

# **Managing Learning Experience in Introduction to Computer Network Device Using Virtual Reality: Study Case Network Laboratory**

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## **Abstract**

Generations Z and A have extensively used virtual reality (VR), particularly in gaming and entertainment. The creation of knowledge from the experience of utilizing VR is encouraged by this use. This encourages academics to carry out virtual reality-based learning experiments. This study tries to pinpoint the elements that affect the learning process when using VR media. This study technique employs experiments by putting students through "Introduction to Network Devices" lessons utilizing virtual reality media in the network lab. This research stage starts with the creation of the Virtual Laboratory Network application. After that, a trial is conducted, beginning with a pre-test on knowledge of network devices; then, students explore network devices by logging into the virtual laboratory network using the Oculus Quest 2 tool, followed by a final test on knowledge of network devices.

## **Introduction**

Generation Z has noticed the advancement of virtual reality (VR) technologies [1]. Virtual reality is becoming a standard part of this generation's everyday activities, including VR gaming and other forms of entertainment [2], [3], and [4]. Users can get visual information by using VR. Generation Z has noticed the advancement of virtual reality (VR) technologies [1]. Virtual reality is becoming a standard part of this generation's everyday activities, including

VR gaming and other forms of entertainment [2], [3], and [4]. The usage of virtual reality (VR) can give users access to visual information, enhancing knowledge absorption on a cognitive, emotional, and psychomotor level.

The networked laboratory is a lab that serves as a location for network learning. This learning is made possible through network devices and connection simulations. The Computer Network Engineering program at Vocational High School (SMK) level has included this study. This draws researchers to use virtual reality-based educational tools in device network learning in the Computer Network Engineering curriculum at Vocational High Schools (SMK).

Tejawati et al. unveiled the multimedia development life cycle technique [6] and combined the Unity3D wind gaming application with Adobe Premiere Pro video editing tools to edit 360-degree films [7] to create a virtual-based application. This was also done by Meidelfi et al. in their study, which used VR BOX to see structures in 3D in virtual reality [8]. In contrast, Utari et al. adopted the Rapid Application Development (RAD) approach in their research [9]. Triani et al. construct prospective regional company marketing media using 360-degree virtual reality panoramas [10]. No researchers have utilized SimLab Virtual Reality (VR) and the Oculus quest, two tools, according to the study that has already been done. Therefore, researchers utilize SimLab Virtual Reality (VR) to build 3D objects and deploy them using the Oculus Quest 2 to create learning materials for introducing computer network components.

## Literatur Review

### *Virtual Reality*

The first virtual reality project was used to humanize the virtual world. Virtual reality (VR) is the development of simulated expertise relatively close to a real-time situation [11]. Virtual reality users can learn from experiences they will have in real life since they feel they are in a different setting [12]. The primary function of virtual reality (VR) is to establish a presence, the sensation of "being" or "acting," while the user is physically present somewhere else [13]. In this situation, the user's senses are linked to the presence and are intended to fool [14] purposely. In their study, Kami'nska et al. found that over the past few years, virtual reality (VR) has expanded from games to professional development. According to him, this has led to significant opportunities for VR in education because it plays a significant role in the teaching process and offers an intriguing method for information extraction [15].

### *SimLab Virtual Reality*

SimLab Virtual Reality is a full-featured VR authoring tool that can create interactive VR experiences for professional-grade 3D visualization [16]. This program makes it simple to import models, after which it produces dynamic visualizations and renders everything into fully interactive VR. This software's features include integration with CAD, cloud sharing, 3D PDF, import and export from various 3D file formats, and CADVRter. With this software, we can create interactive VR content without the need for coding, do VR training, evaluate VR (using tests or surveys to gauge user performance), and browse VR content (Free viewing of VR experiences on all devices).

### *Oculus Quest 2*

An Oculus Quest 2 Head-Mounted Display and two Oculus Touch Controllers were used in this study.



