Developing Micro Learning Video and Virtual Lab Tour to Teach Radio Transmitter

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Abstract. The use of learning videos from the you-tube channel by students to increase learning understanding. Most of the learning videos available on YouTube have a length of more than five minutes. A lot of digital content has the potential to become a distraction or break the focus of learning such as notification of messages on social media, commercial messages, and the desire to switch to other video content. Virtual tours are widely used to present the effect of reality on the virtual world. Radio transmitter learning requires a practical place in the laboratory. To develop a micro learning video combined with a virtual lab tour in radio transmitter learning at the Surabaya Aviation Polytechnic. This study is development research using four stages, namely: (1) Define, (2) Design, (3) Develop, and (4) Disseminate. This study describes the use of micro-learning videos and virtual tours of the radio transmitter lab to make it easier for cadets to learn about transmitters. The use of microlearning with virtual reality technology can also maximize learning outcomes in transmitter courses. Based on the results of the assessment that has been carried out by students in the development trial, an average total score of 84.3% was obtained from the maximum score of 100%. This can be interpreted to mean that the development of virtual reality using a virtual lab tour on transmitter learning in the category of "Very Feasible" for use by students as a learning medium in taking transceiver courses. The result of product validation of material experts is to get a value of 98%, while the validation results of media experts are 80%. The material and media validation values get the "very feasible" criteria. This means that the product is very feasible to implement.

Keywords: Micro learning video · Virtual lab tour · Curriculum · Student characteristics

1 Introduction

The most sought-after learning outcomes now are critical thinking, digital literacy, and technical abilities [1], especially in vocational education institutions. Some of the digital technologies used in teaching radio transmitters at the Surabaya Aviation Polytechnic are the use of learning videos stored on YouTube and Instagram. Videos designed according

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to micro-learning, with audio and interactivity, should be included [2]. The videos used are packaged attractively and have a short duration with the aim of keeping the audience focused. Every day, more than 5 billion videos are viewed on YouTube [3].

In addition to learning videos, Recently, virtual reality (VR) technology has become increasingly present in teaching, learning, and education across a range of application fields [4]. Virtual reality can also be used as a virtual tour to show important locations in education such as laboratories, workshops and workshops. Students used virtual tours for learning, and their behaviour was observed to determine whether it could enable the creation of a novel virtual teaching acceptance model (VTAM) as a theoretical framework for calculating the uptake of educational technology [5].

Learning to use internet media have a costs money for quotas and also requires high data speeds It is possible to see how effective educational movies are at advancing people's knowledge. Particularly YouTube serves as a transmitter of scientific knowledge thanks to its accessibility and minimal barriers [6]. However, Students who learn to use videos on the YouTube channel cannot immediately get answers to questions submitted in the comment's column. Most of the learning videos on the YouTube channel are long, so they have the potential to bring boredom and eventually shift focus to other things. Students who carry out practicum in laboratories and workshops have very limited time.

The use of virtual reality technology is not so popular as a virtual tour in laboratories and workshops at the Surabaya Aviation Polytechnic. Virtual tours in the lab are needed to strengthen understanding of the practicum. This study aims to determine how much influence the combination of using micro learning video with virtual lab tour has in learning radio transmitters.

2 Literature Review

Some of the main reasons people use YouTube are for amusement, information seeking, and academic study. If a video on YouTube is actually pertinent to the topic at hand, we believe it to be a useful tool that can improve the learning experience. It is advised that teachers use YouTube into their individual courses to take advantage of its built-in benefits in the context of learning and teaching [7]. Three individuals founded YouTube in 2005, and it has since risen to the position of second-most-visited website globally [3]. The interest of consumers in video services like YouTube, which is the second-most-frequented website in the world, is another indication of how common films are among private persons [8]. By dividing new ideas into manageable chunks or pills of knowledge, micro-learning, also known as micro-content, helps potential learners through this process [9].

The creation and favourable reception of the micro-learning paradigm have been sparked by a number of variables working together. First, people's ability to maintain single-task focus while avoiding distraction and inattention has declined. In fact, several highly specific research have shown that people only give their attention for 8 consecutive seconds at a time while using the Internet [10]. Second, due to the rapid changes in all fields, particularly technology, workers must regularly refresh their training. According to certain research, employees who lack the necessary IT abilities squander 21% of their working time [11]. Finally, traditional training is not proving to be an effective way

to train employees effectively and efficiently because: (a) lengthy training processes are necessary, which interrupts work; and (b) lengthy, laborious creation processes are necessary it is estimated that 43 to 185 h are needed to create the content for just one hour of training, and this number increases for more specialized training [9], Even less encouraging is (c), which states that the procedure has a very small influence. In fact, according to various studies, just 15% of workers are able to use their information effectively, and 80% of that knowledge is forgotten within just one month.

