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DEVELOPMENT OF INTERACTIVE MULTIMEDIA FOR LEARNING COMPUTER HARDWARE MAINTENANCE VOCATIONAL HIGH SCHOOL

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Abstract. The aim of this reasearch was to develop interactive multimedia for learning computer hardware maintenance in Vocational High Schools. To achieve the objectives of this study, the Research and Development (R&D) method of the ADDIE development model was used. The ADDIE development model in research begins through the stages (1) Analyze, (2) Design, (3) Develop, (4) Implement, and (5) Evaluate. This research was conducted Vocational High School Negeri 6 Pontianak at class X with 27 students participating and three validators, design experts, material experts, and media experts. Data from the instrument and attitude scale were analyzed using qualitative and quantitative analysis. Relatively, from the results of data analysis (in the range of values 1-5) the multimedia design was declared "very valid" with an average of 4.34. Followed by analysis of empirical test data with individual test procedures, small groups, and field tests on 27 students of Vocational High School Negeri 6 Pontianak in class X, showing the attitude of students "very happy" using interactive multimedia with an average of 6.26 in the range 1-7. The multimedia effectiveness test with the criteria of students' attitudes towards multimedia and the pretest and posttest scores involving 30 students turned out to be a significant difference with $t_o \geq t_{tabel}$, namely $13,507 \geq 2,045$. Based on the results of research, interactive multimedia for learning computer hardware maintenance at Vocational High Schools can be applied to basic computer network subjects

Keywords: Development; Interactive Multimedia; Computer Hardware Maintenance

I. INTRODUCTION

Vocational High School is a level of vocational secondary education unit that prints graduates into skilled and trained workers according to the majors taken. Vocational education is secondary education that prepares students especially to work in certain fields. Multimedia majors require graduates who are competent in the field of computer technology, both hardware and software. Based on the Pre-Research interview, the problems obtained include Learning only using Power Point Presentations causing the learning atmosphere to only focus on presentations, and the absence of interactive multimedia in the learning process of computer hardware maintenance which is one of the materials in basic network computer subjects, and learning outcomes students who have not reached the Minimum Completeness Criteria, namely 70.

Innovation in education by teachers is very important to do. Therefore, it is very important for teachers to be able to develop interactive multimedia. According to Griffey (2020,

p. 121) Interactive multimedia is a visual medium with the aim of facilitating effective and enjoyable communication between users and devices. Meanwhile, according to According to Rob Philip (1997) explained: The term multimedia shows new developments in the field of computer programs. Multimedia has several components in the form of text, images, sound, animation, and video. Multimedia programs are usually interactive so they have a special attraction for students to use them (Sutirman 2013, p.18). The benefits and advantages of using interactive multimedia in learning include: more, innovative and interactive learning systems, able to combine text, images, audio, music, animated images or videos in one unit to achieve learning objectives, increase student motivation during the learning process, able to visualize material that has been difficult to explain only with conventional explanations or teaching aids, and to train students who are more independent in acquiring knowledge (Silaban & Tanjung, 2015; Munir, 2015). Furthermore, Munir (2015)

also provides reasons that make learning to be supported by interactive multimedia, namely the message conveyed by the material feels real, can stimulate various senses so that interaction occurs between the senses, visualization of material in multimedia components is easier for students to catch, the learning process is more practical. and controllable, and save time, cost and energy.

This multimedia developed contains computer hardware maintenance materials. Computer hardware maintenance is one of the materials from the 2013 curriculum basic computer network lessons taught in class X Vocational High School. Computer hardware maintenance has two types of maintenance, namely passive maintenance and active maintenance. Passive maintenance is more focused on environmental factors and non-computer objects that help computer performance, while active maintenance is the maintenance we do on the computer itself. learning between teachers and students where the teacher designs learning and students enjoy learning that has been designed by the teacher. Learning computer hardware maintenance is one of the basic competencies where students are able to analyze the types of computer hardware maintenance and know how to maintain computer hardware. This material is in accordance with (the characteristics of the multimedia developed, the learning time of the material is in accordance with the time of the study, the willingness of teachers majoring in multimedia to be involved as research participants, and the multimedia required for computer hardware maintenance materials has not yet been developed). available. The material selection procedure is carried out through (needs analysis with interviews and documentary studies on the 2013 curriculum, the feasibility of the material to be translated into multimedia. Thus it can be explained the relationship between the characteristics of multimedia, the benefits of multimedia, and learning materials).

