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DEVELOPMENT OF ELECTRONIC TEACHING MATERIALS FOR DATA PROCESSING LEARNING BASED ON SCIENTIFIC FOR ELEMENTARY SCHOOL STUDENTS

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ABSTRACT

The purpose of this research is to develop electronic teaching materials for scientific-based data processing learning for fifth grade elementary school students that are valid, practical, and effective. Mathematics learning is carried out using scientific-based electronic teaching materials with the steps of observing, asking questions, gathering information, associating, and communicating. The use of electronic teaching materials is expected to help students understand the concept more deeply and foster students' motivation to learn mathematics. The scientific-based electronic teaching material development model in this study uses the Dick and Carrey development model. There are 10 stages in model development, namely: identifying learning objectives, conducting learning analysis, analyzing student characteristics and learning contexts, formulating specific learning objectives, developing assessment instruments, developing teaching strategies, developing and selecting teaching materials, designing and developing formative evaluations, revising learning, and designing and developing summative evaluations. The trial of teaching materials was carried out at SDN Airlangga I/198 for the 2020/2021 academic year using a pretest-posttest control group design. The subjects of this study were 30 students of class 5C as the experimental class and 30 students of class 5D as the control class. Based on the results of the study, the scientific-based electronic teaching materials developed were declared valid, practical, and effective in learning data processing for fifth grade elementary school students. Based on these results, shows that there are differences in learning outcomes using scientific-based electronic teaching materials in mathematics learning about data processing for fifth grade elementary school students.

KEYWORDS: Electronic teaching materials, data processing, scientific

INTRODUCTION

The development of science and technology today can be said to be quite rapid. In the era of technological development as it is now, the quality of human resources is very necessary. Education is the right effort to produce quality human beings. Quality education, not only prepares students for

future careers, but can also solve problems encountered in their environment. Therefore, education should look far ahead in order to prepare students to face challenges in the future.

The purpose of basic education is to provide students with basic competencies and skills so that they can develop their abilities as individuals, part of society, and the state. The 2013 curriculum is a continuation and refinement of the 2006 Education Unit Level Curriculum. The 2013 curriculum aims to prepare Indonesian people to have life skills as individuals and citizens who hold fast to their beliefs, are useful, innovative and creative, as well as participate in the life of society, nation, and society. and country. The development of learning patterns in the 2013 curriculum is student-centered and interactive learning (Murfiah, 2017:30).

The 2013 curriculum is planned and programmed for students under the guidance of schools to face 21st century competencies. Learning in the 21st century requires the innovative ability and creativity of teachers in managing and planning learning. Learning carried out in facing the 21st century must be able to develop: (1) creativity and innovation of students; (2) critical thinking skills; (3) communication, and (4) collaboration. The scientific approach is the beginning of empirical science by using critical thinking as an instrument to find the truth (Tilaar, 2012: 125). The scientific approach has five activities in its learning, namely observing (observing), asking (questioning), collecting data (experimenting), reasoning (associating), and communicating (Permendikbud, 2013). The characteristic of this approach is student-centred. The scientific approach invites students to improve their thinking skills so that they can understand the material well and can affect their learning outcomes.

Mathematics is a field of study that must be studied by students in elementary school. The purpose of elementary mathematics learning is that students have a rational, critical attitude, are able to analyze carefully, thoroughly, can be responsible, can respond quickly, and don't give up quickly in facing a problem (Permendikbud, 2016). Along with the times, students are required to be able to face challenges in the global era.

Data processing is one of the mathematics materials in grade 5 contained in the 2013 curriculum. One of the basic competencies of mathematics in grade 5 is to analyze data related to students themselves or the surrounding environment and how to collect them (Permendikbud, 2018). The material coverage of data processing in 5th grade elementary school is data collection, data presentation, and interpretation of data presentation (Gunanto, 2016:112). Data processing in elementary schools is a mathematical study that is often encountered in everyday life. Often students are required to be able to read data, interpret and process it into useful information. Unfortunately, the material contained in the textbook only revolves around formulas and examples.

Based on the results of interviews and observations in grade 5 of SDN Airlangga I/198, it was found that interest in learning mathematics tends to be low. This affects the achievement of competencies

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achieved by students. Mathematics is still considered a difficult material, plus the material in mathematics teaching materials is limited. This causes the existing mathematics teaching materials to be less attractive to students to learn mathematics. In addition, the reality of education in the field is that there are still many educators using conventional textbooks that already exist, ready to serve, without any effort to think of plans for their own preparation and preparation. The impact that can occur is that the teaching materials are not contextual, less attractive, seem the same every year, and are not in accordance with the conditions and needs of students (Prastowo, 2015: 18).

Conventional teaching materials are usually in the form of textbooks, government grant books, or LKPD obtained from book distributors. The LKPD books are mostly in the form of practice questions. This can result in learning focused on achieving the target subject matter with the aim that students achieve maximum scores, while the process of gaining knowledge is meaningfully improved.

