

User Experience Evaluation of Virtual Reality-Based for LAN Cable Crimping Simulation Application

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Abstract. Virtual reality is currently evolving rapidly, marked by the emergence of a wide range of products, especially in the educational sector. The State Polytechnic of Batam has developed virtual reality-based learning products, one of which is a LAN cable crimping simulation application. This simulation is intended to simulate the working procedure of the LAN cable crimping practicum. To determine the usability level of LAN cable crimping simulation, it must be measured. The system usability scale was used in this study to determine whether the usability rate met the standard by testing the simulation product. The adjective rating was good, with a final score of 74 based on the system usability scale score. Even though they had never done it directly, the respondents said the simulation helped them understand the LAN cable crimping process.

Keywords: LAN Cable Crimping, Usability, Virtual Reality, System Usability Scale

1 Introduction

In the era of globalization, the development of information and communication technology has affected various fields, especially education. The online learning system, which implements learning from a distance with the help of information technology, is a recent trend. In addition, since the COVID-19 pandemic, the government has taken a policy that teaching and learning activities must be carried out remotely to prevent the spread of COVID-19. This situation also occurs in the university environment, which has reduced face-to-face learning on campus and replaced it with online learning [1].

As the years go by, students at Batam State Polytechnic continue to grow rapidly so the need for the use of laboratories and practicum equipment is increasing, especially in the Informatics department. With a pandemic situation that requires restrictions on students in using the room due to having to maintain distance and increasingly urgent needs for laboratories and practicum tools [2]. Through this situation, it is time for learning activities, especially learning that requires practicum activities, to be assisted by the use of virtual reality (VR). VR can provide a visual experience just like the real situation, students can summarise the time needed to understand the practicum material. Instead of just being passive observers, users are involved in the learning environment as active participants.

To address the situation, DigiArs Studio - Production House under Batam State Polytechnic designed and created a simulation application that utilizes virtual reality (VR)

technology. This simulation application is made by students who are interning with the guidance of lecturers who are experts in their fields. In the division of job description in the project, the modeling team is students from the Animation study program and the developer team are students from the Multimedia and Network study program and Informatics study program. One of the successful simulation applications is a virtual reality-based LAN cable crimping simulation application. This application helps users to get a real visual experience in the LAN cable crimping process. This simulation application has been designed and made, so an evaluation of the product is needed.

In the application that has been made, it is necessary to measure user experience based on the goals or objectives of the product. User experience measurement can be done using usability testing. In usability testing, several approaches can be used in testing, one of which is the system usability scale (SUS). The SUS method conducts direct testing on end users [3]. In this research, the SUS method will be used because usability is a fundamental factor for product success and direct testing to end users who are the target audience. From this research, it is expected that the LAN cable crimping simulation application has a fairly high level of user experience and obtained suggestions for improvement from respondents' comments.

Some previous research can be used as a reference for research comparison. The first research entitled "Usability Evaluation on Learning Management System OpenLearning Using System Usability Scale" by Azizah Fatmawati (2021) is usability research using a system usability scale on software specifically designed to create, distribute, and manage educational content delivery [4]. The second research is research with the title "A Virtual reality Environment Using Concepts of Serious Games and Gamification for the Treatment of Eating Disorders" by Francielly Rodrigues, Priscila Wilbert, Jose Carlos Tavares da Silva, Jauvane C. de Oliveira (2019) is usability research on virtual reality-based therapy simulation applications used in the treatment of patients with eating disorders [5].

And the last research is research with the title "A New Way of Teaching Business Ethics: The Evaluation of Virtual Reality-Based Learning Media" by Mahfud Sholihin, Ratna Candra Sari, Nurhening Yuniarti, Sariyatul Ilyana (2020) using the user experience method in their research. The purpose of this research is to gain experience using VR for students and observe whether the product makes learning more motivating, interesting, and able to increase learning effectiveness [6]. From the three references mentioned before, a user experience evaluation will be carried out that focuses on the usability of virtual reality-based simulation application products using the system usability scale (SUS).