**Figure 1.** *Oculus Quest 2. From the left, the head-mounted display, the left controller (Controller A), and the right controller (Controller B)*

**Source:** [17]

Oculus Quest 2 features 6GB memory, 256GB storage, 1832X 1920 eye @ 72-120 Hz LCD display, Adreno 650 graphics, sound, two built-in speakers/3.5 headphone jack 6DOF inside-out tracking through 4 built-in cameras and two controllers with accelerometer and gyroscope optional QWERTY keyboard via Bluetooth, oculus touch, infrared cameras weighing 503 g [17].

### **Learning Experience**

Due to its capacity to enable immersive learning, teaching through simulation, and learning gamification, virtual reality (VR) technology is beginning to receive more attention in the human-computer interaction field, including technology-assisted learning. Many courses, especially those containing abstract concepts or demanding spatial abilities, such as organic chemistry, can benefit from these systems' high-level multimodal learning experiences [22].

In order to make audience members (players) feel genuinely immersed in anything or to supply involved, like a genuine activity or experience or an artificial setting, immersive is described as a picture that appears to be real around them. The term "immersion" refers to the "presence" or "being there" sensation that is typically related to gaming. This suggests a greater sense of delight that promotes interaction and experience sharing [22].

The four stages of the experiential learning cycle, according to M. Jantjies, T. Moodley, R. Maart [23], are as follows: (1) Abstract conceptualization (reflection can generate new ideas or modify existing abstract concepts); (2) Active experimentation (students apply new or revised knowledge to the world around them and evaluate the results); (3) Reflective observation (viewing and reflecting on experiences); and (4) Concrete experience - (having new experiences or reinterpreting existing experiences) [23]

## **Method**

The following technique was followed in this study:



**Figure 2.** *Research Procedure*

The planning step is carried out to gather the information that will be shown as an item in virtual reality. The application development step is carried out by importing items into the SimLab Virtual Reality program, which is then modified to match the material plan that will

be displayed in virtual reality. The information is validated to ensure it adheres to the Network Computer Engineering curriculum taught in the Vocational High School program. Teachers in the Vocational High School Network Computer Engineering Program who teach computer network-related courses completed questionnaires for content evaluation. Validation of the application is carried out based on several indicators, namely usefulness [18], ease of use [19], ease of learning [20], and satisfaction [21].

The following is the design of the validation questionnaire:

**Table 1.** *Design of the usefulness validation questionnaire*

<b>Usefulness</b>	<b>Feasibility</b>
This application helps students understand more about cisco switch configuration material	
This application adds to students' knowledge of Cisco switch network management hardware	
This application encourages students' deeper interest in knowing network management with Cisco switches	
This application makes it easy for students to understand VLAN switch configuration practices	
This application performs its functions in accordance with the teacher's expectations	
This application meets the needs of teachers in the teaching and learning process on VLAN switch material	

**Table 2.** *Ease of use validation questionnaire design*

<b>Ease Of Use</b>	<b>Feasibility</b>
This app is easy to use	
This app is easy to understand	
This app is user friendly	
Only a few steps are used to use this application	
Users of this application use only a minimum of effort	
Users can use this application without instructions for use	
This application works consistently when used	
Regular VR app users and users who rarely use VR apps will love this app	
Application users can overcome errors when using this application quickly and easily	
Users successfully use this application every time when access it	

**Table 3.** *Ease of learning validation questionnaire design*

<b>Ease Of Learning</b>	<b>Feasibility</b>
App users learn how to use this app quickly	
Application users easily remember how to use this application	
It's very easy to learn how to use this app	
Application users quickly become skilled at using this application	

Following validation, pre-test and post-test were set up to gauge the effectiveness of the training received from the learning application for using computer network devices. The pre-test was administered to the respondent before they used the application, and the post-test was administered following their use. It is possible to gauge how successfully the application

has been constructed using the pre-test and post-test forms. The researcher made adjustments in response to the post-test results before moving on to the launching step, which entails applying to introducing the computer network device as a component of the Vocational High School Network Computer Engineering Program.