Student books as one of the teaching materials that exist today already refer to the minimum standards that must be achieved in the 2013 curriculum. However, it is not fully in accordance with the conditions of the school environment and the character of students. Therefore, new innovations are needed so that learning is more meaningful and in accordance with environmental conditions and student character.

Innovation according to Shoimin (2016: 19) is a form of transformation characterized by a new event that is used in problem solving. The innovation of teaching materials is expected to support students abstracting an object into reality according to its development. The development of teaching materials is one of the efforts to improve the quality of the learning process. To design a lesson, the creativity of a teacher is needed. Teacher creativity starts from basic competency analysis, developing indicators, determining learning objectives, using teaching materials, appropriate methods, to designing student worksheets that are able to develop students' thinking skills and make appropriate evaluations to assess students' cognitive abilities against the material presented. has been obtained.

The teaching materials currently available are already basic materials for teachers. However, according to Permendikbud No. 8/2016, textbooks from the government are not the only source of learning. This can be interpreted that in realizing interesting learning it is not enough to only rely on these teaching materials. Educators can create or look for other references as learning resources.

Technology in education is not something foreign. Students are able to use computers or laptops, even the average student is able to operate smart phones. Students are more interested in reading messages on computer screens or smart phones than reading printed books. Computers and smart phones have the power of audio, visual, video, and are interactive media for students. Yudhi (2013:149) reveals that computers have advantages in processing various symbols as stimuli in the form of numbers, letters, words, audio, still animation, moving animation, and others. This is a challenge for an educator to be able to bring students to use the technology positively in learning, such as learning to use electronic teaching materials.

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Kong & Song (2015: 185) states that "E-books consist of various kinds of multimedia that engage students in learning with quality and well-organized content". E-books consist of various types of multimedia that involve students in learning with quality and well-organized content. The preparation of teaching materials that are interesting, contextual, and have innovations that are in accordance with the conditions of students, requires teacher creativity. Teachers need to develop new ideas so that learning is fun, interesting, and impressive for students. If learning in class is fun, effective learning will be created.

Development of electronic teaching materials containing text, images, audio, video, and evaluation of data processing materials. The discussion about data processing material is taken because there are still rare researches that develop teaching materials for that material. Electronic book-based teaching materials can help students in learning mathematics. These electronic teaching materials can be studied by students independently or with the help of teachers through computers or laptops that are projected in front of the class. Electronic teaching materials developed are not only integrated on computers or laptops, but can also be opened via smart phones. The development of this teaching material uses a flip pdf application to compile teaching materials. After the teaching materials are finished and uploaded, students can access them via the link shared by the teacher.

The results of research conducted by Sugeng (2018), the use of electronic teaching materials can increase student interest in learning, so that the learning achievement achieved increases. While still using conventional teaching materials, student learning outcomes were only at 65. After using electronic teaching materials, student achievement increased to 82. Another study conducted by Troy Jones & Bown (2011) entitled “A Comparison Between E-Learning Books and Traditional Print Book in an Elementary Classroom” revealed that the use of electronic books is more attractive to students than traditional books. Students explore more titles, audio-visuals, and animations. The level of students' understanding of reading is better after using electronic books.

In line with previous research, research conducted by Firmansyah (2019) stated that there were differences in student learning outcomes who used mathematics electronic books to improve understanding of elementary school students' mathematical concepts. The electronic book developed is an electronic book based on the story in it. Based on this opinion, it can be concluded that learning using traditional teaching materials and electronic teaching materials shows a very significant difference. The quality of learning will not develop if educators do not want to be creative to develop existing teaching materials. On the other hand, if educators want to make creative efforts to independently make teaching materials that are more interesting, varied, and in accordance with the level of development of students, it will be a good innovative step. This will certainly improve the quality of Indonesian education.

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According to the head of SDN Airlangga I/198 Surabaya, the development of electronic teaching materials is a new breakthrough in mathematics. This research is expected to encourage educators to develop teaching materials, because at SDN Airlangga I/1998 there are no teachers who make teaching materials in the form of electronic books. In addition, computer facilities in schools are adequate. Teachers can take advantage of computer laboratory facilities to support the learning process.

An interesting formulation that the main thing is to prepare students to overcome various challenges in the future, but not to ignore a conducive learning atmosphere for students. The scientific selection is due to the fact that the scientific stages are in accordance with the 2013 curriculum which can make students improve their thinking skills so that it affects their learning outcomes. Researchers raised data processing material because not many researchers have conducted research on the material. The packaging of teaching materials with electronic media is adjusted to the demands of the times and the conditions of distance learning

RESEARCH METHOD

This study uses the Dick and Carrey development model (Ratumaman, 2014). This development model was chosen because it is systematic based on the theoretical basis of learning design and is programmed with systematic activity steps. There are also electronic teaching materials for scientific-based data processing learning for 5th grade elementary school students, which is the final product that will be produced.

