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Development of interactive video as learning media on fiber optic for class XI students of computer network engineering

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ABSTRACT

This study aims to develop an interactive video on fiber optic material for students of class XI computer network engineering that is valid and practical. The subject of this research is class XI majoring in computer and network engineering at SMKN 4 Bandar Lampung. The method used in this research is R&D using the Branch development model which includes the ADDIE steps, namely the first; analysis (preparation and analysis of needs), second; design (designing the product to be developed), third; fourth development (Test material experts and media experts); product implementation (planning, preparation, testing educators' perceptions and student readability), fifth; evaluation. This development research produces products that meet the valid and practical categories.

KEYWORDS

Interactive videos;
Instructional media; Fiber
optic

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Introduction

Education is one of the most important aspects in a country because education has a very big role in improving the quality of human resources. Education makes human resources more ready to face change. In the 1945 Constitution, the issue of education has been implicitly stated in the preamble, that one of the goals of the state is to educate the nation's life. Efforts to educate the nation's life and improve the quality of Indonesian people in realizing an advanced, just and prosperous society and enable its citizens to develop themselves both in terms of physical and spiritual aspects.

Given the importance of education for a country, the government will always strive for education in Indonesia to continue. In connection with the development of the spread of Corona Virus Disease (COVID-19), the government through the Ministry of Education and Culture (Kemendikbud) issued a circular numbered 36962/MPK.A/HK/2020 and SE Mendikbud 47/2020 regarding online learning and working from home in order to prevention of the spread of Covid-19 which applies to all levels of education, from basic education to higher education. Online learning is a learning system through online that uses the internet network without face to face directly between educators and students.

Changes in learning patterns in online learning regarding the interaction of material delivery require educators to be more creative in developing learning media. According to (Hamalik, 2015) learning media are tools, methods, and techniques that are useful as the effectiveness of communication and interaction between educators and students in the teaching and learning process.

Based on the author's observations at SMKN 4 Bandar Lampung, online learning usually uses conventional learning media such as textbooks, modules and power points. There are so

many theories that are listed in books and modules but there are many students who are not interested, don't even read books and modules because they are considered less interesting. This is because books and modules only use one of the five senses, namely the eye. (Purba & Kwarrie, 2017) in their research said that images and text alone were not sufficient in delivering material. This is shown based on the results of interviews with educators of broad-based network technology subjects for class XI TKJ SMKN 4 Bandar Lampung that the average daily test score of students is still below the KKM. New teaching methods and media need to be developed to add to the traditional teaching paradigm. Learning media serves as a communication tool used to channel messages and can stimulate students' thoughts, feelings, and abilities so that they can encourage an effective and efficient learning process (Amir & Sari, 2018) In online learning, students and educators need interactive communication with utilizing information and communication technology. The use of technology can combine all media elements such as text, video, animation, images, graphics, and sound into one presentation, so that all these elements can be combined with the learning modalities of students. This combination can accommodate students' visual, auditory and kinesthetic learning styles (Amir & Sari, 2018).

Based on the results of research by Augman Baugh, Edgar Dale and Geofery Wilson in 1976 in (Haling & Pattaufi, 2017) regarding the learning experience through the use of sensory devices for learning, namely Augman Baugh, put forward a theory which states that all learning experiences that a person has are divided into 90 percent obtained through the sense of sight, 5 percent obtained through the sense of hearing, and 5 percent through the other senses. Edgar Dale argues that the human learning experience as much as 75 percent is obtained through the sense of sight, 13 percent through the sense of hearing, and 12 percent through the other senses. Meanwhile, according to Geofery Wilson that the comparative figures from the results of his research are almost the same as the figures put forward by previous experts who stated that approximately 82 percent of a person's knowledge enters through the senses of sight, 12 percent through the senses of hearing, and 6 percent through the other senses. One of the learning media that uses visual media is interactive learning video. Interactive digital video gives students control of computer visualization techniques and enables them to collect, analyze, and model two-dimensional motion data. Activities using this technique were developed for students to investigate the concept of frames of reference in various real-life situations (Escalada & Zollman, 1997)

Research on the development of interactive videos in learning has been carried out by many researchers. Such as research on the development of interactive videos for chemical engineering learning (Cresswell et al., 2019), the development of interactive videos as learning objects in Web Design courses (Kemal et al., 2020) and the development of interactive videos on mathematics learning (Suseno et al., 2020).

