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College Students' Perceptions Toward Usability of Simulator Application as a Form of Virtual Experiment at the Distance Learning

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Abstract

The use of simulator applications as one of the learning media is used in face-to-face classes. Its use is rarely used to support distance learning. In fact, the distance learning process must have the same quality as face-to-face learning. The role of technology and media is one of the keys to success in conveying material to students. This study examines the use of simulator applications in distance learning in terms of its reusability. The simulator application used is Cisco Package Tracer on learning computer networks with modules as the main teaching material used by students. The use of this media aims to understand and practice computer network simulations. By involving 60 participants, a case study regarding usability feasibility was measured by using the USE Questionnaire which consisted of 4 usability dimensions: Usefulness, Ease of Use, Ease of Learning, and Satisfaction. The findings show that the use of simulator applications in distance learning gets good or positive responses in the context of usability. This shows that the use of simulator applications is suitable for use in distance learning.

Keywords: Cisco package tracer, computer network, distance learning, USE questionnaire

1. Introduction

Distance learning is a learning concept that separates teachers from students or students. The development of information technology is currently creating a distance learning process that supports students' needs for more optimal learning (Olapiriyakul & Scher, 2006). Meanwhile, for higher education providers, distance learning requires low costs, is flexible, and reaches a larger market (Casey, 2008), (Saunders et al., 2020). However, distance learning still has limitations, including control from students who are less independent, and many students cannot manage themselves and need direction from their lecturers (Rovai & Jordan, 2004). Furthermore, several previous studies have explained that distance or online teaching requires different pedagogy and expertise than traditional classrooms (Fetherston, 2001); (Hardy & Bower, 2004); (Oliver, 1999). For example, in the context of courses that involve theory and practice, such as computer network courses, students must be involved in practical activities. Of course, in distance learning activities these practical activities become exceedingly difficult to do. Even though these activities provide a lot of experience and benefits to students because they can experience firsthand what they should understand through practical activities. This requires a solution, at least students have the experience to practice through simulations. The presence of simulator software certainly helps students understand practical activities with different experiences such as learning how to interactively simulate interactions between (Prisk & Dunn, 2002). This simulator assists in delivering learning content (Akilli, 2007) and implementing learning outcomes in the form of simulations (Gredler, 2013). The use of simulator software also helps in evaluating and testing network performance, checking network configurations, and makes it easier to learn without having to disturb the real network (Elias & Ali, 2014).

In the context of direct learning in class, the use of simulation software provides several benefits. Ruiz-Ramos (Ruiz-Ramos et al., 2017) reveal how the use of simulation software is useful in providing firsthand experience. Like previous research, Beneroso (Beneroso & Robinson, 2022) revealed that simulation software can bridge the need to study facts, theories, models, and methodologies in solving problems in the real world. In a different context, real or imaginary simulation learning helps students understand how a tool works (Landriscina, 2013) as well as experience recognizing real events, situations and objects (Yalcin et al., 2015). They also emphasized that the application of

simulation program practices can be focused on two different objectives, namely explaining a particular topic, or explaining the steps that must be followed in solving a particular case. Although the use of learning processes that use simulation programs provides real benefits in learning concepts or solving certain cases, research that focuses on simulations in the context of distance learning is still very rarely done.

This study aims to find empirical evidence of how students accept or review the usability of simulation software in distance learning. The distance learning model has its own challenges where students experience difficulties and limitations in managing learning (Irfan et al., 2020). In this distance learning, a module is used as the main teaching material for students in conducting simulation practicums using Cisco package Tracer. This is a simulator application that can be used for learning and training on computer networks (Shanmugam et al., 2011). The use of this simulator aims to be able to understand the theory and concepts of computer networks virtually (Javid, 2014) so that students can perform experiments and practice computer network assignments online independently (Noor et al., 2018). In addition, this simulation software can assist students in learning computer networks both in class and at their homes through an e-learning platform as done (Podsadnikov et al., 2021). Students are actively involved in conducting experimental simulations using this simulator application in distance learning. Thus, so that this research goes on the right track, the research question to be answered is how to evaluate the usability of computer network simulations using simulation software on distance learning from user experience?