Research on the development of interactive multimedia has been carried out by several researchers. The results of the research on the development of interactive multimedia based on the Ispring suite 8 Ariyanti (2020) found that the interactive multimedia developed was valid, practical, and effective. It is also strengthened by the findings of Suyitno (2016) that interactive multimedia can be used as a medium to improve material understanding, as well as the findings from Purwosiwi (2016) which show interactive multimedia is effective in motivating creativity and increasing learning outcomes significantly. Therefore, the use of interactive multimedia has the opportunity to increase student interest in learning, skills, and learning outcomes.

Previous research has shown that interactive multimedia only focuses on a combination of text, audio, and images. There are no videos, interactive questions that state students' participation in multimedia. When compared with previous research, this research has differences. This multimedia development offers five sub menus, namely menu, home, instructions, competence, video and practice questions. Which is where the exercise menu becomes the center of interaction, students can answer multiple choice practice questions and find out if students' answers are right or wrong

after completing the practice questions, the final score calculation display will appear from student answers. The results of the practice questions can be sent directly to the teacher or student via email.

Based on previous problems and research, this study aims to develop interactive multimedia for learning computer hardware maintenance in Vocational High Schools. This research is very important to do so that students can be excited, like, and improve learning outcomes in learning to care for computer hardware.

II. METHODS

Location, Time and Research Participants This research was conducted at Vocational High School Negeri 6 Pontianak, West Kalimantan. from May 3 to June 11. The participants of this study consisted of one teacher and a class X student of Vocational High School majoring in Multimedia.

Development Procedure In developing this interactive multimedia product using the ADDIE design model. According to Branch (2009) ADDIE has five stages which can be described in detail as follows:

Analysis Phase:

At this stage of analysis, researchers collect information that can help the process of developing interactive multimedia. This is important because to know the problems that occur in teachers and students in learning. at this stage of analysis, it must contain a library study which contains (Literature Review, Curriculum Study, Relevant Research). Followed by instructional analysis and student character analysis. The three stages of the analysis must contain the validation of the gap between the real and the ideal abilities, knowing the number of students in the study, knowing the location of the research subject, knowing the data on the distribution of students' abilities or research subjects, knowing the content of the material from the curriculum, knowing the technology that can be used, and knowing the facilities. owned by students and schools.

Design Phase:

at this stage is a lesson plan in the product and designing computer hardware maintenance materials. By setting goals to be achieved using interactive multimedia. The design of the initial interactive multimedia product begins with determining the initial concept of the storyboard and then it is designed into a visual prototype or commonly called a conceptual product. This initial product concept design is ready to enter the initial product development stage which will be validated by experts.

Development Phase:

Stages of development by realizing the initial product to become the final product in the form of interactive multimedia. The development stage starts from the initial product creation, expert validation and revision, as well as three trial stages accompanied by revisions to produce the final product. Some of the details of the steps carried out include:

Initial Product Development. At the development stage, what is done is to realize the interactive multimedia product design that has been designed in the previous stage so that at this stage it produces an initial product.

Expert Review. Expert validation is carried out to determine the feasibility of the interactive multimedia product concept that has been designed. Validation involves several professional and experienced experts in their fields to validate the materials, media, and product designs developed.

Revision and Initial Product. After expert validation, revisions are made from expert input. The results of the revision made the product as the initial product accompanied by instructions for using interactive multimedia. This is done to make the product quality better and suitable for use at the individual trial stage.

One-to-one Trial. Individual trials were conducted on 1 (one) student with average ability. This trial is to determine the initial reaction from the use of the initial product which has been revised from expert validation tests.

Revision of one-to-one Trial. After conducting individual trials, the initial product was revised. Product improvement is carried out by considering input from individual trial students.

Small Group Trial. Small group/class trials were conducted on 6 (six) students with high, average and low abilities. This trial is more complex in terms of the input given by students from the experience of using the initial product.

Revision of Small Group Trial. After conducting a small group trial, the initial product was revised again. Product improvement is carried out by considering input from small group trial students.

Field Try. Field trials/large classes were conducted on 20 students. This trial is more extensive and the input given by students from the experience of using the initial product is very important to produce the final product.

Revision of Field Try. After conducting a large group trial, the product was revised again. Product improvement is carried out by considering input from large group trial students to produce interactive multimedia final products.

The Final Product. The researcher made revisions and improvements from every input that existed during the trial, until the final product of interactive multimedia was obtained for learning computer hardware maintenance at Vocational High School.

