third, it is difficult to find the right and relevant media. The development of information and communication technology makes it easy for teachers to find various technology-based learning resources, through the internet network can be found various computer-based learning media that can be downloaded for free. However, not all of these learning resources are valid, effective, and efficient for use in learning activities. According to Luik (2010), this usually happens because multimedia is not evaluated by experts, and some learning materials are made by

people who do not know pedagogical principles and do not know how to make effective educational software.

Based on the analysis of the need for computer-based learning media described above, researchers developed computer-based learning media with a scientific approach to the subject matter of Probability. This study aims to produce computer-based mathematics learning media with a scientific approach on the subject matter probability of class VIII SMP that is valid and practical for use in learning activities and are effective in increasing student interest in learning.

2. Methodology

This type of research is research development or Research and Development (R&D). The R&D model used in this study was 4-D developed by Thiagarajan and Semmel (in Mulyatiningsih, 2014). The 4-D model consists of 4 stages, namely: Define, Design, Develop, and Disseminate. At the define stage, the researcher performs a preliminary analysis, student analysis, task analysis, concept analysis, and specifies learning objectives. At the design stage, the researcher made a program structure design, teaching material design, and media display design. In the development stage, the researcher made a prototype of learning media to test its validity and practicality. The research instrument used was a validity instrument in the form of a media validation sheet, and practical instruments consisting of student response questionnaires and teacher response questionnaires. The data collection technique was carried out by validating the learning tools to determine the validity and distributing questionnaires of teacher and student responses to determine the practicality of the learning tools.

The data analysis technique used is quantitative data analysis and qualitative data analysis. Quantitative data analysis consisted of data validation and practicality data analysis. Validation data analysis was carried out to determine the validity level of the developed learning media. This analysis was carried out by determining the average value of each aspect on the validation sheet and the results obtained were adjusted to the validity criteria used.

Furthermore, the practicality data analysis of the student response questionnaire aims to determine the practicality level of the learning tools developed by determining the average percentage of the value of each aspect of the student response questionnaire. Furthermore, the results of practicality data analysis will be adjusted to the practicality criteria used. Data analysis from the validation sheet is calculated using the following formula.

$$\bar{M}_v = \frac{\sum_{i=1}^{n} \bar{V}_i}{n}$$

Note:

$\bar{M}_v$: the average total validation
$\bar{V}_i$: validation mean of the ith validator
n : number of validators

Based on the data analysis from the validation results, the media are categorized into four criteria, namely invalid, less valid, valid, and very valid. The media developed is said to be feasible to be tested if the minimum level of validity achieved based on the results of the validator's assessment falls into the valid category with a value of >2.50 or very valid with a value > 3.25.

The practicality of the learning media in this study was obtained from the student response questionnaire analysis. Data analysis uses the following formula:

$$V_p = \frac{Tsa}{Tsh} \times 100\%$$

Note :
V_p : respondent score
Tsa : the total empirical score of the respondents
Tsh : the maximum total score expected

Based on the analysis of the student response questionnaire data, the media are categorized into four criteria, namely impractical, less practical, practical, and very practical. According to Akbar (2013), learning media can be used if the percentage obtained is more than 70%. The media developed is said to have fulfilled the practical aspect if the level of practicality achieved is in the practical category with a percentage of > 70% or very practical with a percentage of > 85%.

3. Results and Discussion

3.1 Result

This study uses a 4D development model. At the define stage, five things must be done, namely preliminary analysis, student characteristic analysis, concept analysis, task analysis, and objective specification. In the preliminary final analysis, researchers analyzed the use of computers in learning activities at school. The analysis was carried out using interview techniques with several teachers to determine the frequency of teacher use of computers in learning activities, the availability of computer-based learning media in schools, and the constraints experienced by teachers in using computer-based learning media in schools.

In the student analysis, researchers dig deeper into the intellectual abilities of students at the junior high school level. The majority of junior high school students are in the age range of 13-15 years. At this age range, students already can be able to think abstractly and logically. At this age children already can draw conclusions, interpret and develop hypotheses. The role of learning media at this age is very crucial, appropriate learning media can help children understand various abstract objects in the subject matter and guide students to think logically.

Computer-based learning media is a form of media that is appropriate for learning activities. Computers have a variety of programs that have a high degree of

flexibility. Computer-based learning media can provide feedback for every input that students enter as media users. The use of computers as a learning medium can encourage students to actively learn, provoke students' curiosity as well as provide a new learning dimension for students.

The next analysis is concept analysis is carried out to compile the teaching material to be developed in learning media systematically. Based on the analysis of the concept of teaching materials, probabilities are grouped into 4 sub-materials, namely: empirical probabilities, sample space, and sample points, theoretical probabilities, and the relationship between empirical and theoretical probabilities. The results of the concept analysis are used to determine the tasks that will be carried out by students during learning. The defined stage ends with the specification of learning objectives. Learning objectives are determined based on the results of concept analysis and task analysis.