Based on the explanation above, learning innovation in vocational schools is needed at this time. In addition, various types of learning using video have been carried out but the use of learning media in the form of interactive videos is still rarely done. Therefore, this study aims to develop a valid learning media in the form of interactive videos in vocational high schools. This research is expected to be used as a reference for researchers and educators to innovate the learning media used, especially in vocational schools.

Methods

The method used in this development research is Research and Development (R&D) where the development research aims to produce a certain products and test the feasibility of these products according to (Sugiyono, 2013). The development model used refers to the ADDIE development model which was adapted from (Branch, 2009). This development model has five stages, namely (1) analysis, (2) design, (3) development, (4) implementation, (5) evaluation.

Results And Discussion

Analysis

The analysis phase is carried out by collecting important information related to the problems that occur in Broad-Based Network Technology learning. Data collection activities were carried out using a Google form aimed at educators and students of SMK 4 Bandar

1. Based on the results of the preliminary study that the researcher did, an outline could be drawn in the analysis phase. The first is the analysis of the curriculum, SMK Negeri 4 Bandar Lampung uses the 2013 curriculum. The second is the analysis of the students, based on the observations that the author has made that students do not understand fiber optic material. This is because students are bored with the applied learning system, the learning media used by educators are less attractive, and educators still use the lecture method in delivering learning material. So that students have not played an active role in the learning process. Based on the author's observations, the use of gadgets in class XI students of SMK Negeri 4 Bandar Lampung, Department of Computer Network Technology is very adequate. All students already have smartphones or laptops that can support learning. This information became the author's basis in developing interactive video learning media on fiber optic material. The third is material analysis, based on the syllabus in Basic Competencies 3.4 and 3.5, it is known that the main material that must be achieved by students in fiber optic material is fiber optics, fiber optic working principles, fiber optic point to point technology, point to multipoint technology, cable characteristics fiber optic, Cable capacity, color coding and labeling of fiber optic cable, Characteristics of multimode cable types, Characteristics of singlemode cable types, Duct Cable construction types, Direct Buried Cable construction types, Aerial Cable construction types, Indoor Cable construction types, Fiber optic connector types. The fourth is to formulate learning objectives, based on the identification of the curriculum analysis that has been carried out, it can be determined the objectives of the learning to be carried out. The learning objectives are that students are expected to be able to 1) explain the basics of fiber optics, (2) explain the working principles of fiber optics, (3) explain fiber optic technology, (4) explain the types of fiber optic cables. (5) Explain the characteristics of fiber optic cables (6) Explain the construction of fiber optic cables, (7) Explain the types of fiber optic connectors.

Design

At the Design stage, the researcher makes an initial product or product design that will be developed.

A. Pre Production

1. Program

2. identification Program identification is a number of analysis activities carried out on video production activities which include identification of needs, materials, situations, pouring out ideas, etc. Program identification can be seen in table 1.

Table 1 Programs

Basic Competency	Subjects of Discussion	Sub-Point of Discussion	Forms of Presentation
Understanding Fiber Optic Networks	Explaining the basics of <i>fiber optics</i>	Collecting data on <i>fiber optics</i>	Discussions
	Explaining the working principles of <i>fiber optics</i>	Observing to identify and formulate problems regarding the principlework <i>fiber optic</i>	Discussion
	Explaining <i>fiber optic</i>	Processing data about <i>fiber optic point to point fiber optic/ metro-e technology Point to multipoint</i>	Discussion
Understanding the types of <i>fiber optic</i>	Explaining the types of <i>fiber optic</i>	Collecting data on the types of multimode and singlemode <i>fiber optic</i>	Discussion

2. Synopsis

Synopsis is used to provide a brief, concise, and clear description of the theme of the material to be produced. The goal is to make it easier to capture messages and concepts in videos. Synopsis can be seen in table 2 below.