The development of scientific-based electronic teaching materials contains 10 steps, including: 1) identifying learning objectives, the initial stage is determining what students want in learning so that learning objectives can be achieved; 2) conduct a learning analysis, the second stage is the identification of the relevant stages to obtain the competencies or skills needed by students; 3) analyze the characteristics of students, the characteristics of students who are analyzed are initial abilities, ways of learning, and attitudes during learning activities; 4) formulating specific learning objectives, formulating the ability or behavior of students after participating in learning; 5) develop assessment instruments, develop assessment instruments to measure the achievement of student learning outcomes and measure the expected student abilities in the objectives; 6) developing learning strategies, using scientifically-based electronic teaching materials that were developed; 7) developing and selecting teaching materials. In selecting and developing teaching materials, one must adjust the results of the analysis and observations that have been made; 8) designing and evaluating formative, determining the evaluation instrument must measure the ability of students to achieve the learning objectives that have been formulated; 9) learning revisions, revisions to scientific-based electronic teaching materials drafts; 10) designing and developing a summative evaluation, the final evaluation of the Dick and Carey development model. Summative evaluation is carried out after the scientifically-based electronic teaching materials developed have been completed.

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The subjects in this trial were 30 students of class 5C of SDN Airlangga I/198 Surabaya as the experimental class and 30 students of class 5D of SDN Airlangga I/198 Surabaya as the control class. Data were collected using a questionnaire and test instrument. Questionnaire instrument to generate validation data by experts, student response data and teacher response data. Test instruments to measure student learning outcomes during the learning process using electronic teaching materials.

Data on the development of teaching materials is obtained from teaching materials that have been validated by experts/experts in teaching materials and materials experts. The results of the media assessment were concluded in a qualitative descriptive form using Likert's reference. Likert's reference table is as follows. ‘

Table 1. Material and Media Validation Rating Scale

Score	Criteria
1	Not good
2	not good
3	Pretty good
4	Well
5	Very good

(Sugiyono, 2012:141)

The data generated from the validation is in the form of a score. The score is then calculated using the following formula:

$$p\% = \frac{jumlah\ skor\ hasil\ pengumpulan\ data}{skor\ maksimal}\ x\ 100\%$$

(Riduwan, 2013:41)

The feasibility of digital non-fiction text-based learning media if, on average, the validation of media and materials gets ≥ 61% of the criteria table for the percentage of eligibility. The following is a table of eligibility percentage criteria.

Table 2. Validation Percentage Criteria

No.	Average Score	Category
1.	0% - 20%	Very less
2.	21% - 40%	Not enough
3.	41% - 70%	Enough
4.	71% - 80%	Good / Decent
5.	81% - 100%	Very Good / Very Decent

(Riduwan, 2013:41)

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Observational data obtained from observations of teacher and student activities during the implementation of online learning by using zoom. The results of observations in the form of scores using Likert's reference. Likert's reference table is as follows.

Table 3. Observation Rating Scale

Score	Criteria
1	Not good
2	Not good
3	Pretty good
4	Well
5	Very good

(Sugiyono, 2012:141)

The scores obtained from the observations are then processed using the following formula.

$$p\% = \frac{total\ score\ of\ data\ collection\ result}{\max score}\ x\ 100\%$$

(Riduwan, 2013:41)

The percentage of observations is used to determine the implementation of the learning process when using non-fiction digital-based learning media. After the percentage results are obtained then interpreted based on the following criteria table.

Table 4. Observation Percentage Criteria

No.	Average Score	Category
1.	0% - 20%	Very less
2.	21% - 40%	Not enough
3.	41% - 70%	Enough
4.	71% - 80%	Good / Decent
5.	81% - 100%	Very Good / Very Decent

(Riduwan, 2013:41)

The data from the questionnaire were obtained through a questionnaire from the responses of teachers and students to the developed electronic teaching materials. The measurement scale of the questionnaire data uses the Guttman scale reference. The Guttman scale is described in the following table

Table 5. Student Questionnaire Rating Scale

Answer	Score
Yes	1
Not	0

(Riduwan, 2013:44)

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The scores obtained from the results of the student and teacher questionnaire responses were then processed using the following formula

$$p\% = \frac{total\ score\ of\ data\ collection\ result}{\max score}\ x\ 100\%$$

(Riduwan, 2013:41)

The percentage of the questionnaire was used to determine the response of teachers and students to electronic teaching materials for scientific-based data processing materials. After the percentage results are obtained then interpreted based on the following criteria table.

Table 6. Student Questionnaire Percentage Criteria

No.	Average Score	Category
1.	0% - 20%	Very less
2.	21% - 40%	Not enough
3.	41% - 70%	Enough
4.	71% - 80%	Good / Decent
5.	81% - 100%	Very Good / Very Decent

(Riduwan, 2013:41)

Test result data analysis. Research on the development of electronic teaching materials for scientific-based data processing materials for fifth grade elementary school students is quantitative using a pretest – posttest control group design. Pretest – posttest control group design pattern. The design is described as follows.