At the design stage, the researcher designed computer-based learning media which was developed based on the analysis that had been carried out at the define stage. The stages carried out by researchers include designing the program structure and making the initial design of the media display. The initial design of the media display consists of an opening page view, a material page view, a training page display, and a formative test page display. The initial design of the media display was made in a paper-based form.

The Develop stage (development) is a continuation of the design stage. Activities carried out at this stage are the development of learning media, product validation and revision, and product testing. At the development stage, the researcher poured the initial design of the media display at the design stage into a media prototype that was compiled using the Microsoft Office Power Point 2013 program. The display of the media page created at the development stage can be seen in Figure 1.

Figure 1. Display of the opening page on learning media

On the opening page, there is the title of the subject matter which is right in the middle of the opening page. Under the title of the subject matter, there is a

navigation button that can be clicked to start the lesson. The researcher added a page number to the top left corner of the page and a button to close the media in the top right corner of the page. Furthermore, the appearance of the teaching material page can be seen in Figure 2.

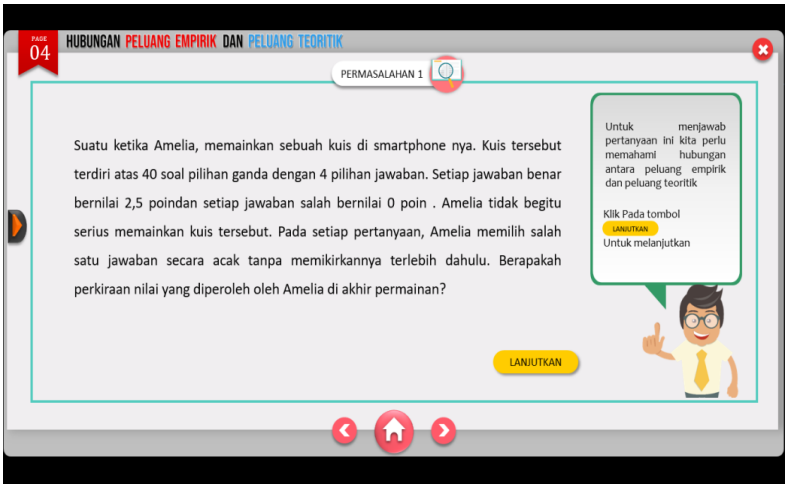

Figure 2. Display of teaching material page on learning media

On the teaching material page, there are navigation buttons next slide, previous slide, and home at the bottom of the page. On the left side of the page, there is a navigation menu to make it easier for users to move between material pages, practice pages, and formative test pages. The researcher adds a page number in the upper left corner and a button to close the page in the upper right corner. The title of the teaching material is positioned next to the page number. Each teaching material always begins with contextual problems that will be resolved by students in learning activities. Furthermore, the display of the training page can be seen in Figure 3.

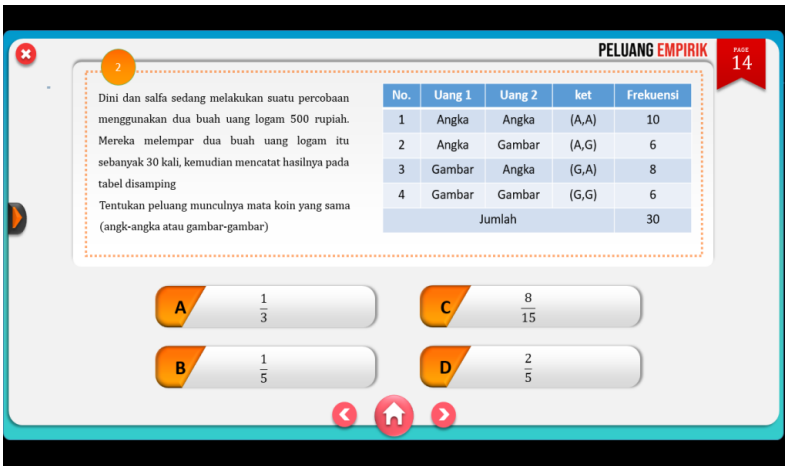

Figure 3. Display exercise page on learning media

The questions on the practice page are in the form of multiple-choice questions with four answer choices. Users can answer questions by clicking on the answer

option that is considered correct on each given question. Furthermore, the display of the formative test page can be seen in Figure 4.