2 Methods

System usability scale to end user testing steps include 4 stages, namely determining the scenario (scenario), selecting respondents or determining respondents (respondent), testing by respondents (collecting data), and recapitulating test results or determining results (report).

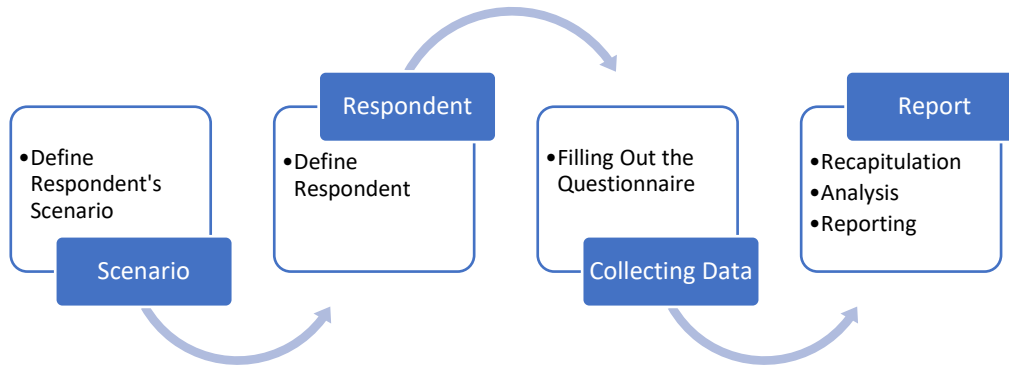


Fig. 1. Research methods flow.

2.1 Scenario

Before conducting research, designing a research procedure scenario is the earliest stage to do. The following is a scenario of user experience research procedures in the LAN cable crimping simulation application:

1. Selecting respondents based on study program, semester, student status, and status that they have never received LAN cable crimping practicum.
2. Convey to all respondents the time or date for respondents to conduct basic training on the use of VR and testing on simulation applications.
3. Respondents were given basic training on the use of VR using the SteamVR interaction system.
4. Respondents played the simulation application and performed each set of processes in the LAN cable crimping simulation application, then filled out the questionnaire directly after using the simulation application.
5. Processing the test results data that has been obtained from the questionnaire, the data is processed to get the average of each factor in the test.
6. Recapitulating the test results data, at this stage displaying the average value in the SUS method. This value will later be used to determine which part of the user experience of the LAN cable crimping simulation application needs to be improved.
7. Analyse the test results that will serve as a reference to improve and enhance the user experience on the object of research and provide reasons why to improve and enhance factors that are considered unsatisfactory.
8. Provide conclusions and suggestions for the tests that have been carried out. Conclusions are obtained from the results of the data evaluation. Suggestions contain a list of improvements for user experience in the LAN cable crimping simulation application concerning the SUS method.

2.2 Respondent

Respondents of this research are end users. According to [3], the determination of the number of respondents varies in each study according to the needs of the researcher himself. In research using several questionnaires including the SUS questionnaire, a minimum respondent size of 12-14 participants is required to obtain fairly reliable results [7]. Therefore, in this study 14 respondents will be used. The profile of respondents to be studied is active students of Batam State Polytechnic from various study programs and who have never done LAN cable crimping practicum from lectures.

2.3 Collecting Data

Measurement of user experience in this study uses the system usability scale (SUS). SUS consists of 10 instruments that cover the assessment of effectiveness, efficiency, and satisfaction [8]. In each question, a comment column is given so that respondents can submit comments, suggestions, and user experience. The following are 10 measurement instruments that exist in the SUS method [9]:

Table 1. SUS Measurement Instruments

<i>No</i>	<i>Statement</i>
Q ₁	I think that I would like to use this simulation frequently
Q ₂	I found the simulation unnecessarily complex
Q ₃	I thought the simulation was easy to use
Q ₄	I think that I would need the support of a technical person to be able to use this simulation
Q ₅	I found that the various functions in this simulation were well integrated
Q ₆	I thought that there was too much inconsistency in this simulation
Q ₇	I would imagine that most people would learn to use this simulation very quickly
Q ₈	I found the simulation very awkward to use
Q ₉	I felt very confident using the simulation
Q ₁₀	I needed to learn a lot of things before I could get going with this simulation

2.4 Report

SUS has several answer scales which are shown in table 2 as follows [4]:

Table 2. SUS Answer Scale

Scale	Category
1	Strongly Disagree
2	Disagree
3	Somewhat Agree
4	Agree
5	Strongly Agree

After the questionnaire data given to respondents was collected, calculations were made to obtain the SUS value using [10].