Implementation Phase:

In implementation, preparing teachers and students is the main thing in using interactive multimedia products as follows:

Prepare The Teacher. Teachers are trained to be able to use interactive multimedia as teaching materials.

Prepare The Students. Students are trained to be able to use interactive multimedia as a learning resource.

Evaluation Phase:

The evaluation in this study focuses more on whether product development can have good effectiveness for

teachers and students in the learning process. To determine the effectiveness of interactive multimedia, students received initial attitude questionnaires (cognitive) and pretest questions before using interactive multimedia, continued to give treatment using interactive multimedia end products, then students were given final attitude questionnaires (affective-conative) and posttest questions after using multimedia (both before and after implementation). This stage is carried out on 30 students. The results of the attitude measurement data were calculated on the total average and attitude scale while the results of the pretest and posttest scores were carried out by a t-test to determine the difference before and after the use of interactive multimedia.

Data collecting techniques. This study uses three techniques in data collection, namely interviews, questionnaires, and written tests. The data collection tools are interview guides, questionnaire questions, and test questions.

Expert validation questionnaire. The researcher uses qualitative descriptive data to show the analysis of data from expert validation results in using website-based interactive multimedia. Presentation of data using tables and graphs. The criteria for the validity of designs, materials, and media are as follows:

Table 1. Likert Scale

No	Criteria	Score
1	Excellent	5
2	Good	4
3	Average	3
4	Poor	2
5	Very Poor	1

Here is the formula to calculate the average score;

$$\bar{X} = \frac{\sum X}{N} \tag{1}$$

Where;

\bar{X} = Average Score

$\sum X$ = Total Score

N = Total participants

To find the interval range between categories Widoyoko (2018) using the procedure in (Mering, 2020):

$$i = \frac{\text{highest score} - \text{lowest score}}{\text{total class}} \tag{2}$$

Where;

Highest Score = 5

Lowest Score = 1

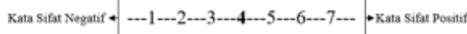
Total Class = 4 (criteria)

The interval range is $i = \frac{5-1}{4} = \frac{4}{4} = 1$, thus the categories obtained are: 1.0 – 2 = “Invalid”, 2.1 – 3.0 = “Less valid”, 3, 1 – 4.0 = “Valid”, and 4.1 – 5.0 = “Very Valid”. To make it easier to use the validity criteria, it can be seen in table 2 below.

Table 2 Multimedia validity criteria

No	Criteria	Score
1.	Very Valid	4,1 – 5,0
2.	Valid	3,1 – 4,0
3.	Less Valid	2,1 – 3,0
4.	Invalid	1,0 – 2,0

Differential semantics of attitude questionnaire. An attitude statement item towards multimedia is used to measure students' attitudes towards the use of interactive multimedia using. The measurement scale uses a semantic differential technique. Negative (unfavorable) adjectives are on the left and positive (favorable) adjectives are on the right (Azwar, 2016, p.172; Periantalo, Fadzlul, & Saputra, 2014). The following format is the differential semantic scaling of two opposite adjectives:



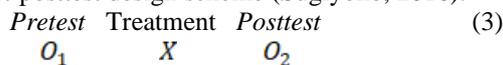
If a scale contains k items, then the individual scores will move between $(1 \times k = k)$ to $(7 \times k = 7k)$. The closer the score to 7k, the individual's score can be interpreted as more positive or more favorable. Conversely, the closer the score to k, the more negative or unfavorable the attitude is. If the individual score is around 4k, then the intensity is low and indicates that the respondent is neutral (Azwar, 2016, p.174).

To assist in the scaling, intervals between categories of Widoyoko (2018) can also be made using the procedure (in Mering, 2020) from the attitude norms obtained from the respondents. This is the formula to get the interval distance is $i = \frac{7-1}{4} = \frac{6}{4} = 1,5$, thus the categories are obtained: 1.0 – 2.5 = “Unhappy”, 2.6 – 4.0 = “Less Happy”, 4.1 – 5.5 = “Happy”, and 5.6 – 7.0 = “Very Happy”. To make it easier to use the validity criteria, it can be seen in table 3 below;

Table 3 Student Attitude Norms

No	Kriteria Penilaian	Skor
1.	Very Happy	5,6 – 7,0
2.	Happy	4,1 – 5,5
3.	Less Happy	2,6 – 4,0
4.	Unhappy	1,0 – 2,5