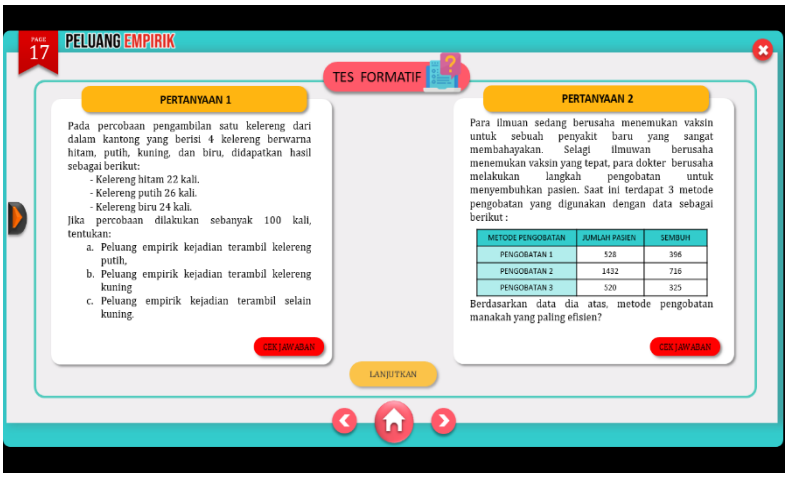

Figure 4. Display of the formative test page on learning media

On the formative test page, two questions must be answered by the user. Each question is placed in a textbox in the middle of the page. At the bottom of the question, there is a button "Check Answers". This button serves to display the answer key to the question given.

After the media development is complete, the researcher then carries out the validation process. The learning media validation process is carried out by assessing the media that has been made from two aspects, namely the material aspect and the media aspect.

Learning media validation activities from the material aspect are carried out to assess the subject matter contained in the media. Validation of subject matter contained in the media is viewed from two aspects, namely aspects of learning and aspects of the curriculum. The learning aspect in general assesses the clutter of teaching materials, the delivery of concepts, and the questions contained in the learning media. Curriculum aspects in general assess the suitability of learning media with the applicable curriculum. The results of the media validator from the material aspect can be seen in Table 1 below.

Table 1. Validation Results by Material Validators

No	Assessment Aspects	Media-1	Media-2	Media-3	Media-4
1	Learning Aspects	3.55	3.60	3.40	3.55
2	Curriculum Aspects	3.50	3.55	3.55	3.55
	Average	3.55	3.53	3.58	3.48
	Criteria	Very Valid	Very Valid	Very Valid	Very Valid

Based on the results of the material aspect validation, the average value of the validator for media-1 is 3.55, media-2 is 3.53, media-3 is 3.58, media-1 is 3.48.

The four media met the very valid criteria. According to the validator, from the aspect of computer-based learning media material, it is feasible to be used in learning.

The validation of learning media from the media aspect was carried out by assessing the learning media on the cosmetic aspects and program aspects. The cosmetic aspect in general assesses the appearance of the media, starting from the choice of color composition, the use of images, and the use of animation. This aspect of the program in general assesses the functionality of learning media such as the use of navigation buttons and the ease of operating the media. The results of the validation of aspects of the material media can be seen in Table 2 below.

Table 2. Validation Results by Media Validators

Assessment Aspects	**Media-1**	**Media-2**	**Media-3**	**Media-4**
Cosmetic Aspects	3.43	3.57	3.43	3.29
Program Aspects	3.50	3.51	3.70	3.33
Average	3.46	3.54	3.57	3.31
Criteria	Very Valid	Very Valid	Very Valid	Very Valid

Based on the results of the validation of the media aspect, the average value of the validator for media-1 is 3.46, media-2 is 3.54, media-3 is 3.57, media-1 is 3.31. The four media met the very valid criteria. Overall, based on the validation of the material and media aspects, learning media is in a very valid category. After the learning media was revised according to the suggestions and input from the validator, the media development was continued to the product trial stage.

The revised device according to the advice of the validator was then tested on 16 grade VIII students of SMP Mutiara Harapan Pangkalan Kerinci. 16 class VIII students were divided into 2 groups. Each group consists of 2 high-ability students, 4 moderate-ability students, and 2 low-ability students. Selection of students based on suggestions from the teacher of mathematics at school. A limited trial was conducted to see the readability of the media being developed. The limited trial will be held on Thursday, 28 May 2020.

Limited trial runs are carried out online via the zoom application. The trial process cannot be carried out face-to-face due to situations and conditions that are not possible in the Covid-19 pandemic. In the trial process, students were assisted online by a math teacher.

After testing the use of media students are asked to respond to the media they have tested by filling out a response questionnaire. The response questionnaire contains aspects of the appearance of learning media, aspects of presenting material on learning media, and aspects of programs on learning media. The results of student responses can be seen in Table 3 as follows.