Table 7. Pretest-Posttest Control Group Design Model Schematic

E	O1	X	O2
K	O3	-	O4

Information:

E = Experiment Class
K = Control Class
X = Treatment of electronic teaching materials
- = Student book treatment
O1 = Result *pretest* experimental class
O2 = Result *posttest* experimental class
O3 = Control class pretest results
O4 = Control class posttest results

(Sugiono, 2012: 111)

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Data analysis in this study used the independent t-test formula to determine the effectiveness of the scientifically-based data processing electronic teaching materials developed. Statistical analysis, including parametric statistical tests, must meet the prerequisite tests, namely normality tests and homogeneity tests. The error rate (significance level) used in this study was 0.05. This analysis prerequisite test aims to determine whether or not there are deviations from the existing variables. After the prerequisite test has been carried out, then the independent sample t-test t-test analysis is carried out using SPSS

RESULT

The development of scientific-based electronic teaching materials is equipped with a Learning Implementation Plan and developed question sheets. The indicator of the validity of scientific-based electronic teaching materials for grade 5 students is measured by 4 criteria for teaching materials consisting of material components, presentation, language, and graphics. The validator reviews the feasibility of scientific-based electronic teaching materials that have been made to be suitable for use by grade 5 elementary school students. This validation includes material validation, presentation, language, and graphics. The validator provides an assessment of each electronic teaching material instrument on a validation sheet that has been prepared with predetermined indicators. At the end of the assessment of each instrument, the validator provides a general assessment and conclusions on the instruments that have been made.

This research was carried out online (online) due to the Covid-19 emergency so that learning in schools is no longer done face-to-face. Face-to-face online learning is carried out with the help of the Google Meet platform. Face-to-face online learning is carried out based on students' obligations to Study from Home (SFH) in semester 2 starting in March 2020. Learning is carried out synchronously by utilizing the Google Meet application so that teachers and students can ask questions directly and asynchronously (indirectly). direct) in this case homework assignments such as project activities, observations, and evaluation questions using Google Forms. The digital comic media used in the study was sent by the researcher through a whatsapp group created with parents (guardians).

The format of the teaching materials developed consists of several parts, namely as follows: a) the initial part which consists of the front cover, instructions for the rubric of teaching materials; b) the middle section consists of learning materials, activity sheets; c) and the closing section consists of a bibliography.

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Table 8. Teaching Material Validation Results by Expert Validators

No	Aspect	Average Score (%)	Criteria
1	Material components	88.4%	Very worth it
2	Serving components	91.3%	Very worth it
3	Language component	87.5%	Very worth it
4	Graphic component	94.6%	Very worth it
5	RPP	90.2%	Very worth it
6	Question sheet	88.5%	Very worth it

Based on the data above, it can be seen that the overall feasibility aspect of electronic teaching materials for scientific-based data processing in mathematics learning gets a very decent percentage with criteria between 81%-100%. Thus, the entire instrument can be used to conduct research.

Furthermore, the results of the student response questionnaire to the developed teaching materials. The results of this questionnaire were filled out by 30 students in the experimental class. The following is a recapitulation of the results of the student response questionnaires stated as follows.

Table 9. Student Response Questionnaire Results

No	Question	Student Response		Percentage	
		Yes	Not	Yes	Not
1	Is the display of scientific-based teaching materials attractive?	30	0	100%	0%
2	Does this scientific-based electronic teaching material make you more enthusiastic in learning mathematics?	30	0	100%	0%
3	Can using scientific-based electronic teaching materials make learning Mathematics fun?	29	1	96.7%	3.3%
4	Does this scientific-based electronic teaching material support me to master Mathematics material about data processing?	29	1	96.7%	3.3%
5	Does this scientifically-based electronic teaching material contain interesting descriptions, pictures, audio, video and animation?	28	2	93.3%	6.7%
6	Does the future of images in scientific-based electronic teaching materials have an effect on understanding the lesson?	28	2	93.3%	6.7%
7	Are scientific-based electronic teaching materials easy to use?	28	2	93.3%	6.7%

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8	Is the material presented in scientific-based electronic teaching materials easy to understand?	30	0	100%	0%
9	Do these scientifically based electronic teaching materials encourage me to practice math?	30	0	100%	0%
10	Do you get new experiences by using scientific-based electronic teaching materials?	29	1	97%	3%
	Average Percentage			**97%**	**3%**

Based on the table above, students' responses to scientific-based electronic teaching materials were obtained with an average percentage of 97%. This means that the practicality of scientific-based electronic teaching materials in mathematics is very good or can be said to be very practical

The effectiveness of electronic teaching materials developed by researchers can be seen from the results of the tests given, namely the pretest and posttest. The design in this research and development uses a pretest-posttest control group design. In the experimental class, scientifically-based electronic teaching materials were given treatment, while in the control class, conventional learning was usually carried out by the teacher.