One group pretest – posttest design. One group design before and after the use of interactive multimedia to find out how much influence the use of interactive multimedia has. The pretest was conducted before the students received the multimedia treatment. After the students were given the treatment of interactive multimedia learning based on the website, a posttest was carried out. The following is a one group pretest-posttest design scheme (Sugiyono, 2016):



Where:

X = Treatment

O₁ = Pretest conducted before treatment

O₂ = Posttest conducted after treatment

T-test. The t-test was conducted to test the differences in the average of the two samples obtained from the learning

outcomes before being given treatment and learning outcomes after being given treatment. The t-test conducted for the sample correlated with a small study subject ($n \geq 30$) so that the data were single or not grouped. Here are the steps in using t-test; (1) T-test was conducted on a sample of 30 participants; (2) Microsoft Excel is used to calculate the data; (3) The error rate used is 5% (0.05) or 95% confidence level (0.95); (4) Provide conclusions on the results of the t-test. From the results of the comparison of learning outcomes before being given treatment (pretest) and learning outcomes after being given treatment (posttest), it is concluded whether interactive multimedia for learning computer hardware maintenance in Vocational High School has an influence on the learning process.

Hypothesis;

$$H_0: \mu_1 = \mu_2$$

$$H_a: \mu_1 \neq \mu_2$$

With the provision that if $t_o \geq t_{table}$ then H_0 is rejected, it means that there are differences in student learning outcomes before and after using interactive multimedia, and vice versa if $t_o < t_{table}$ then H_0 is accepted. For the t_0 test, it can be calculated using the following formulation (Mering, 2020, p.90):

$$t_o = \frac{M_D}{SE_{M_D}}$$

The above formulation can be assisted by the following formulation:

$$M_D = \bar{x}_1 - \bar{x}_2$$

$$SE_{M_D} = \frac{SD_D}{\sqrt{N-1}}$$

$$SD_D = \sqrt{\frac{\sum D^2}{N} - \left(\frac{\sum D}{N}\right)^2}$$

Where;

t_o = observation t value

N = total data

D = score difference $x_1 - x_2$

\bar{x}_1 = mean initial attitude score before multimedia is used

\bar{x}_2 = mean final attitude score after multimedia is used

M_D = mean D

SE_{M_D} = error of measurement standard

SD_D = deviation standard D (score difference $x_1 - x_2$)

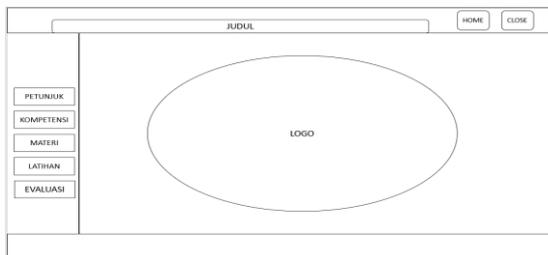
III. RESULT AND DISCUSSION

Result

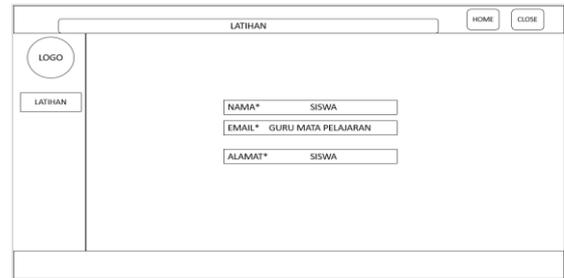
Analysis Phase. The findings show that computer hardware maintenance material is one of the learning materials that do not have learning media which causes students to feel bored in participating in learning and results in the learning outcomes of some students not reaching the minimum completeness criteria score of 70. Based on this study there are several students who have positive attitudes towards learning to take care of computer hardware get

learning outcomes that reach the minimum completeness criteria and some students who have a negative attitude towards learning to care for computer hardware get learning outcomes that have not reached the minimum completeness criteria. The development of interactive multimedia was developed referring to the 2013 Curriculum with the material in the multimedia department in class X even semester is maintaining computer hardware. The results of the field findings show that the age of class X students is 14-15 years where students are in the operational stage of the format, tend to have a fairly high curiosity towards the use of interactive multimedia where students will think abstractly and logically by using possible thinking patterns by using multimedia. interactive can improve learning outcomes. Class X state Vocational High School students are currently taking online/online learning processes using gadgets and laptops 82% (49 students) and offline/offline 18% (11 students) of the total X class students majoring in multimedia 60 students The learning methods used by teacher lectures, questions and answers, and discussions. The current use of learning media is google classroom, google meet, and google form. Vocational High School Negeri 6 Pontianak has a computer labtop/PC facility and adequate internet network to support the distance learning process. Students who do not have facilities/access to study can use existing facilities at the school on condition that they comply with the Health protocol.