Table 2 Synopsis

NO	SYNOPSIS	
	VISUAL	AUDIO
1	Introduction to	<i>Backsound</i>
	Opening Video	Narrative Conversation
	Title Video	<i>Backsound</i>
	Basics <i>Fiber Optic</i>	Basics <i>Fiber Optic</i>
	Introduction <i>Fiber</i>	Narration Explains Introduction
	to How <i>Fiber Optic</i>	Narration Explains How <i>FiberCable</i>
	Difference Between <i>Fiber Optic</i> and Copper Cable	Narration Explains the Difference Between <i>Fiber Optic</i> Cable and Copper Cable
	Cover	Conversation Narrative

3. Treatment

Treatment provides a more detailed picture. Treatment starts from the beginning of the appearance of the image to the end of the story that is told chronologically.

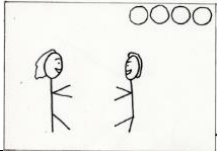

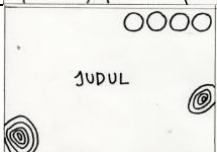

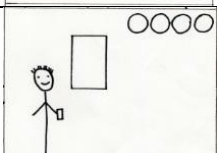
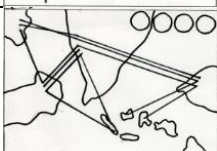
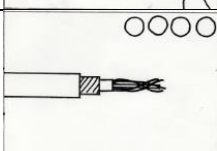
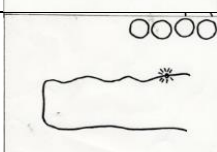

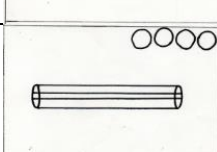

The treatment in this interactive video can be explained as follows. This interactive video learning media on the topic of fiber optic networks and types of fiber optic cables consists of three main frameworks consisting of an initial section, a core section, and a cover.

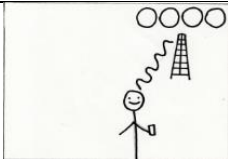
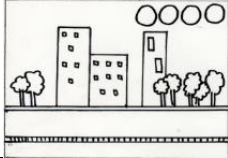
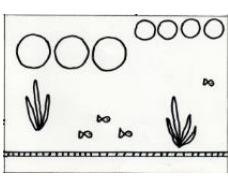

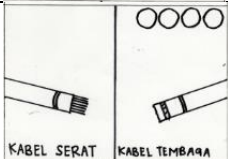

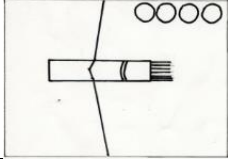
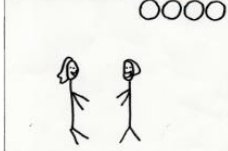
At the beginning of the video contains the opening and introductory impressions. The opening show uses a pop up animation that aims to attract the attention of students at the beginning of learning. While the introductory impression contains the title of the video. The core section of the video contains a complete description of the material, namely fiber optic basics, fiber optic working principles, point to point fiber optic/metro-e technology, point to multipoint technology (FTTx), fiber optic cable characteristics, cable capacity, color code and labeling of fiber optic cables, Characteristics of multimode cable types, Characteristics of singlemode cable types, Duct Cable construction types, Direct Buried Cable construction types, Aerial Cable construction types, Indoor Cable construction types, Fiber optic connector types. Each material is explained in separate sequels to facilitate learning. The material is explained in detail with animation containing techniques accompanied by video explanation narration

4. Story board

Story board is used to describe the series of scenes that will be made in the video. The description of the series of scans will be poured into sketch images/photos to see if the series of scans are in accordance with the story plot of the video. storyboard can be seen in table 3 below.