The use of e-learning is a learning medium that supports the development of IT in the era of the Industrial Revolution 4.0. The use of e-learning in the learning process has four benefits, namely getting a personal learning experience, reducing costs, being easy to obtain and increasing responsible ability [10]. Along with the development of technology and information, learning media is also growing, both software and hardware learning media so that the role of teachers as learning resources will gradually shift to become facilitators [11]. Learning materials in the context of learning are one of the components that must exist, because learning materials are a component that must be studied, observed, studied and used as material material that will be mastered by students and at the same time can provide guidelines for learning it. Without learning materials, learning will not produce something [12].

The use of technology and the development of creativity, independence, communicative skills, knowledge and understanding represent undisputable traits quite necessary for the improvement of then qualifications of cadets who do on the job training. It is, also, important to be noted that the assessment of the implementation of the transience curriculum is given special consideration [13]. Online media also serves as a medium for exchanging data and exchanging information quickly and cheaply. Online media also serves as a medium to find information or data and one of the important and accurate sources of information [14]. Further, millennials can be trained in techniques to self-manage their technology use effectively [15].

Microlearning has several different definitions, but none of them has been universally recognized. Theo Hug's, which is based on seven dimensions, is possibly the most widely accepted [16]: (1) Time, (2) Content, (3) Curriculum, (4) Format, (5) Process, (6) Media, (7) Learning Model. Time is a minimal effort that results in condensed time needs. Content is short units with clearly defined subject matter and rather straightforward issues. Curriculum is portions of modules; Format is succinct didactic components. Process is including pieces, tablets, test reports. Media is activities that are iterative in nature, standalone, or incorporated into a larger environment. Learning in a classroom or online using various multimedia content. Models for education. Repetition, reflection, pragmatism, constructivism, concept-based learning, con-nativist learning, etc.

VR is "the sum of the hardware and software systems that strive to create an all-encompassing, sensory illusion of being present in another place," according to one definition [17]. VR panoramas have been integrated into social networking platforms mostly to accommodate photographic pieces generated by 360-degree cameras. Such cameras create equirectangular spherical perspective pictures and the VR software provides an immersive experience, by monitoring the viewpoint of the user's mobile phone or headset and rendering at each instant a plane perspective of a certain field of view from within the total picture [18].

Equirectangular projection is the default output form of a rotating (rotating) panoramic camera equipped with a fisheye lens a 180° fisheye lens gives a full circle at 360° rotation. Rotating cameras sometimes cover more than one 360° turn but software sometimes accepts equirectangular images covering 360° horizontal and 180° vertical, i.e. make sure your equirectangular image has 27 actual aspect comparisons of 2:1 [19].

3 Research and Methodology

The study used a method of research and development methodology with a focus on using a 4D model. Development research was a technique used to develop a particular product and assess its efficacy [16]. Model 4D has four phases, including define, design, develop, and communicate [20].

Definitions for the model of evaluation of learning media products can be made through five steps, namely: (1) front-end analysis; (2) learner analysis; (3) task analysis; (4) concept analysis; and (5) defining the educational objective [21]. In the front-end analysis section, the Educators performs an initial diagnosis to boost learning efficiency and effectiveness. The second step, known as learner analysis, entails learning motivation, apprehension about failure, and other learner characteristics. In the following section, titled "Task Analysis," the instructor analyzes the tasks that need to be completed by the student in order for them to reach a minimum level of competency. In contrast, during the concept analysis phase, the many tasks that will be carried out rationally will be disseminated. The final step is to identify the learning objectives, which entails writing down the changes that are expected to occur once students have mastered the language of professional work. In the context of developing instructional video content using the microlearning principle, task definition is carried out in a number of ways, including (1) curriculum analysis, (2) determining the purpose of the lesson, (3) characterizing the learner, and (4) material analysis.

The curriculum that was in use when this research was done will be examined at the curriculum analysis step. The curriculum is designed to support the competencies that students will acquire after completing the educational process. By using newly created microlearning media content, curriculum analysis can be used to determine which fundamental skills in each topic need to be attained. In order to understand the limitations of creating learning media material, learning objectives are developed.