Design Phase. Activities at this stage are learning plans in products and designing computer hardware maintenance materials. By setting goals to be achieved using interactive multimedia. At the stage of designing teaching materials for computer hardware maintenance materials, there are several stages, namely choosing instructional materials and caring for computer hardware which is one of the materials in the multimedia department in class X even semesters, the instructional strategy used is Blended Learning. The media used in the learning process is internet media, namely web pages <https://multimedaiinteraktif.haiterigas.com/>, The time allocation in the learning process is 2 meetings, with each meeting 2 x 45 minutes, and the criteria for the test items used are multiple choice questions with a total of 20 questions that are adjusted to the learning objectives. Initial product concept design stage by making a storyboard landscape interactive multimedia. The general and specific views are as follows:



Picture 1 Display Storyboard section Home Menu

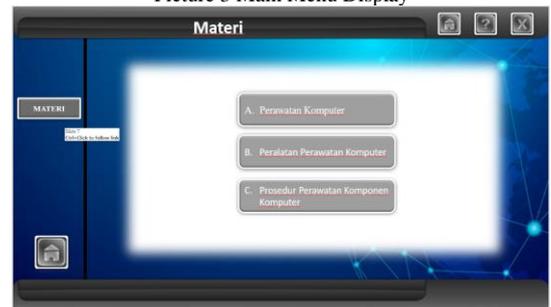


Picture 2 Storyboard display section Training menu (Interactive Layout)

Development Phase. At this stage, product development starts from the initial product, instrument validation will be validated by three experts, product validation will be validated by three experts, each expert will validate the three aspects, namely design, material and media then revised and the trial phase is then carried out. revised again so that it becomes the final product. Some of the details of the results of the development stage carried out include (product display):



Picture 3 Main Menu Display



Picture 4 Material Menu Display



Picture 5 Exercise Menu Display

Expert Review. At this stage, interactive multimedia is validated by 3 (three) experts who have expertise in all three aspects of material, media, and learning design. Validation of this product is carried out from May 3, 2021 - May 7, 2021 with the following data results:

Table 4 Learning Design Expert Validation Results

No	Aspek	No	Indikator	A _i
A	Eligibility Characteristics	1.	The suitability of learning theory in interactive multimedia	4.33
		2.	Learning objectives	5.00
		3.	Interactive multimedia has an impact on increasing interest in learning in class	4.66
		4.	Interactive system	4.33
		5.	Specific ways of learning	4.33
B	Feasibility of learning activity design	6.	Preliminary activity plan	4.00
		7.	Core activity plan	4.33
		8.	Closing activity plan	4.66
C	Eligibility Stages of multimedia learning	9.	Interactive multimedia systematics	4.33
		10.	Continuity of material and examples provided	5.00
		11.	Continuity of early learning activities	5.00
		12.	Continuity of end of learning activities	4.66
D	Feasibility Assumed implementation of the design	13.	Ease of application of the concept	4.00
		14.	Interactive multimedia efficiency	4.66
		15.	Improve students' thinking skills	4.33
E	Eligibility Assessment strategy	16.	Assessment aspect relationship	4.00
		17.	Assessment of theoretical material coverage	4.33
Design Validation Average				4.42

Where:

A_i = Average expert validation score

Based on the data from the validation results of learning design experts, it shows that interactive multimedia on computer hardware maintenance materials at the Vocational High School level is very valid. The suggestions for improving the validation of the learning design by experts were revised according to the instructions given.

Table 5 Material Expert Validation Results

No	Aspek	No	Indikator	A _i
A	Content Eligibility	1.	The suitability of the material with the Basic Competencies	4.55
		2.	Material accuracy	4.11

B	Serving Eligibility	3.	Encourage curiosity	4.16
		4.	Presentation technique	4.33
		5.	Serving support	4.50
C	Contextual Eligibility	6.	Learning Presentation	4.33
		7.	Contextual nature	4.33
		8.	Contextual component	3.55
Material Validation Average				4,17

Where:

A_i = Average expert validation score

Based on the data from the material expert validation, it shows that the computer hardware maintenance material in multimedia is very valid. The suggestions for improvement of material validation by experts are revised according to the instructions given

Table 6 Media Expert Validation Results

No.	Attitude Object Component	Average Total Attitude Score			Total
		Cognitive	Affective	conative	
1.	Multimedia function	13,0	24,0	19,0	56,0
2.	Ease of use of multimedia	27,0	26,0	19,0	70,0
3.	Multimedia content	27,0	45,0	49,0	121,0
4.	Multimedia appearance	25,0	20,0	20,0	65,0
	Total	92,0	115,0	107	314,0
Rata-rata Skor					6,4

Where:

A_i = Average expert validation score

The attitude of students at the individual trial stage was "very happy" towards the use of interactive multimedia for learning computer hardware maintenance for Vocational High Schools. From the results of individual trials conducted on one student, no suggestions and improvements were found, this product is feasible to be tested in the small group trial stage.