Data analysis used different independent t-test to answer the problem formulation and objectives in research on the effectiveness of scientifically based electronic teaching materials developed, where statistical analysis including parametric statistical tests must meet the prerequisite tests, namely normality test and homogeneity test. The error rate (significance level) used in this study was 0.05. The purpose of this analysis prerequisite test is to determine whether there are deviations from the existing variables. The prerequisite test used is as follows.

In order to know whether the data is normal or not, it can be seen from the magnitude of the p-value of the chi-square test for each variable to be studied. If the p value 0.05 then the data is normally distributed. On the other hand, if the p value < 0.05, the data is not normally distributed. The results of the normality test of several variables in this study can be seen from the following table.

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Table 10. Normality Test Results

Group	Variable	Significance (p)	Information
Control	Pretest learning outcomes	0.299	normal
	Posttest learning outcomes	0.180	normal
Experiment	Pretest learning outcomes	0.180	normal
	Posttest learning outcomes	0.392	normal

Based on the table above, it can be seen that the significance value for the pretest and posttest learning outcomes variables in the control and experimental groups is greater than 0.05, so the research data is declared to be normally distributed.

Homogeneity test can be done using Levene's test, by looking at the significance level of the calculated Levene value. If the Levene value shows a significance level of more than 0.05, it can be said that there is no difference in variance between the sample groups or in other words the variance between groups is the same. The results of the homogeneity test can be seen in the following table.

Table 11. Homogeneity Test Results

	Class	Significance	Information
Pretest	Control Experiment	0.387	Homogeneous
Posttest	Control Experiment	0.671	Homogeneous

Based on the table above, the homogeneity test in the pretest obtained a value of 0.387 which means greater than 0.05, while the posttest homogeneity test shows a value of 0.671 which means greater than 0.05. From the two data, it can be said that there is no difference in variance between sample groups or in other words the variance between groups of pre-test and post-test variables for learning outcomes is the same or homogeneous.

The requirements for parametric statistical tests consisting of normality tests and homogeneity tests have been met, so that the next stage of analysis can be carried out. Prerequisite analysis has been done, the next step is to analyze the data. The data analysis technique used an independent t test. Because the learning outcome variable meets the assumption of normality, an independent t test is used to test the research hypothesis which reads "There are differences in learning outcomes using scientific-based electronic teaching materials in learning mathematics about data processing for grade 5 elementary school students". The hypothesis is as follows.

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Ho = There is no difference in learning outcomes using scientific-based electronic teaching materials in learning mathematics about data processing for 5th grade elementary school students.
Ha = There are differences in learning outcomes using scientific-based electronic teaching materials in learning mathematics about data processing for 5th grade elementary school students.

Table 12. Hypothesis Testing Results

	t count	Sig. (p)	Information
Pretest	1,468	0.147	No difference
Posttest	3,665	0.001	There's a difference

Based on table 12 above, the calculation using a significance test on the pre-test value of this study obtained tcount of 1.468 with a significant of 0.147. So, it can be concluded that the significance value (p) > 0.05 then Ho is accepted so Ha is rejected. Thus, it can be concluded that there is no significant difference before using scientific-based electronic teaching materials in learning mathematics about data processing for grade 5 elementary school students. Meanwhile, based on table 4.26 the calculation using a significant test on the post test value in this study obtained a significance probability value (p) < 0.05, so the conclusion is Ho is rejected and Ha is accepted.

The results of the calculation show that the average post-test of learning outcomes in the control class is 84 (completed KKM), while the average post-test of learning outcomes in the experimental class is 90.8 (completed KKM). Based on the average value, it can be said that there are differences in learning outcomes between the control and experimental groups. This is reinforced by the results of the t test, namely the tcount = 3.665 with a significant level (p) of 0.001, meaning less than 0.05. So, it is proven that there are differences in learning outcomes using scientific-based electronic teaching materials in learning mathematics about data processing for 5th grade elementary school students. In other words, the application of scientific-based electronic teaching materials developed for grade 5 students is effective.

DISCUSSION

The development of scientific-based electronic teaching materials on data processing has gone through various considerations according to the 10 stages of Dick and Carrey, namely: identifying learning objectives, conducting learning analysis, analyzing student characteristics and learning contexts, formulating specific learning objectives, developing assessment instruments, developing teaching strategies, developing and selecting teaching materials, designing and developing formative evaluations, revising learning, and designing and developing summative evaluations.

At the stage of identifying learning objectives, researchers saw the objectives of learning mathematics in the 2013 curriculum, namely students can understand factual and conceptual knowledge by observing and asking questions based on curiosity about themselves, and students can present factual

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and conceptual knowledge systematically, logically, and critically. The results of the experience of teaching practitioners, obtained factual and conceptual understanding of students is still low, especially in the field of mathematics. Researchers raised data processing material with various considerations, namely students still had difficulty understanding the material and there were no similar studies that raised the material.