**Table 4.** *Satisfaction validation questionnaire design*

Satisfaction	Feasibility
Application users are satisfied with this application	
App users will recommend this app to others	
It's fun to use this application	
This application works according to the wishes of the User	
Application users are comfortable in using this application	
App users must have this app	

The following are the forms of pre-test and post-test questions:

**Table 5.** *Pre-test & post-test design*

Item	Question	Answer
1	Which of the below network devices enhances network performance without needing a router?	a. Switch Cisco Catalyst b. Hub c. Wireless Router d. LAN Card
2	The Cisco Catalyst 9300 Switch has the interface shown below.	a. Network Modules, Power Supplies, Stacking, Fan b. Network Ethernet Port, Power Supplies, Fan c. Network Ethernet Port, Power Supplies, Stacking d. Network Modules, Power Supplies, Fan
3	When configuring a switch for the first time, you must respond "no" to the dialogue's opening inquiries. What happens as a result of the response "no"?	a. switch# b. switch> c. switch (config)# d. switch (config if)#

The first question asks students to comprehend the definition of a network device, the second asks them to comprehend the components of the network, and the third asks them to comprehend the commands used to install network devices.

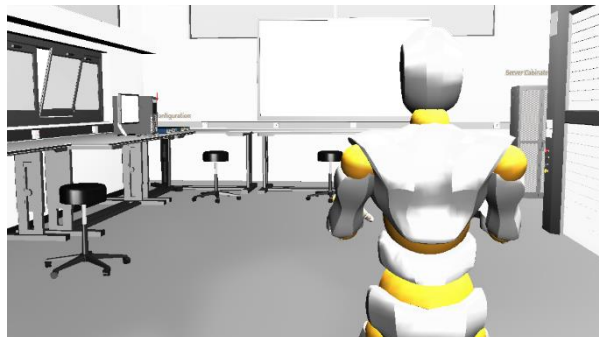
## Results and Discussion

### Planning

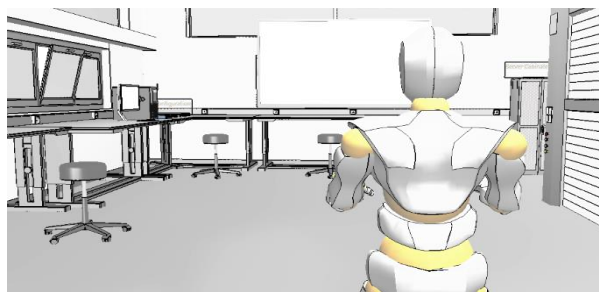
The material for the SMK Department of Computer Network Engineering's 2013 curriculum is in line with the VLAN Configuration material when preparing the design of the Cisco network configuration practicum. At the design stage, the server cabinet, PC and Cisco switch, server hardware, and the practicum room were created as 2D sketches that were then converted into 3D models.

***Room for practicing 3D modelling***

To produce an application that consumers can use effectively, a 3D design requires a preliminary concept and the appropriate scenario. A sketch of the practicum room is shown in figure 2, and the final 3D model that is created may be viewed in figure 3.



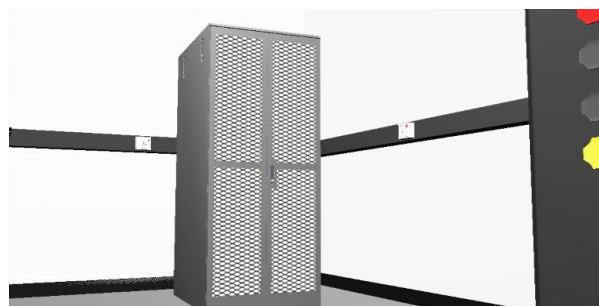
**Figure 2.** *Sketch of the practicum room*