Table 3 Storyboard

Video Basics and Working Principles of <i>Fiber Optic</i>					
Scene	Board	Durati on	Sound	script	Action
1 Bridging		45 secon ds	backsound	Two people chatting in cafe	Object on set
2 Opening		4 secon ds	backsound	Flying rocket	Object move
3		3 secon ds	backsound	Title text	Pop up text
4		-	-	-	-
5 Stamp		21 secon ds	backsound	People playing smartphones	Object on set
6		10 secon ds	backsound	Fiber optic cable around the world	Object on set
7		7 secon ds	backsound	Fiber optic cable	Object on set zoom in
8		8 secon ds	backsound	Light passes through the glass fiber optic cable	Object on set
9		-	-	-	-
10		30 secon ds	backsound	Glass cylindrical shape	Object on set
11		28 secon ds	backsound	People playing smartphones	Object on set

12		30 seconds	background	Light waves and Tsel tower	Object on set Zoom in
13		3 seconds	background	Light passes underground	Object on set
14		19 seconds	background	Light passes through the ocean floor and submarine cable company	Object on set Pop up picture
15		31 seconds	background	Globe spinning surrounded by fiber optic cable	Object on set
16		40 seconds	background	Fiber optic cable and copper cable	Object on set Move looping
17		-	-	-	-
18		15 seconds	background	Fiber optic cable through laser light	Object on set
19 Closing		19 seconds	background	Two People chatting in a cafe	Object on set

5. Video script/script

After making the Story board then make a video script/script. ² The script writing format for this video program is almost similar to a story board where the script is made in the form of two-column pages. The left column is a visualization column and the right is everything related to sound including dialogue, narration, music and sound effects. The script/manuscript can be seen in table 4 below.

Table 4 Scripts/Scripts

1 Basics and Working Principles of <i>Fiber Optic</i>	
Visual	Audio
Two people chatting in a cafe	A : Hey... who are you chatting with? B : oh this, I'm having a discussion in the class chat group, usually discussing assignments A : oh

	<p>I see B : but I'm curious, how come we can receive messages from anywhere in an instant</p> <p>A : If that's the case I know the answer, it all happened because fiber optic cable.</p> <p>B: fiber optic cable, what is it?</p> <p>A : Let's see my explanation.</p>
Opening rocket flying	Backsound
Title text	Backsound
Question	
People playing smartphones	<p>16 Have you ever thought about how to get email or other information from any corner of the world in an instant. This can happen because of a network of cables laid underground and under the sea.</p>
Fiber optic cables surround the world	<p>4 The cables that carry most of the world's data are fiber optic</p>
cables. Fiber optic cables	<p>3 Let's learn what fiber optics are and how they work. fiber optic cable is a cable consisting of thousands of strands of fiber and a single fiber strand as thin as a human hair</p>
Light passes through the glass section of fiber optic cable Optical	fiber carries information in the form of light
Question	-
Cylindrical shape of glass through which laser light passes	<p>3 Optical fiber uses cylindrical glass with a high refractive index. light laser hits the interface at an angle greater than the critical angle total internal reflection will occur and the light will reach the other end. This means light can be confined within optical fibers over long distances and no matter how complex the shape of the fiber.</p>
People are playing smartphones and sending messages HELLO	<p>4 How does fiber optic transmit information such as phone calls or internet signals. Any information can be represented in the form of zeros and ones. Imagine when you want to send a text message "HELLO" via your cell phone. First this word will be converted to the equivalent binary number "n" as a sequence of zeros and ones. After conversion your phone will transmit these zeros and ones in the form of electromagnetic waves. One is transmitted as a high frequency wave and zero as a low frequency wave.</p>
Light waves and cell	<p>towers Local cell towers receive these electromagnetic waves. The tower will produce light waves if the electromagnetic waves are of high frequency. Now, these light waves can be easily transmitted through fiber optic cables.</p>
Light passes underground	These cables are placed underground and under the sea
Light passes through the ocean floor and submarine cable management companies	Mainly cellular service providers such as AT&T, orange, Verizon and Google (Pronounced; ei ti and ti, orenc, Verizon and Google) are some of the global