The next stage is to analyse the characteristics of students. This stage is intended so that students can use and take many benefits from the learning media content that will be developed, because it is in accordance with its character. Some of the characteristics of students that need to be explored and analyzed are: (1) individual academic abilities, (2) learning abilities, (3) economic and social background, (3) previous learning experiences, and (4) learning motivation.

The last is the material analysis phase, which will be carried out by identifying the main material, collecting and selecting relevant material, and systematically rearranging it. Identify the materials needed in the development of teaching media content and collect them from various literatures, both research articles in reputable journals and literature studies on video media on trusted internet sites.

The design stage can be divided into four activities, namely: (1) constructing criterion-referenced test, (2) media selection, (3) format selection, and (4) initial design [22]. Develop a criterion test (constructing criterion referenced test), as a link from the definition stage to the design stage. In addition, as an evaluation tool to measure the success of the implementation of activities in terms of achieving the competencies to be achieved. The preparation of test standards is based on the results of the analysis of the specificity of the learning objectives and student analysis. At this stage, a learning outcome test grid will be prepared. The tests that will be given will be adjusted to the cognitive abilities of the cadets. The selection of the form of presentation (format selection), will be adjusted to the most appropriate learning media with the results of the needs and curriculum. The design stage (initial design) in this study was carried out based on the content framework of the results of the defining stages that had been carried out previously.

The development stage can be divided into two activities, namely: (1) expert appraisal and (2) developmental testing [23]. In the context of developing learning media content, the development stage is carried out by testing material design (see Table 1), visual communication and software engineering results, to material experts and learning technology experts at the time of validation. The test results are then used for revision so that the product will meet user requirements. While the trial data will get data in the form of responses, reactions and comments from the target users, namely the cadets from the Air Navigation Engineering program at the Surabaya Aviation Polytechnic. From the results of this trial, it will be used to improve the product so as to produce products that are in accordance with the needs of students and learning outcomes in the curriculum.

The disseminate stage is divided into three activities, namely: (1) validation testing, (2) packaging, and (3) diffusion and adoption [23]. At the validation testing stage, the product that has been revised at the development stage is then implemented on the real target. At the time of implementation, measurement of the achievement of objectives is carried out. This measurement is carried out to determine the effectiveness of the developed product. After the product is implemented, the developer needs to see the results of achieving the goals. The solution that has not been achieved needs to be explained so that the same mistakes do not repeat after the product is disseminated.

The next activity from the development stage is packaging, absorption and adoption. This stage is done so that the product can be used by others. The final packaging of learning media products can be done by making a VLE link into a simple and easy to remember link, and also in the form of a QR Code, which can be accessed using various electronic media. After the product is packaged in the form of an easily accessible link, further socialization of this learning media product will be carried out as well as distribution. This is done to get the response value, feedback from users on learning media products that are being developed. If the user response value gets a value for use, the product will be distributed to a wider range of users.

In this development research, the data development technique uses questionnaires. Questionnaires are used to measure the feasibility of the learning media content that is being developed. The questionnaire consists of aspects of learning materials, aspects of visual communication, and aspects of software engineering. Questionnaires are given to material experts and media experts according to the assessment aspects. Material experts

Table 1. Learning material design aspect of assessment instrument grid

Indicator	Item
Clarity of learning objectives (formulation, realistic)	1, 2
Relevance of learning objectives to the curriculum	3
Scope and depth of learning objectives	4
Appropriate use of learning strategies	5
Interactivity	6
Giving motivation to learn	7
Contextuality and actuality	8, 9
Completeness and quality of study aid materials	10, 11
The suitability of the material with the learning objectives	12
Depth of matter	13
Ease of understanding	14
Systematic, sequential, clear logic flow	15
Clarity of descriptions, discussions, examples, simulations, exercises	16
Evaluation consistency with learning objectives	17
The accuracy and precision of the evaluation tool	18
Providing feedback on the evaluation results	19

will judge based on aspects of learning materials and visual communication, while media experts will judge based on aspects of software engineering (Table 2).

The measuring instrument used in making the questionnaire is called the instrument. An instrument is a tool used to measure the observed natural and social phenomena. Research instruments are basically tools used to collect data in research. Instruments for material experts contain the suitability of media content seen from the design aspects of learning materials and visual communication. Material experts are lecturers who are experts in the field of study in the developed courses. The media expert instrument will assess the suitability of the media used for several aspects that must be met as a good learning media.