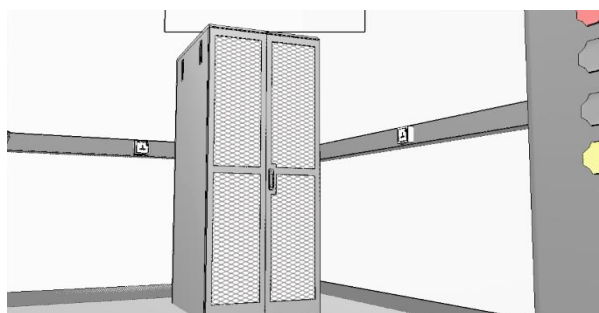
**Figure 3.** *3D objects in the practicum room*

***3D Modelling Server Cabinet***

Figure 4 shows the cabinet sketch, while Figure 5 shows the outcomes of the implementation of creating 3D server cabinet objects. The cabinet server serves to hold server hardware or network devices that may be used for practicum.



**Figure 4.** *Server cabinet modelling sketch*



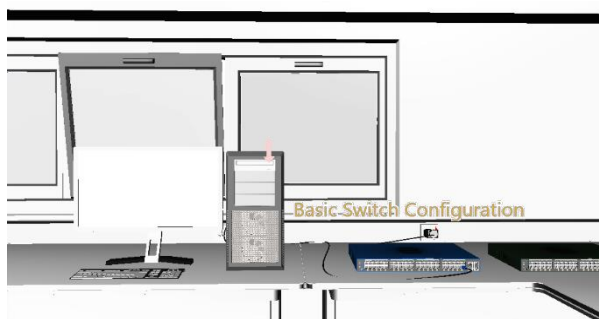
**Figure 5.** *3D Modelling server cabinet*

**3D Modelling PC dan Switch Cisco**

Figure 6 is a drawing of the switch's manageable hardware, which is needed before practicing a configuration switch. Figure 7 is a representation of the outcomes of the 3D item design.



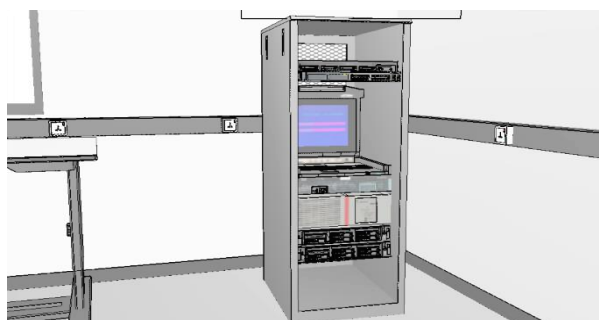
**Figure 6.** *PC modeling sketch and CISCO Switches*



**Figure 7.** *3D PC modelling and CISCO Switches*

**3D Modelling of Server Hardware**

Server hardware can be seen within the server cabinet in sketch figure 8, together with Cisco catalyst switches, voice servers, KVM server network devices, and UPS backup power sources.