1. On odd statements, the answer scale is reduced by 1.

$$SUS_{\text{odd score}} = \sum_{Px-1} \quad (1)$$

Where Px is the number of odd-numbered statements.

2. On even statements, the answer scale is reduced by 5.

$$SUS_{\text{even score}} = \sum_{5-Pn} \quad (2)$$

Where Pn is the number of even-numbered statements.

3. Scale responses were summed and multiplied by 2.5.

$$\text{Total score} = (\sum \text{skor}_{\text{odd}} + \sum \text{skor}_{\text{even}}) \times 2,5 \quad (3)$$

4. The average answer is determined from the statements.

$$\bar{x} = \frac{\sum x}{n} \quad (4)$$

Description:

\bar{x} = average score which is the final result of the calculation

x = total score

n = number of respondents

The recapitulation of the value in the form of the average cumulative value of the instrument will determine the results of the evaluation of the simulation application under study.

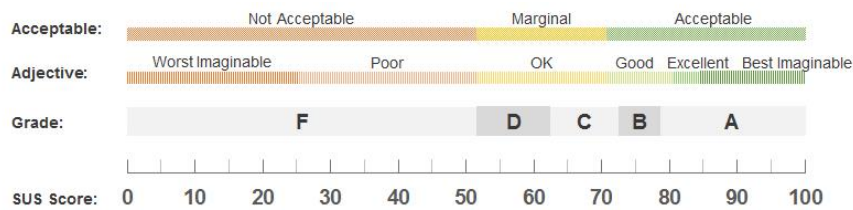


Fig. 2. Determination of usability evaluation results with SUS

Source: [11]

3 Results

3.1 System Usability Scale (SUS) Evaluation

After testing the LAN cable crimping simulation application, the following are the respondents' responses to the 10 questions on the questionnaire submitted.

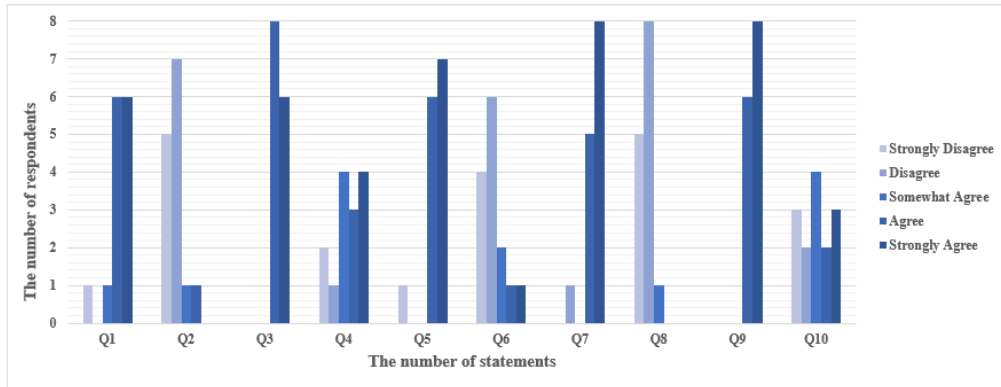


Fig. 3. Graph of the results of respondents' answers

According to the graph in **Figure 3**, the results of respondents' answers can be summarised as follows:

No. Result

Q1 There are 2 most scales filled in by users, namely the Strongly Agree scale with a percentage of 42.9% (6 people) and the Agree scale with a percentage of 42.9% (6 people). With the percentage mentioned, it can be concluded that statement number 1 (odd) is by expectations, namely, most users will often use the LAN cable crimping simulation application.