At the stage of conducting a learning analysis, the researcher identified the relevant learning stages in achieving the specified KD and analyzed the teaching materials used previously. Learning data processing begins with data collection, data presentation, and interpretation of data presentation. The teaching materials used previously were conventional teaching materials. The use of conventional teaching materials is not suitable for use during a pandemic because students must be able to learn independently while the student learning process is different.

At the stage of analyzing student characteristics and learning context, the researcher conducted an analysis of student abilities, learning styles, and student attitudes during learning activities. Based on the results of observations, it was found that students had high curiosity, students could visualize concrete objects, students could use computers or smart phones, students were enthusiastic about new teaching materials, and the average student learning style was audio-visual. The researcher also conducted a context analysis by looking at the current conditions and situations. The pandemic that hit this country has caused all learning to be carried out online, where students learn through electronic devices such as laptops or smart phones. Therefore, researchers convey data processing material in the form of electronic teaching materials.

Furthermore, the researchers developed specific learning objectives that could measure students' abilities and behavior after learning. Specific learning objectives are formulated based on KI and KD mathematics in the 2013 curriculum. The specific objectives produced are: 1) students can explain data related to themselves or the environment correctly; 2) students can collect data relating to themselves or their surroundings with full responsibility; 3) students can explain the presentation of data related to themselves in the form of lists, picture diagrams, line charts, or pie charts correctly; and 4) students can analyze the presentation of data related to themselves in the form of lists, picture diagrams, line charts, or pie charts with confidence.

The next stage is to develop an assessment instrument. The researcher developed a knowledge assessment instrument in the form of a test, as well as an attitude and skill assessment instrument in the form of an observation sheet. The assessment instrument made to measure students' ability to data processing material amounted to 10 questions. The instrument for measuring attitudes and skills uses an observation sheet filled out by the teacher.

Next is the stage of developing learning strategies. The process of developing learning strategies is related to the 2013 curriculum and the times. Learning strategies carried out during the pandemic

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through printed teaching materials lent by schools with necessary explanations using WhatsApp class groups. The use of this strategy turned out to cause problems for students, namely getting bored quickly, and not understanding the material in the book. In accordance with the 2013 curriculum, researchers used a scientific approach strategy to help students understand factual and conceptual knowledge and develop students' ability to present data. The scientific approach strategy is contained in the lesson plans. As for the implementation stage, in the preliminary activity, the teacher conducts an appreciative orientation, conveys the goals and benefits through the class group WhatsApp. Furthermore, students were distributed links to the developed electronic teaching materials. In the core activity, students access electronic teaching materials that are distributed by observing, asking questions if they do not understand through WhatsApp class groups, and collecting information. Communication activities are carried out through google meet with the meet link shared on the class group WhatsApp. After carrying out the series of stages, then the teacher and students carry out closing activities, by concluding the material, reflecting, assigning, moral messages, and ending the activity by saying greetings. Communication activities are carried out through google meet with the meet link shared on the class group WhatsApp. After carrying out the series of stages, then the teacher and students carry out closing activities, by concluding the material, doing reflections, assignments, moral messages, and ending the activity by saying greetings. Communication activities are carried out through google meet with the meet link shared on the class group WhatsApp. After carrying out the series of stages, then the teacher and students carry out closing activities, by concluding the material, doing reflections, assignments, moral messages, and ending the activity by saying greetings.

After the strategy was developed, the researcher developed and selected teaching materials. The product development process begins with designing teaching materials and designing electronic teaching materials. In the manufacturing process, researchers used flipbook software, articulate storylines, google forms, and QR code generators. The researcher uses the information repackaging model by using the flow of preparation of teaching materials according to Prastowo (2015) which consists of: 1) titles according to KI and KD as well as materials, instructional instructions; 2) supporting information that is written in detail and densely in the form of writing, images, audio, and video; 3) Tasks are written clearly; 5) assessment at the end of the lesson, and 6) sources of preparation of teaching materials. In addition to electronic teaching materials, researchers also developed learning tools in the form of syllabus, lesson plans, and questions.

The design of the preparation of teaching materials begins with making covers and compiling data processing materials through Microsoft Word, then designing LKPD through articulate storyline 2 software, making evaluation questions via google form, changing LKPD links and questions into a QR code generator, combining links and QR codes to in the material in Microsoft Word, and upload it into a professional flipbook. The front cover page contains the Unesa logo, types of teaching materials, book titles, class descriptions, descriptions of material content, subject information, and the name of the author. As for the cartoons used, the researchers used cartoons of students in elementary school uniforms because they were adapted to the context of the material and the subject. Introduction page,