**Figure 8.** *Server hardware modelling sketch*

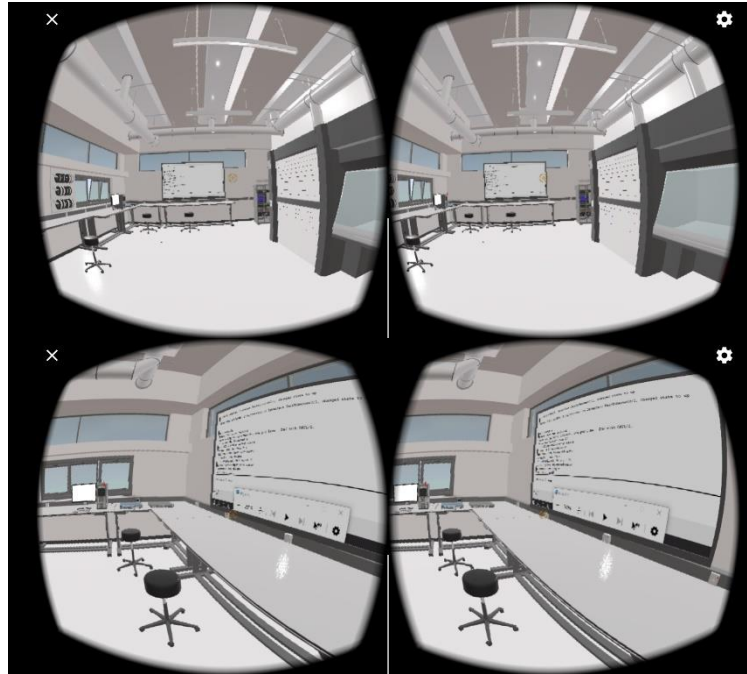


**Figure 9.** *3D modelling of server hardware*

## Application Development

### Camera Movement and Navigation

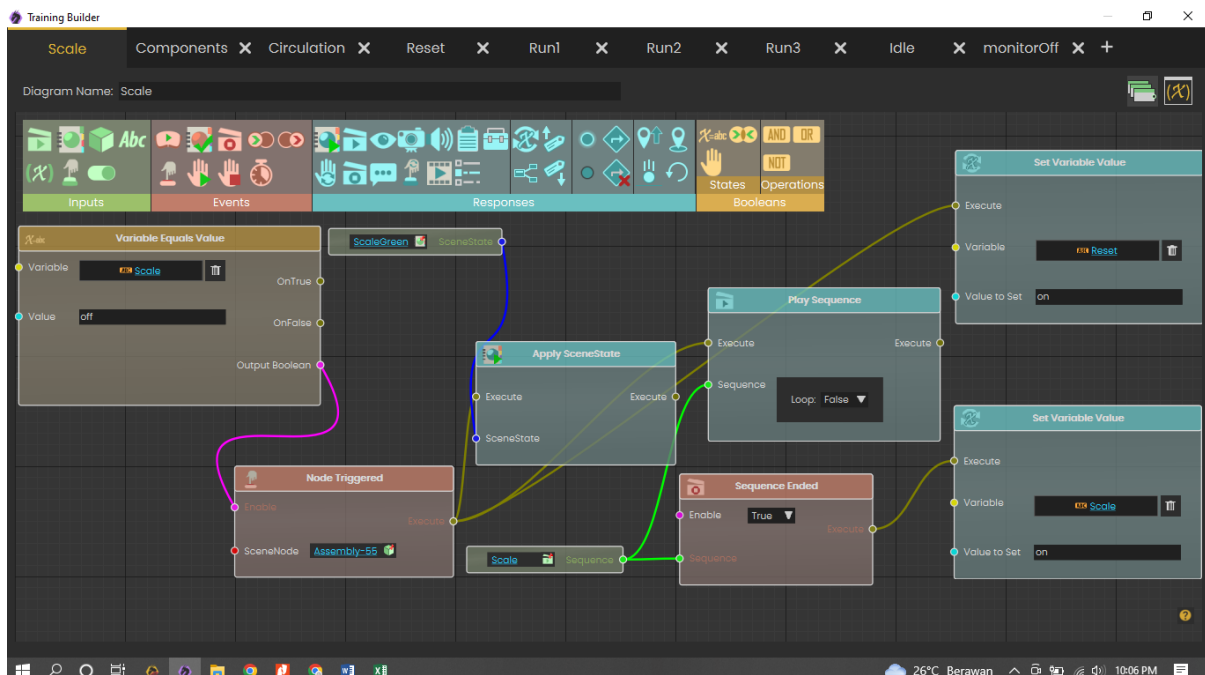
When running Virtual Reality apps, the camera and navigation functions have a significant impact and are helpful for choosing the proper location or angle.