The data analysis technique that will be carried out in this research is descriptive analysis technique. Descriptive analysis technique is done by using descriptive statistics. Descriptive statistics are statistics used to analyse data by describing or describing the data that has been collected as it is without intending to make conclusions that can be applied to the public or generalizations [24]. Quantitative data that has been obtained from the Likert scale measurement is converted based on the weight of a predetermined score, namely one, two, three, and four. This data is quantitative data which is then analysed with descriptive statistics, see Table 3.

Table 2. Visual Communication and software engineering design Aspect of Assessment Instrument Grid

Indicator	Item
Communicative; in accordance with the message and can be accepted / in line with the wishes of the target	20
Creative in ideas and pouring ideas	21
Simple and alluring	22, 23
There is narration, sound effects, background, music	24
There are layout designs, typography, colours	25
There are animations, and movies	26
Layout Interactive (navigation icons)	27
Effective and efficient in the development and use of learning media	28, 29
Reliable	30
Usability (easy to use and simple in operation)	31
Accuracy in selecting the type of application/software/tool for development	32
Compatibility (learning media can be installed/run on various existing hardware and software)	33
Packaged learning media programs are integrated and easy to execute	34
Part or all of the learning media program can be reused to develop other learning media	35

Table 3. Eligibility Percentage

Rating score	Score range	Category
4	75%–100%	Very worth it
3	56%–75%	Worthy
2	40%–55%	Decent enough
1	0%–39%	Not enough

The score obtained from the questionnaire is then converted to determine the percentage of eligibility, the percentage is determined by the following formula:

$$eligibility\ \% = \frac{Score\ obtained}{Maximum\ score\ that\ can\ be\ obtainedang} \times 100\%$$

4 Findings and Discussions

4.1 Findings

Curriculum Analysis

The achievement of basic competencies in each subject that can be done through virtual reality content on micro learning media for transceiver courses in the Air Navigation Engineering study program is as shown in Table 4. Through VR, the cadets can No user input is necessary to create a virtual world, whether it be one that is real or made up entirely. Applications for immersive virtual reality (VR) that are intended to improve multiuser wireless VR video require extremely high data rates and minimal latency to function well (depth of learning support system) VR adventure [25]. Experience the digital world according to the learning materials provided by the teacher. Things that may be difficult to do in the real world, because the practical tools are only in the communication laboratory of the Surabaya Aviation Polytechnic. This VR technology is very applicable in all subjects that do require scenarios in the delivery of the material.

In the stage of formulating learning objectives, it is found that there are limitations in the development of VR, namely only on subjects that have practical tools in the telecommunications laboratory. The practicum tool is in the form of a trainer board which is used to practice each block diagram on the radio transmitter and radio receiver. The topics that can be explained using VR are: (1) FM Transceiver Block Diagram, (2) Carrier Generator, (3) and Power Amplifier.

Analysis of Student Characteristics

At this stage of analysing the characteristics of students, it is known that there are several special characters of cadets who can use VR teaching media so that they can use and take many benefits, namely: (1) individual academic abilities, (2) learning abilities, (3) economic background and social, (3) previous learning experiences, and (4) learning motivation. The results of the analysis of the academic ability of cadets in using VR content can be seen in Table 5.

Analysis of Material

The main material in the transceiver course is the theory of radio wave propagation, the workings of each block of diagrams both on the transmitter and on the receiver, the characteristics of the transmitter and the characteristics of the receiver. All the material mentioned above is very relevant if presented in the form of virtual reality. Here is the arrangement of the main material that the fish systematically deal with, as shown in Table 6.

4.2 Discussion

The research that produces the final product in the form of this module is a type of R&D (*Research and Development*) using a 4-D (*Four-D Models)* development model. The stages carried out are *define*, *design*, *develop*, and *disseminate*.

Table 4. Transceiver curriculum analysis

No	Basic competencies	Subject	VR Implementing
1.	Students are able to explain the definition and function of transceiver equipment based on their use	Transceiver	No need
2.	Students are able to explain the use of working frequency and radio wave propagation	Radio wave propagation and working frequency on transceiver equipment	No need
3.	Students are able to name the functions of the transceiver equipment in a block diagram	a. Transceiver AM Block Diagram b. Transceiver FM Block Diagram	Need to Use VR
4.	Students are able to explain the characteristics of radio receivers and transmitters	a. Transceiver Characteristics b. Noise c. Tunned Circuit	No need
5.	Students are able to explain about the carrier generator process on transceiver equipment	Carrier generator	Need to Use VR
6.	Students are able to explain about power amplifiers on transceiver equipment	Power amplifier	Per Need to Use VR
7.	Students are able to explain about impedance-matching networks	Networks	No need

In the defining stage (*Define*) problem identification and analysis are carried out in the form of (1) curriculum analysis, (2) formulating learning objectives, (3) analyzing student characteristics, and (4) material analysis. The results obtained from this defining stage found problems that required the development of virtual reality using a virtual lab tour for transmitter learning.