	players that own and maintain submarine cables.
rotating globe surrounded by fiber optic cables	Light waves carrying information must travel through a complex network of wires to reach their destination. For this purpose the whole world is covered with fiber optic cables. This whole discussion is referring to that if cable and optics don't reach a certain part of the world, then that part of the world will be isolated from the internet or mobile communications.
Fiber optic cable and copper cable	If we compare fiber optic cable and traditional copper cable, fiber optic cable is superior in every way. Fiber optic cables provide greater bandwidth and transmit data at much higher speeds than copper cables. This is because the speed of light is always greater than the speed of electrons. The flow of electrons in copper wires creates a magnetic field even outside the wires which can cause electromagnetic interference. On the other hand, the light that travels through the optical cable is always confined inside so that the possibility of interaction with external signals is nonexistent
Question	-
The fiber optic cable is passed through by laser light	. along the cable. Thus the fiber optic cable provides high data security.
Closing two people are chatting in a cafe	B : Wow, I heard your explanation... I'm getting more curious, I want to know more about optical fiber A : if you want to know more, see my next explanation.

B. Production

The production stage is the stage of realizing all the steps in the pre-stage production. The production stage contains activities for making animated images, and sound recordings according to the demands of the script. The production stage can be seen in Figure 1 and Figure 2

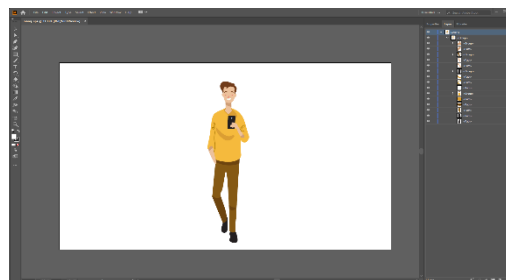
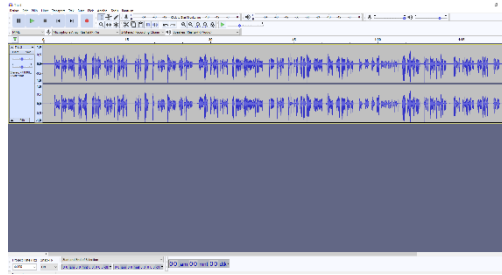


Figure 1 Making Animated



Images Figure 2 Sound Recording

C. ² Post-production

The post-production stage is the final stage in video production before the video is presented/distributed. At this stage there is a process of editing, mixing and mastering. The finished videos are then inserted and combined. The following is a video display at the final design stage.

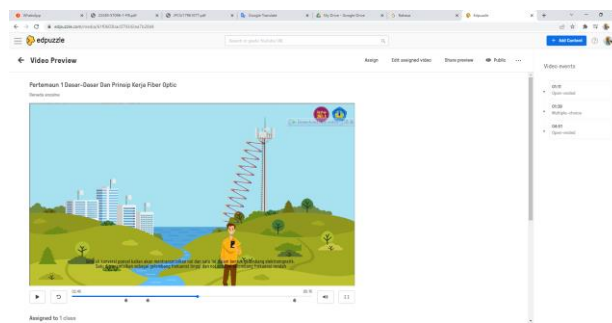


Figure 3 Final Display of Interactive Video

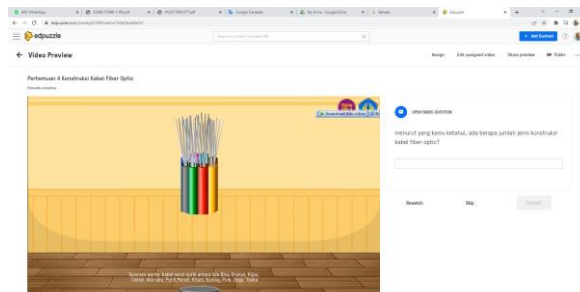


Figure 4 Display of Questions in Interactive Video

Development ¹

The next stage is product development according to the design that has been made. At this stage an assessment of the expert validation test is carried out. The results of the recapitulation of the media test and material test ²³ can be seen in the following table.