Initial Product Trial

The Result of Individual Trial (one to one trial) and Revision. After being validated by experts, interactive multimedia will continue to the trial phase. The trial phase carried out was the individual trial phase which was carried out on May 20-21. The individual trial phase was carried out on one student with average ability. The purpose of this individual trial was to determine the initial attitude of using the product which had been revised by expert validation. The results of the individual trial stage are as follows:

Table 7 The Result of one-to-one trial

No.	Attitude Object Component	Average Total Attitude Score			Total	No.	Attitude Object	Average Total Attitude Score			Total
		Cognitive	Affective	conative				Cognitive	Affective	conative	
1.	Multimedia function	13,0	24,0	19,0	56,0	3.	Multimedia content	23.3	43.5	49.0	49.0
2.	Ease of use of multimedia	27,0	26,0	19,0	70,0	4.	Multimedia appearance	24.3	18.1	24.9	24.9
3.	Multimedia content	27,0	45,0	49,0	121,0	Total		82,9	108.3	103.2	294.4
4.	Multimedia appearance	25,0	20,0	20,0	65,0		Rata-rata Skor				6.0
Total		92.0	115,0	107	314,0						
		Rata-rata Skor			6,4						

The attitude of students at the individual trial stage was "very happy" towards the use of interactive multimedia for learning computer hardware maintenance for Vocational High Schools. From the results of individual trials conducted on one student, no suggestions and improvements were found, this product is feasible to be tested in the small group trial stage.

Table 8 The Result of Small Group Trial

No.	Attitude Object Component	Average Total Attitude Score			Total
		Cognitive	Affective	conative	
1.	Multimedia function	12.2	25.7	19.2	57.1
2.	Ease of use of multimedia	25.3	25.7	19.3	70,3
3.	Multimedia content	25.3	45.8	52.2	123.3
4.	Multimedia appearance	25.5	20.0	19.5	65,0
Total		88.3	117.2	110.2	315,7
		Rata-rata Skor			6,4

The attitude of students at the small group trial stage was very happy with the use of interactive multimedia for learning computer hardware maintenance for Vocational High Schools. From the results of individual trials conducted on one student, no suggestions and improvements were found, this product is feasible to be tested in the large group trial stage.

Table 9 The Result of Field Try

No.	Attitude Object Component	Average Total Attitude Score			Total
		Cognitive	Affective	conative	
1.	Multimedia function	11.3	22.6	17.1	17.1
2.	Ease of use of multimedia	24.0	24.1	18.6	18.6

Based on the data from the large group trial, it showed that the attitude of the students at the small group trial stage was very happy with the use of interactive multimedia for learning computer hardware maintenance for Vocational High Schools. The suggestions for improvement from individual trials were revised according to the input given as the final product. The profile of the final product of interactive multimedia for learning to care for computer hardware for vocational high schools is as follows:



Picture 6 The initial display of the media contains the enter button to start the learning media



Picture 7 Display on the home menu that provides sub menus namely the Instructions Menu, Competence Menu, Material Menu, Video Menu and, Exercise Menu



Picture 8 The display on the menu contains a learning video that can be displayed directly on the learning media without opening a web browser



Picture 9 Display on the Training Menu which has 3 columns that must be filled with Name, Email (teacher email) and, Address.

Implementation Phase. At this stage, the final product that has gone through expert validation, individual trials, small group trials, and field trials/large classes can be applied to teachers and students by making preparations for using interactive multimedia products. Here's the preparation for teachers and students: (1) *Prepare the teacher.* Teachers attend training so that they can use interactive multimedia learning as teaching materials. The results of the teacher training implementation plan are designed with four components, namely identification, tools and materials, time allocation (training schedule, duration: 1 hour), and training implementation. (2) *Prepare the student.* Students participate in exercises for the use of interactive multimedia products as well as the implementation of computer hardware maintenance learning materials. The preparation of students in the form of two lesson plans (RPP) with a duration of 4 x 45 minutes for each meeting.