Q2 There are 2 most scales filled in by users, namely the Strongly Disagree scale with a percentage of 35.7% (5 people) and the Disagree scale with a percentage of 50% (7 people). With the percentage mentioned, it can be concluded that statement number 2 (even) is by expectations, namely, most users consider the LAN cable crimping simulation application to be made according to the needs of the existing practicum module.

Q3 There are 2 most scales filled in by users, namely the Strongly Agree scale with a percentage of 42.9% (6 people) and the Agree scale with a percentage of 57.1% (8 people). With the percentage mentioned, it can be concluded that statement number 3 (odd) is as expected, namely, all users feel that the LAN cable crimping simulation application is easy to use.

Q4 There are 3 most scales filled in by users, namely the Strongly Agree scale with a percentage of 28.6% (4 people), the Agree scale with a percentage of 21.4% (3 people), the Somewhat Agree scale with a percentage of 28.6% (4 people). With the percentage mentioned, it can be concluded that statement number 4 (even) is less in line with expectations, namely, most users need help from technical people to use the LAN cable crimping simulation application due to the first-time testing using virtual reality tools.

Q5 There are 2 most scales filled in by users, namely the Strongly Agree scale with a percentage of 50% (7 people) and the Agree scale with a percentage of 42.9% (6 people). With the percentage mentioned, it can be concluded that statement number 5

4	<i>R4</i>	4	3	4	3	4	3	4	3	4	4	36	90
5	<i>R5</i>	2	3	3	0	3	4	4	4	4	1	28	70
6	<i>R6</i>	0	3	3	2	0	2	3	3	3	3	22	55
7	<i>R7</i>	4	3	4	2	4	2	4	2	4	2	31	78
8	<i>R8</i>	3	4	3	1	3	3	3	3	4	1	28	70
9	<i>R9</i>	3	3	3	2	3	3	3	3	3	2	28	70
10	<i>R10</i>	4	4	3	0	3	3	4	3	3	2	29	73
11	<i>R11</i>	3	1	3	0	4	1	4	4	4	0	24	60
12	<i>R12</i>	3	4	4	0	4	0	4	4	3	0	26	65
13	<i>R13</i>	3	3	3	2	3	4	1	3	3	0	25	63
14	<i>R14</i>	4	4	4	4	4	4	4	4	4	4	40	100
<i>Total Score (Result)</i>												74	

Based on the research method, the usability evaluation research results of the LAN cable crimping simulation application received a final result of 74 in the following category:

- Acceptability ranges: Acceptable
- Grade scale: B
- Adjective rating: Good

Things that can be improved based on respondents' comments on the low score given are in the scene of the work on the color sorting part of the cable contents, respondents feel that the distance between the contents of the cable is too close so that it is quite sensitive and often touched by the contents of the cable that are not in order so that error signs often appear. In testing the simulation application, it was also found that some objects disappeared when the object fell to the floor and making respondents have to repeat the scene to continue the task. Respondents also suggested the addition of interactive audio, pop-up information, and ongoing processes to make it more interactive and provide a pleasant experience for users.

4 Conclusion

4.1 Conclusions

Based on the results of the usability evaluation using the SUS questionnaire to 14 respondents, the LAN cable crimping simulation application received an overall average score of 74 with an adjective rating of "good" and a grade scale of B. The results of the analysis of the ten instruments, there were 28.6% of respondents who gave the lowest score to instrument number 4 regarding the respondent's need for technician assistance in using the application and there were 28.6% of respondents who gave the lowest score to instrument number 10 regarding the need for many things to be learned before using this simulation application. Overall, the respondents involved in the study commented that the simulation application is good and if successfully implemented it will be very useful for learning.

4.2 Suggestions

Based on the research results on the LAN cable crimping simulation application, here are suggestions for further development:

1. This simulation application can be designed as a learning media, such as how to memorize the colour sequence of cable contents and differences in installation depending on the type of UTP cable. It is intended that this simulation application can be maximized as a learning media that can be a companion media or can be a substitute for conventional media.
2. This simulation application can be added to its features as a competency test media to measure student understanding of the LAN cable crimping process. It is intended that this simulation application can be used as an alternative in testing student competence.

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