Table 5 Results of the media and material test recapitulation.

No	Validator	Type Test	Score	Description
1	Expert Lecturer 1	Material Validation	3.68	Very Valid
		Media Validation	3.77	Very Valid

2	Expert Lecturer 2	Material Validation	3.64	Very Valid
		Media Validation	3.60	Very Valid

- The material expert test consists of 50 statements for assessment on presentation of the material and the accuracy of the material by getting an average score of 3.66 which is qualitatively categorized as very valid.
- The media expert test consists of 60 statements for the assessment of interactive video design getting an average score of 3.68 which is qualitatively categorized as very valid. This shows that the quality of the material and interactive video media developed is very good and valid.

Suggestions and Improvements

At the time of validity testing, the developed product received suggestions from the validator. The suggestions from the validator can be seen in Table 6 below.

Table 6 Results of Suggestions and Improvements from Expert Validation Test

No	Aspects of Assessment	Recommendations	Improvement Results
1	Material	Adding an introductory sentence to the apperception questions in the video	An introductory sentence has been added to the apperception question in the video, namely 'to reflect on the material in the previous video'.
		Added some evaluation questions at the end of the video	An evaluation question was added at the end of the video
		Added reference Libraries at the end of each video	Added reference Libraries at the end of each video
2	Media	Added text containing important points explained in the video	Added text containing important points explained in the video
		Insert the original image The original	image has been inserted
		Clarify <i>subtitles</i> both size and color	<i>Subtitles</i> have been clarified

Implementation

After the interactive video is declared valid, then proceed to the implementation stage. At the implementation stage, a practicality test is carried out. The practicality test consists of product readability tests for students and educators' perceptions to determine the

suitability of needs, attractiveness and readability of interactive video learning media as potential users of the developed product.

1. Teacher's Perception Test

Table 7 Results of Teacher's Perception Test Recapitulation

No.	Teacher	Score	Description
1	TKJ 1 teacher	, 72	Very Good
2	TKJ 2	3, 90	Very Good

educator's perception questionnaire contains 50 statements that are assessed.

The average percentage obtained from filling in the perception questionnaire by educators is 95.25% with a very good category.

Product Readability Test The readability

test questionnaire was given to students consisting of 25 statements. From the 28 students who became respondents, the results of the readability test obtained an average percentage of 93.54% in the very good category.

Evaluation

The final stage of this development research is evaluation. This evaluation stage is carried out to see the activities at each stage of the development procedure are appropriate and running well or not. This evaluation is carried out at each stage of the development procedure, namely at the analysis, design, development and implementation stages. In addition, an overall evaluation was also carried out on interactive video products developed for two vocational wide-based network technology educators. Evaluation at the analysis stage should add an indicator aspect or aspect in each statement in the needs analysis questionnaire. Evaluation at the design stage, namely the material discussed in the interactive video should be more complete.

Evaluation at the development stage is the interactive video validation test. In the validation test, interactive video improvements were made based on suggestions for improvement from the validator. Based on the results of the educator's perception test of the developed interactive video, two educators stated that the interactive video developed was good and can be used in online learning and face-to-face learning, but it takes time to complete during this pandemic and needs to be adjusted to KD so that the demands of the community are met. KD can be achieved. Through evaluations and improvements that have been made at each stage, this research produces products in the form of interactive videos that are valid and practical for use during the COVID-19 pandemic and during normal teaching and learning activities.

Conclusion

This development research resulted in a product that met the valid and practical categories. Interactive video development using the ADDIE development model. This development model has five stages, namely: Analysis, consisting of curriculum analysis, student analysis, material analysis and analysis of learning objectives. Design, consisting of the pre-production stage; program identification, synopsis, treatment, storyboard, script/script, production, and post-production; editing, mixing, mastering. Development, consisting of the validity test of material experts and media experts. Implementation, consisting of educator perception test and product readability test. Evaluation, consisting of evaluation of the analysis stage, evaluation of the design stage, evaluation of the development stage, evaluation of the implementation stage and overall evaluation

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