Evaluation Phase. At the evaluation stage, each stage of analysis, design, development, and implementation of the ADDIE model always has a simultaneous evaluation stage. The results of the evaluation carried out at each stage will improve the quality of development to the next stage. Thus, the final evaluation results in this study focus more on the effectiveness results after using this product. The results of the effectiveness can be seen in detail in the results of the effectiveness test.

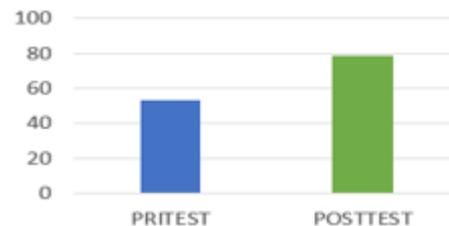
Multimedia Effectiveness Student attitude measurement results In this study, 30 students of class X Vocational High School Negeri 6 Pontianak used a differential semantic scale to see the attitudes of students before and after the use of interactive multimedia which was held on 10-11 June 2021, following are the results of measuring student attitudes using a differential semantic scale:

Table 10 The Result of Student Attitudes

No.	Average Total Attitude Score	Total			Total Score
		Cognitive	Affective	Conative	
1.	Multimedia function	25.1	25.5	18.8	56.2
2.	Ease of use of multimedia	25.0	25.2	18.9	69.0
3.	Multimedia content	45.0	45.6	51.5	122.4
4.	Multimedia function	18.9	19.1	19.1	63.5
Total		87.4	115.4	108.3	311.1
		Rata-rata Skor			6.3

Based on the attitude data of students at the effectiveness test stage, they were very happy with the use of interactive multimedia for learning computer hardware maintenance for Vocational High Schools.

The results of measuring student learning outcomes. Student learning outcomes in this study were only measured from student knowledge, student learning outcomes were seen from two stages, namely pretests and posttests. At the pretest stage, it was carried out by giving 20 multiple choice questions to 30 class X students of Vocational High School Negeri 6 Pontianak using the google form link which was distributed using whatsapp. Students are given 45 minutes to do it. Furthermore, at the posttest stage students are given the same 45 minutes, here are the student learning outcomes at the pretest and posttest stages that have been carried out:



Picture 10 pretest and posttest result

To find out how big the difference in student learning outcomes after the pretest and posttest, the next step is to perform a t-test analysis. The calculation of the t-test is as follows:

t-Test: Paired Two Sample for Means

	Variable 1	Variable 2
Mean	53.43889	78.62222
Variance	210.5258	68.78723
Observations	30	30
Pearson Correlation	0.727232	
Hypothesized Mean Difference	0	
df	29	
t Stat	-13.5072	

With *df* 29 (degrees of freedom = N – 1 or 30 – 1 = 29) and the error rate used is 5% (0.05) or 95% confidence level (0.95), it is obtained $t_{table} = 2.045$. It is known that $t_0 = -13.507$

or 13.507 and $t_{table}=2.045$, then $t_o > t_{table}$. With the provision that if $t_o \geq t_{table}$ then H_0 rejected means that there are significant differences in student learning outcomes before and after the use of interactive multimedia for learning computer hardware maintenance.

Discussion

At the analysis stage, the study of the curriculum found that the curriculum used was the curriculum used at the Pontianak 6 State Vocational High School, the 2013 curriculum. Computer hardware maintenance is one of the materials taught in class X Multimedia major in even semesters. The minimum completeness criteria (minimum completeness criteria) uses the class minimum completeness criteria where all subjects in class X Vocational High School have the same minimum completeness criteria, which is 70.

In a relevant research study, it was found that the results of the research on the development of interactive multimedia by Dwi Ariyanti (2020), the results showed that the learning media had met the criteria, students achieved completeness scores. Furthermore, the findings from Suyitno (2016), research results show that this multimedia product can be used as a medium to improve understanding of technical measurement material. Furthermore, the findings from Purwosiwi Pandansari (2016) showed that there was an increase in learning outcomes before and after the use of interactive multimedia. Furthermore, research from Oktavia Hardiyantari (2017) the results of the study show that the interactive multimedia products developed are suitable for use as learning aids. Furthermore, research from Dian Puspita Eka Putri (2018) research results show interactive multimedia products are very feasible to use.