Table 3. Student Response Results at the Limited Trial Stage

No	Assessment Aspects	Media 1	Media 2	Media 3	Media 4	Average	Criteria
1	Display Aspects	92.0%	88.4%	87.5%	85.3%	88.3%	Very Practical
2	Aspect Presentation Material	95.1%	95.5%	88.4%	89.3%	92.1%	Very Practical
3	Program Aspects	92.7%	91.1%	92.7%	89.1%	91.4%	Very Practical

Based on Table 3 on the limited trial, the display aspect obtained an average value of 88.3% which is in the very practical category. The presentation aspect of the material obtained an average value of 92.1% with very practical criteria. Aspects of the program an average score of 91.4% with very practical criteria. Overall the results of the limited trial are shown in Table 4 as follows.

Table 4. Results of Student Response Analysis in Limited Trials

	Media-1	Media-2	Media-3	Media-4
Average percentage	93.25%	91.69%	89.53%	87.87%
Criteria	Very Practical	Very Practical	Very Practical	Very Practical
Total average	90,59 %			
Criteria	Very Practical			

The results of student responses show that all media have met the very practical criteria with an average percentage of 90.59%. Overall the implementation of the limited trial ran smoothly. The students admitted that they were enthusiastic about using the media provided by the researcher. Through student response questionnaires, the media received a lot of positive feedback. According to students, the use of media in learning activities makes the learning process fun and interesting. The use of learning media can present a new and not boring learning atmosphere. The color composition used in the media is very precise, making it attractive to the eye. Presentation of information on learning media uses language that is simple, clear, and easy to understand.

In the final stage, the researcher packages the learning media development products into a compact disc (CD). Then the learning media is given to schools that contribute to this research in the hope that it can be used by mathematics teachers at the school and can be used as a reference for developing mathematics learning media in other materials.

3.2 Discussion

Following the selected development model, this research follows the planned stages according to the 4D development model stages. Learning media that have been developed will be assessed for their validity and practicality. At the

development stage, researchers develop learning tools following the initial design, validation process, and product testing.

The media validation process developed was carried out on the material and media aspects. In the material aspect, the validator assesses the learning and curriculum aspects. The learning aspect in general assesses the clutter of teaching materials, the delivery of concepts, and the questions contained in the learning media. Curriculum aspects in general assess the suitability of learning media with the applicable curriculum. Based on the results of the analysis of the validation results, for both aspects of the assessment, the score was ≥ 3.25 with very valid criteria.

In the media aspect, validation was carried out on cosmetic aspects and program aspects. The cosmetic aspect relates to the appearance of the media, starting from the choice of color composition, the use of images, and the use of animation, while the program aspects generally assess the functionality of learning media such as the use of navigation buttons and the ease of operating the media. Based on the data analysis, the results of the validation of each aspect for the four learning media obtained a value of ≥ 3.25 with very valid criteria. Assessment of the media and material aspects with very valid criteria means that computer-based learning media with a scientific approach can be used as a medium in carrying out the learning process, especially on probability material.

Furthermore, to see the practicality of the media being developed, a limited trial was carried out. Limited trials are given to students who have studied the previous probability material. The response to the learning media developed was obtained from student response questionnaires. Based on the analysis of the results of the student response questionnaire to the four learning media developed, it was concluded that the developed media received a good response with an average percentage of 90.59% with very practical criteria. This means that the media is easy to use and the level of implementation is in a good category and can be implemented properly. This is supported by previous research, which states that computer-based learning media can help students understand the subject matter (Karuniakhalida, 2019). In line with this, Riyadi's (2014) research result also states that computer-based learning media can be used by teachers and students so that it can support the learning process. Students state that they can use and operate instructional media well.

Based on the cosmetic aspect, the appearance of the media is very interesting and the explanation of the material on the media is easy for students to understand. Besides, the existence of interesting animation and pictures on the media makes students interested and helps in understanding the material. This is supported by the results of research by Roza (2017) which states that in practical terms, students claim that it is easy to use computer-based learning media and animation on media is very interesting so that it can help students in learning. Saputra (2017) states that students understand the material more easily by looking at the illustrations contained in the learning media accompanied by explanations compared to the verbal explanations that are often done by the teacher. The

existence of computer-based learning media can also increase student motivation to learn. This is following the results of research by Ulfa (2016).

Based on the results of the validation and the results of the student response questionnaires, there are limited trials, it can be concluded that the computer-based learning media with a scientific approach to the probability material has met the validity and practicality requirements.

4. Conclusion

Based on the results of the validation of learning media, it can be concluded that the computer-based learning media with the scientific approach developed have met the valid criteria. That is, all the components of the learning media developed have been connected consistently. Based on the student response questionnaire, it can be concluded that the learning media developed have met the practical criteria. The development research carried out has resulted in a product in the form of computer-based learning media with a scientific approach to the probability material. The resulting learning media is considered valid through the validation process and practical through limited trials.

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