At the design stage, there are several steps, namely compiling a constructing *criterion referenced test*, as a preliminary analysis to measure the feasibility of the learning media product being developed. In addition, it is an evaluation tool to measure the success of the implementation of activities in terms of achieving the competencies to be achieved. This stage is carried out to select the media according to the content of the educational material to be developed. The selection of the form of presentation (format selection), will be adjusted to the most appropriate learning media with the results of needs and curriculum. The initial design stages in this study were carried out based on the content framework of the results of the definition stages that had been carried out previously.

Table 5. Student characteristic

No	Student Characteristic	Score	Explanation
1	Talent and intelligence	74%	Good
2	Interest	86%	Very Good
3	Motivation	91%	Very Good
4	Emotional	70%	Good
5	Ambition and Determination	87%	Very Good
6	Health	98%	Very Good
7	State of the senses	93%	Very Good
8	Family	79%	Very Good
9	Lecturer	84%	Very Good
10	Learning Methods	88%	Very Good
11	Curriculum	79%	Very Good
12	Facilities	80%	Very Good
13	Discipline	83%	Very Good
14	Environment	89%	Very Good
15	Public	84%	Very Good

The development stage (*develop*) there are steps, including *Expert appraisal* is a technique to validate or assess the feasibility of the product design. In this activity, an evaluation is carried out by experts in their fields. The provision of advice is used to improve the material and learning design that has been prepared. Developmental testing is a product design trial activity on the subject and actual research targets. At the time of this trial, data on responses, reactions or comments from the target user model was sought. The results of the trials are used to improve the product. After the product is repaired, it is then retested until it gets effective results.

In the context of developing learning media content, the development stage is carried out by testing material design, visual communication and software engineering results, to material experts and learning technology experts at the time of validation. The test results are then used for revision so that the product will meet the needs of the user.

As the last stage of this study, namely *dissemination.* This is done to get response value, feedback from users towards the learning media product being developed. If the user response value gets a value worth using, then the product will be spread to users more broadly.

The assessment questionnaire for users is divided into 3 aspects, namely curriculum aspects, material aspects and student character aspects. Based on the results of the assessment that has been carried out by students in the development trial, an average total score of 84.3% was obtained from the maximum score of 100%. This can be interpreted to mean that the development of virtual reality using a virtual lab tour on transmitter

Table 6. Main materials in transceiver courses

No	Basic Competencies	Subject Matter	Sub-Subjects
1	Able to explain the use of working frequencies and propagation of radio waves	Propagation of radio waves and working frequencies on transceiver equipment	a. Polarization b. Sky Wave c. Ground Wave d. Frequency Spectrum e. Wave Length
2	Able to mention the function on the transceiver equipment based n the block diagram	A. Transmitter diagram block	a. Power Supply b. Pre Amplifier c. Exciter/ Modulator Oscillator with Buffer) d. RF Amplifier e. RF Power Amplifier f. Transmission Line g. Transmitting Antenna
		B. Receiver Diagram Block	a. Antenna b. Power Amplifier c. Demodulation (oscillator with Buffer) d. Audio Amplifier e. Power Amplifier f. Power Supply
3	Able to Explain the characteristics of transceivers and receivers	A. Transmitter Characteristics	a. Frequency prone b. Power c. Efficiency d. Noise
		B. Receiver Characteristics	a. Sensitivity and Selectivity b. Fidellity c. Distortion d. Signal Max

learning in the category of "Very Feasible" for use by students as a learning medium in taking transceiver courses.

The result of product validation of material experts is to get a value of 98%, while the validation results of media experts are 80%. With reference to the feasibility percentage rubric in Table 3, the material and media validation values get the "very feasible" criteria. This means that the product is very feasible to implement. This shows that the development of virtual reality uses a virtual lab tour on transmitter learning for cadets of the Air Navigation at the Surabaya Aviation Polytechnic.

5 Conclusions

This study explains the use of microlearning video and virtual lab tour to teach radio transmitters to be able to facilitate cadets in learning transmitters. The use of microlearning with virtual reality technology can also achieve maximum learning results in transmitter courses. The choice of VR media format is a 360^0 image that is displayed in the application in the form of a *tour laboratory*. The development of this virtual reality is not only used for learning at the aviation polytechnic, but it can be used for other learning in any agency.

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