The design stage consists of the planning and product design stages and the initial product design in the form of a storyboard. A good storyboard is a form of images that are prepared with a clear explanation (Rusman, 2018). After designing the storyboard, the initial product development is carried out by realizing interactive multimedia products. The product is designed with power point 2019 and ispring 9. Next, buy hosting and a domain with a link address name <http://multimediainteraktif.haiterigas.com/> After the product has been designed, teaching materials for computer hardware maintenance are published in the whatshap group. After the initial product development is carried out, the next stage of development is product validation by experts. The purpose of this product validation is to determine the feasibility of the initial product on the material, media, and design aspects before being tested in the field.

The process of implementing the use of interactive multimedia was carried out on 10 and 11 June 2021 for two meetings. At the first meeting, students were given a cognitive attitude questionnaire link on the google form after explaining the product to students to see students' attitudes before using interactive multimedia. After that, students were given a pretest which was done on google form to see the initial ability of students before using interactive multimedia. carried out according to the Learning Implementation Plan (RPP) 1 which had been prepared

previously. After that, for the second meeting, the learning process was also carried out according to the Learning Implementation Plan (RPP) 2. At the end of the activity, the researcher gave a posttest which was done on google form to determine students' abilities after using interactive multimedia. Then, students were asked to fill in the affective-conative attitude questionnaire link on the google form that had been prepared to determine student attitudes after using the product. Changes in student attitudes can be seen from the acquisition of the total student attitude score is 311.1 from a total score of 343 with 49 items. This means that a total score of 311.1 has an average score of 6.3, so that students' attitudes are very happy with the use of interactive multimedia for learning to care for computer hardware in Vocational High Schools. This change in learning attitude is inseparable from the use of interactive multimedia used by students which provides a learning experience for students. Students feel happy and motivated in learning (Khalid, Alias, Razally, Yamin, & Herawan, 2010).

Obtaining these learning outcomes can be seen by looking at the cognitive aspects of the learning process. Success in improving student learning outcomes using interactive multimedia is indicated by an increase in students' understanding of the learning process using interactive multimedia. This can be seen from the comparison of the results of the pretest and posttest carried out by students. Based on the results obtained, it is known that the average pretest score is 53.1 posttest is 78.6 with minimum completeness criteria is 70 which is determined by the school. Thus, the pretest score data shows that 22 students have not reached the minimum completeness criteria and 8 students have reached the minimum completeness criteria. Meanwhile, the posttest data shows that 3 students have not reached the minimum completeness criteria and 27 students have reached the minimum completeness criteria. From the pretest and posttest data, it can be said that there was a significant increase. With df 29 (degrees of freedom = $N - 1$ or $30 - 1 = 29$) and the error rate used is 5% (0.05) or 95% confidence level (0.95), it is obtained $t_{table} = 2.045$. It is known that $t_o = -13.507$ or 13.507 and $t_{table} = 2.045$, then $t_o > t_{table}$. With the provision that if $t_o \geq t_{table}$ then H_0 rejected means that there are significant differences in student learning outcomes before and after the use of interactive multimedia for learning computer hardware maintenance.

The results of measuring the attitudes of students who are very happy with the use of interactive multimedia and there is a very significant difference between the results of the pretest and posttest students, then interactive multimedia website-based for learning to care for computer hardware in Vocational High Schools is categorized as very effective. This can also be seen from the results of Caesariani's research (2018), showing that the benefits of interactive multimedia include: students can learn independently and have fun, students' attitudes are enthusiastic and enthusiastic, and improve student learning outcomes. It was also emphasized from the results of Parata & Zawawi's research (2018), that interactive multimedia can increase students' motivation and cognitive learning outcomes. That is,

interactive multimedia learning is an effective tool to improve student learning outcomes or achievement (Rajendra & Sudana, 2018; Batubara, 2015; Ayda & Widjajanti, 2014).

IV. CONCLUSION

The results of the research that has been done can be concluded as follows:

The effectiveness of the use of the final product was carried out to see how much the students were happy and there was a significant difference before and after the use of interactive multimedia. The scale for measuring student attitudes uses a semantic differential technique (semantic differential technique). The average score for students' attitudes is 6.3 from the range 1-7, so that students' attitudes are categorized as very happy with the use of interactive multimedia. The acquisition of pretest and posttest scores from the use of students' multimedia was tested through the t-test obtained $t_{obt} > t_{table}$, which is $13,507 > 2,045$. The results of the t-test showed a significant difference in student scores before and after the use of interactive multimedia. The results of the effectiveness test of the use of interactive multimedia carried out through testing the attitudes and values of student learning outcomes can be categorized as very effective.

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