**Figure 10.** Camera movement design

### Program Code Block

Program Code Blocks are used in the building of this Virtual Reality Network Configuration Program so that the application may execute in accordance with the code block command applied.





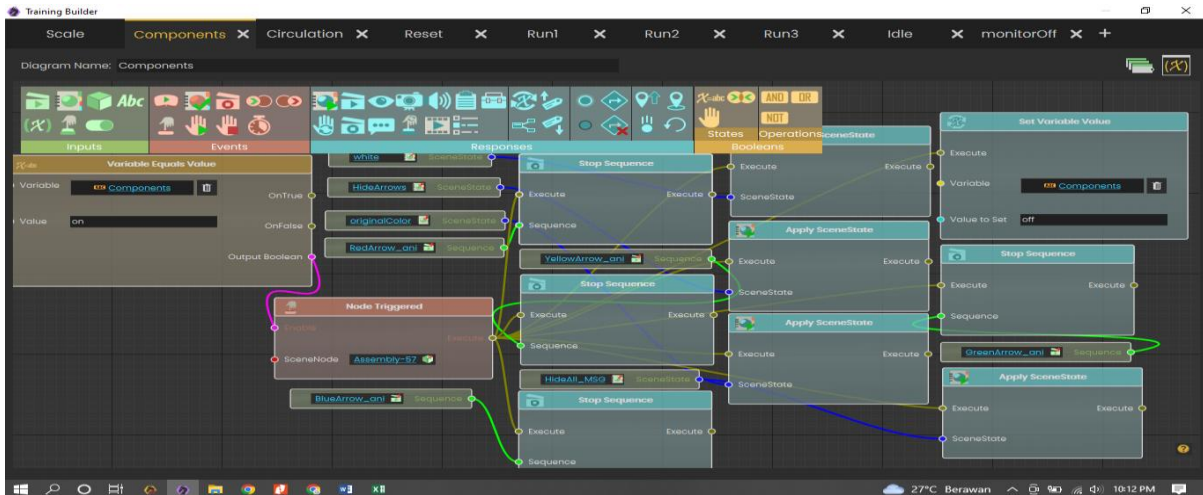


Figure 11. Block code

## Application Implementation

### Practice Room Information Display and Switch

In VR, you will initially be led with an arrow pointing towards the practice and instructed to approach the PC and Switch practice hardware, after which you will be instructed to hover over the arrow.



Figure 12. Practice Room and Hardware

### Display of Switch Configuration Practice Information

To initiate the network configuration procedure, the user must push the PC's power button after turning on the computer.

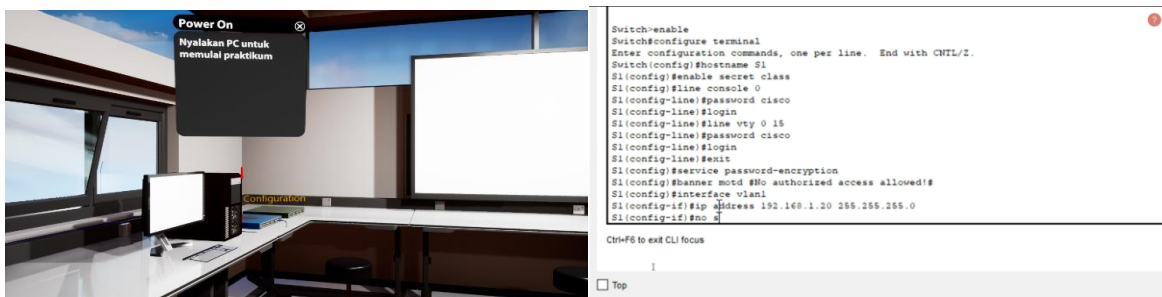


Figure 13 Switch Configuration Practice

### Server Cabinet Information Display

In the posture of an angel in front of the server cabinet, the user will be presented to the current hardware that supports the server's operation in a network. The user must press the