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contains introductory text from the author. table of contents page, contains a list of teaching materials equipped with pages to make it easier for students to find pages. Instructions, contains text instructions for the use of teaching materials. KI and KD, adapted to the 2013 curriculum. The main material, contains text, videos, and illustrations to increase students' understanding. The subject matter is also equipped with LKPD, IT exploration, and learning summaries. The assessment page contains an evaluation link and a barcode for questioning. Bibliography page, containing book references and internet site addresses used. Author bio page, contains the identity of the author. The back cover page contains the title text of the teaching material, the focus of the lesson, class description, information on the content of the teaching material, and the Unesa logo. illustration images to increase students' understanding. The subject matter is also equipped with LKPD, IT exploration, and learning summaries. The assessment page contains an evaluation link and a barcode for questioning. Bibliography page, containing book references and internet site addresses used. Author bio page, contains the identity of the author. The back cover page, contains the title text of the teaching material, the focus of the lesson, class description, information on the content of the teaching material, and the Unesa logo. illustration images to increase students' understanding. The subject matter is also equipped with LKPD, IT exploration, and learning summaries. The assessment page contains an evaluation link and a barcode for questioning. Bibliography page, containing book references and internet site addresses used. Author bio page, contains the identity of the author. The back cover page, contains the title text of the teaching material, the focus of the lesson, class description, information on the content of the teaching material, and the Unesa logo.

The next stage is to design and develop formative evaluation. Teaching materials and learning tools that have been previously developed are then evaluated formatively by the validator. The format of the evaluated teaching materials includes the components of the material, presentation, language, and graphics. The learning tools that were evaluated included the syllabus, lesson plans and questions. After being evaluated formatively, the next step is to revise teaching materials and learning tools. Revision of teaching materials is carried out based on input and suggestions from the validator regarding the material, presentation, language, and graphics. As for learning tools, based on input and suggestions related to the syllabus, lesson plans and questions developed.

The final stage is to design and develop a summative evaluation. Summative evaluation is carried out after the scientifically-based electronic teaching materials developed have been evaluated and revised based on standards. The results of research on the procedure for developing Dick and Carrey teaching materials conducted by Luluk (2020) stated that the design of this development model was programmed with a series of structured activities. This development model can also be used to solve problems in learning activities. The selection of strategies and teaching materials developed is also arranged based on a systematic sequence, so that appropriate strategies and teaching materials are obtained to overcome learning problems.

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The feasibility of teaching materials is known from the validation results assessed by 2 validators. The validated teaching materials are e-book teaching materials. The validator looks at the feasibility of e-book teaching materials on the components of the material, presentation, language and graphics. The validator assesses each item of the eligibility criteria used to obtain conclusions on the feasibility of scientific-based electronic teaching materials. In addition to validating the e-book, the validator also validates the syllabus learning tools, lesson plans, and questions.

The learning tools developed can be said to be feasible if they meet certain criteria. Learning devices are declared valid in terms of content and construction which refers to the characteristics of the learning model (Nieveen, 1999).

Recapitulation of the assessment by the validator on the feasibility of e-book teaching materials on the components of material, presentation, language, and graphics. The material component obtained a percentage of 88.4% with a very decent category. The presentation component gets a percentage of 91.3% with a very decent category. The linguistic component obtained a percentage of 87.5% with a very decent category. The graphic component obtained a percentage of 94.6% with a very decent category.

Based on these results, it can be concluded that the development of scientific-based electronic teaching materials on data processing for grade 5 elementary school students is very feasible and in accordance with target characteristics so that it can be used in learning mathematics for grade 5 students.

The next validated learning tool is lesson plans. Before carrying out learning activities, a guide in the form of RPP is needed so that learning activities can be carried out properly. This is in accordance with the opinion of Ngalimun (2017:25) that RPP is a plan that describes the procedures and organization of learning to achieve certain basic competencies. The RPP developed is in accordance with the components of the Minister of Education and Culture Number 22 of 2016 which is oriented to a scientific approach.

Based on this description, it can be concluded that the learning tools in the form of syllabus, lesson plans, and questions have met the specified eligibility criteria, namely the learning tools are said to be valid if they have validity criteria > 70% (Akbar, 2014:41). The results of research on the validity of electronic teaching materials are in line with research conducted by Nurhaurunnisah (2017) which states that teaching materials are declared feasible if they meet most of the indicators in each aspect with certain validity criteria. Based on this description, it can be concluded that the learning tools developed in this study have met the validity aspects so that the devices are suitable for use in learning.

After conducting a feasibility assessment by two validators, the next step is to test the practicality of scientific-based electronic teaching materials. To test the practicality of teaching materials, it can be seen through student responses, teacher questionnaires, learning implementation observation sheets,

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and student activity observation sheets. The results of student responses in large group trials obtained an average score of 97% so that scientific-based electronic teaching materials in mathematics subjects can be said to be very practical.

The learning process using scientific-based electronic teaching materials is carried out online, which is divided into 3 activities, namely introduction, core, and closing. In the preliminary activity, the teacher conducts orientation by greeting and praying according to their respective beliefs and checking student attendance via WhatsApp, doing apperception, conveying learning objectives, and motivating students, as well as distributing e-book links via WhatsApp class groups. In the core activity, the teacher uses a scientific approach. These steps are observing, asking, collecting information, associating, and communicating (Hosnan, 2014:39). In the closing activity, the teacher invites students to conclude the material that has been studied, do reflections

Research on the practicality of teaching materials is in line with research conducted by Luluk (2020) which states that the practicality of teaching materials can be seen from the implementation of learning and student activities in the classroom. Learning tools are said to be practical if they get a percentage > 70%. Based on this description, it can be concluded that the learning tools developed in this study have met the practical aspects so that the devices can be used in learning.