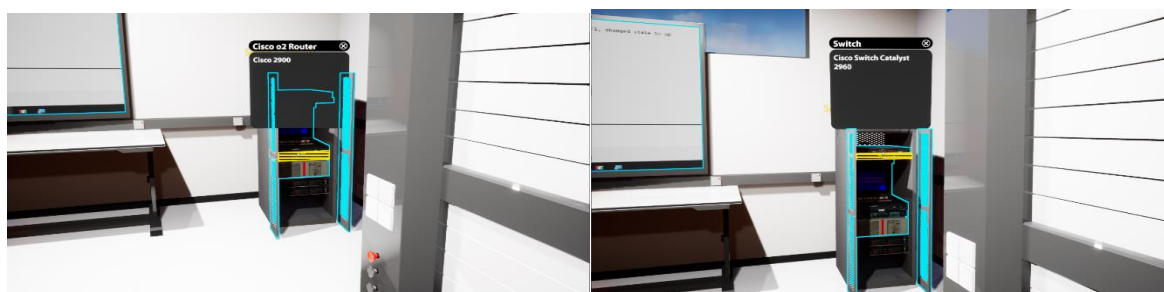
cabinet door in order to open the server cabinet's door. The server cabinet contains devices that may be selected with the cursor so that users can identify the server's supporting equipment.



**Figure 14.** *Server Cabinets*

### **Hardware Grabbing Information Display**

Each piece of hardware in the server cabinet is depicted with its corresponding data in the image. The hardware may be disassembled in order to examine the component specs.



**Figure 15.** *Hardware Grabbing*

### **Validation**

Validation of the feasibility of the VR application used by five effective TKJ instructors intends to assess the usability testing approach, which comprises Usefulness, Satisfaction, and Ease of Use (USE), by having respondents fill out a questionnaire after trying the program. The questionnaire consists of 27 statements and five responses from TKJ teachers who are productive. The findings of the USE questionnaire represent the degree of application users' usefulness, convenience, and satisfaction. The following are the findings of the respondents' validation.

**Table 6.** *The results of the usefulness feasibility validation*

<b>Usefulness</b>	<b>Feasibility</b>
This application helps students understand more about cisco switch configuration material	88
This application adds to students' knowledge of Cisco switch network management hardware	76
This application encourages students' deeper interest in knowing network management with Cisco switches	76
This application makes it easy for students to understand VLAN switch configuration practices	72
This application performs its functions in accordance with the teacher's expectations	80
This application meets the needs of teachers in the teaching and learning process on VLAN switch material	92
Average	80,6

**Table 7.** *Easy of use feasibility validation results*

<b>Ease Of Use</b>	<b>Feasibility</b>
This app is easy to use	72
This app is easy to understand	76
This app is user friendly	72
Only a few steps are used to use this application	72
Users of this application use only a minimum of effort	40
Users can use this application without instructions for use	76
This application works consistently when used	76
Regular VR app users and users who rarely use VR apps will love this app	68
Application users can overcome errors when using this application quickly and easily	64
Users successfully use this application every time when access it	40
Average	65,6

**Table 8.** *Ease of learning feasibility validation results*

<b>Ease Of Learning</b>	<b>Feasibility</b>
App users learn how to use this app quickly	68
Application users easily remember how to use this application	76
It's very easy to learn how to use this app	80
Application users quickly become skilled at using this application	76
Average	75

**Table 9.** *Results of satisfaction feasibility validation*

<b>Satisfaction</b>	<b>Feasibility</b>
Application users are satisfied with this application	76
App users will recommend this app to others	68
It's fun to use this application	72
This application works according to the wishes of the User	76
Application users are comfortable in using this application	68
App users must have this app	72
Average	72

Based on the average usefulness eligibility validation of 80.6 it can be stated that this application is in accordance with the expected material curriculum. Meanwhile, from the results of the eligibility validation of 65.6, it was found that the ease of use factor of the application still needs to be improved, this could mean that there are other factors that influence such as the user's habitual behavior in using VR. The results of the eligibility validation of the ease of learning of 75 prove that this application can be learned easily but the ease of learning still needs to be increased. The satisfaction feasibility result of 72 shows that this learning application still needs to be improved.

### **Testing**

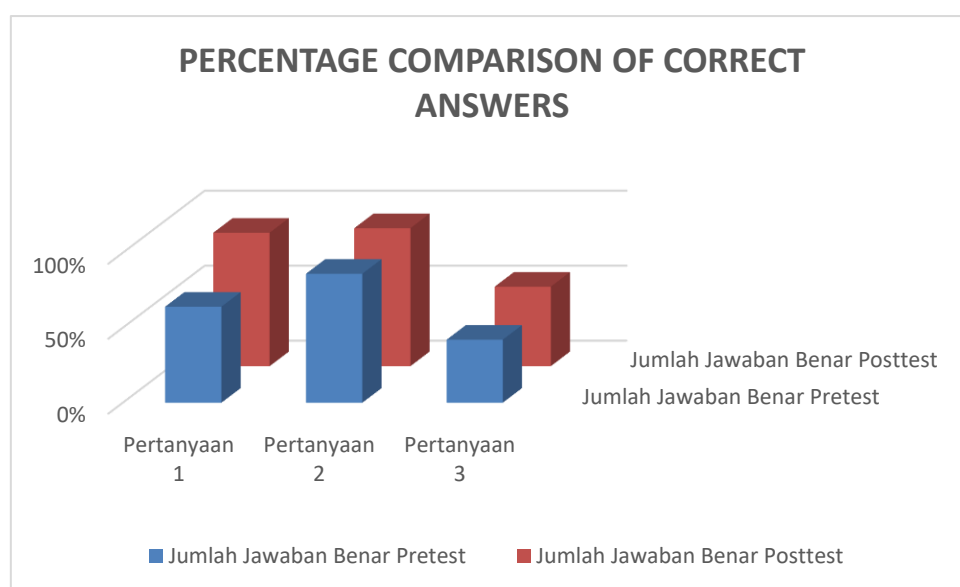
The Oculus Quest 2 is utilized to do application feasibility tests on a device that runs the application. Before students utilize the Oculus VR Viewer, they are given a pre-test to determine what they will practice and utilize in the program. After completing the pre-test, students will test the hardware with the provided recommendations to ensure its use is appropriate.

VR application testing aims to guarantee the functionality of apps developed using the gear mentioned above. With the Oculus 2 VR Viewer hardware, the application's findings operate successfully by displaying application-designed device networks and providing a clear picture of students' cognitive learning in device networks.

The following table displays the outcomes of the VR device network application's pre- and post-testing:

**Table 10.** *Post-test results.*

Item	Question	Percentage of Correct Answers	
		Pre-test	Post-test
1	Question 1st	64%	89%
2	Question 2nd	86%	92%
3	Question 3rd	42%	53%



**Figure 16.** *Comparison graph of the percentage of correct answers for the pre-test and post-test.*

The chart above demonstrates that students' ability to answer pre- and post-test questions grew, with scores of 100 for 17 students, 67 for 14 students, and 33 for 5 students. Based on these findings, it can be inferred that the VR device network application is beneficial for enhancing students' cognitive comprehension.

## Conclusion

The introduction of computer network devices utilizing virtual reality may suit the learning demands of vocational high school network computer engineering programs, allowing institutions to create learning material that can be facilitated using virtual reality. The findings of the pre-test and post-test indicate that question point 3 is difficult for pupils to comprehend. This also demonstrates that in a practical situation, when typing is required, it makes it challenging for users and becomes one of the impediments to pupils' comprehension. Understanding the description and the introduction of an item, as evidenced in questions 1 and 2, indicates that pupils have a solid grasp of the material. Further study may examine the rise in usability and ease of learning in virtual reality-based learning mediums.

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