In this study, there were two groups of data tested, namely the student data group without using scientific-based electronic teaching materials or called the control class and the student group being taught using scientific-based electronic teaching materials or called the experimental class. At the beginning of the study, both groups were given a pre-test to determine whether there was a difference between the experimental group and the control group (Sugiyono, 2012:110).

Based on the results of learning data processing material on 30 control class students, the pre-test had a class average score of 66.2 (not complete KKM). Meanwhile, after the post test, the average score was 84 (completed KKM). The average value of n-gain in the control class is 0.51 in the medium category (Sundayana, 2014:151). The learning outcomes of data processing materials for 30 experimental class students can be seen in table 4.22. Based on the table, the pre-test has an average value of 70.7 (not complete KKM). Meanwhile, after the post test has an average value of 90.8 (completed KKM). The average value of n-gain in the experimental class is 0.71 in the high category (Sundayana, 2014:151).

Determine the effectiveness of the developed electronic teaching materials, it is necessary to carry out statistical analysis that must meet the prerequisite tests, namely normality and homogeneity tests. This prerequisite test aims to determine whether there are deviations from the existing variables. The results of the normality test can be seen that the significance value for the pre-test and post-test learning outcomes variables in the control and experimental groups is greater than 0.05, so it can be stated that the research data is normally distributed. After the data is declared normal, the next step is to test the

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homogeneity. The homogeneity test results in the pre-test and post-test learning outcomes in the control and experimental groups are greater than 0.05, so it can be said that there is no difference in variance between groups or is homogeneous.

When the prerequisite test has been met, the next step is to analyze the data using the independent t test. The results of the SPSS output in the pre-test control class and experimental class in table 12 obtained a significance probability (p) > 0.05 then H0 is accepted and Ha is rejected, so it can be said that there is no significant difference before using electronic teaching materials.

After the experimental class was given treatment, the results of the SPSS output on the control and experimental class post-test can be seen in table 4.26. In the table, it is known that the probability of significance (p) < 0.05 then the conclusion Ho is rejected and Ha is accepted. It is proven that there are differences in learning outcomes between the control group (without using scientific-based electronic teaching materials) and the experimental class group using scientific-based electronic teaching materials.

The results of research on the effectiveness of electronic teaching materials are in line with research conducted by Firmansyah (2019) which states that there are differences in student learning outcomes who use mathematics e-books to improve understanding of elementary school students' mathematical concepts. Similar research on e-books was conducted by Gwo-Jen Hwang & Chiu-Lin Lai (2017) which states that the use of mathematics e-books can increase students' independence in learning and improve student achievement. In addition, Bruce Allen Knight, Maria Casey, and John Dekkers (2017) observed the phenomenon of students' mathematical experience when using e-books during mathematics lessons. The use of mathematics e-books has a positive impact on the process of gaining experience and knowledge in learning mathematics. Based on this description, it can be concluded that the learning tools developed in this study have met the aspects of validity, practicality, and effectiveness, so that the device is feasible to use in learning.

CONCLUSIONS

The results of the validation of electronic teaching materials for scientific-based data processing learning for grade 5 elementary school students were declared very suitable for use in learning. This is in accordance with the results of the validation assessment by 2 validators which reached 90.3%. This is also supported by the results of the validation of the syllabus which reached 91.7%, the lesson plans reached 90.2%, and the question instruments reached 88.5%.

The practicality of electronic teaching materials for scientific-based data processing learning for grade 5 elementary school students is measured by the response of large group students reaching 97% in the "very good" category, teacher questionnaires reaching 95% in the "very good" category, the implementation of learning with a score of 89, 7% in the "very implemented" category and student

activities with a score of 88.3% in the "very good" category. In other words, scientific-based electronic teaching materials have met the practical requirements.

The effectiveness of learning using electronic teaching materials for scientific-based learning can be seen from the results of the pre-test calculation, namely the tcount value of 1.468 with a significant 0.147. So, it can be concluded that the significance value (p) > 0.05 then there is no significant difference before learning to use scientific-based electronic teaching materials in learning mathematics about data processing for grade 5 elementary school students. While the results of the post test calculation show that in this study the tcount value of 3.665 was obtained with a significant of 0.001, meaning less than 0.05. This is reinforced by the descriptive results of the average value of the experimental group in the post test of 90.8 which is greater than the control group post test of 84.0. Based on these results, it can be said that there are differences in learning outcomes using scientific-based electronic teaching materials in learning mathematics about data processing for grade 5 elementary school students. In other words, the application of electronic teaching materials for scientific-based data processing learning developed is effective.

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