2. Materials and Methods

2.1. Materials

2.1.1 Participants

The sample data used for this study are students of the Information Systems study program at one of the state universities in Indonesia who have integrated the Network Administration and Server Administration courses with a total of sixty students in 2022. The participants are spread throughout Indonesia with a distribution of the city of Jember 16.52 %, Makassar 14.20%, Bandar Lampung 8.41%, Jakarta 6.67%, Bogor 5.51% and the remaining thirty-one other cities in Indonesia. The age range of the participants was between 20 years and 45 years with the proportion of men being 60% and women being 40%.

2.1.2 Instruments

Questionnaire is used as an instrument of this research. The questionnaire in this study contains closed questions with the aim of exploring an overview of feelings and experiences with measurable data in the use of simulators in distance learning. Questions on the questionnaire used a Likert scale with 5 different answers: Strongly agree (scale 5), Agree (scale 4), undecided (scale 3), disagree (scale 2), and strongly disagree (scale 1). the larger the value indicates a positive answer and the smaller the value indicates a negative answer. There are 19 research questions divided into 4 factors, namely *usefulness (US), satisfaction (SA), ease of use (EU), and ease of learning (EL)* , according to indicators referring to *the Use Questionnaire* (Aelani, 2012). The validity of the instrument was evaluated using the Pearson product moment correlation, namely there were 19 valid questionnaire items and 0 invalid items, meaning that each question item above was valid and all of these question items could be included in the reliability test count. Cronbach's reliability measurement Alpha is used to measure the extent to which a questionnaire or measurement instrument used in research is consistent and dependable, Cronbach's value Alpha is 0.955. If you look at the reference value, the level of reliability is based on Cronbach's Alpha, the value range is included in the Very High category. It can be concluded that the questionnaire instrument consisting of nineteen questions used is reliable to be a usability measurement tool. This research instrument is used to obtain measurement results on the usability of Cisco applications. package Tracer for materials and computer network simulation (Álvarez et al., 2018); (León-Mantero et al., 2020).

2.2. Methods

2.2.1 Research design

This research is a particular case study research. The flow of this study uses *the USE Questionnaire* with the following stages: conducting a literature study, determining respondents, determining questions according to the *USE Questionnaire* collecting responses, analyzing test results, making results and conclusions. The stages of the research can be seen in Figure 1.

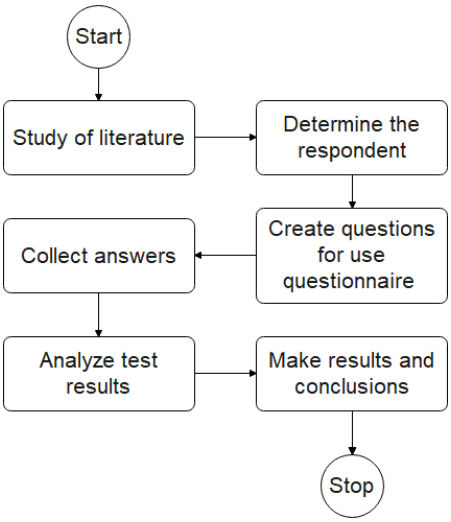

Figure 1: Research Stages

Literature study was conducted by identifying problems related to the observed object, namely the use of Cisco package Tracer in the subject matter book for Network Administration and Server Administration courses in the Information Systems Study Program. Then, sampling was carried out by purposive sampling, namely a sampling technique using the non-sampling method where researchers will determine and take samples by establishing special characteristics so that the purpose of determining this sample is to be able to answer research problems (Andrade, 2021); (Arash et al., 2022); (Sari & Maningtyas, 2020). The sample in this study were students who had taken Network Administration and Server Administration courses in the Information Systems Study Program. Next study *the USE Questionnaire* and make questions that refer to the *USE Questionnaire method.* Google Form is used as a medium for distributing questionnaires to students.

2.2.2 Analysis Data

We analyzed the data using two approaches. First, calculate the average of the 4 factors regarding usability in the USE *Questionnaire* to find out students' perceptions of usability using a Likert scale with the aim of measuring phenomena based on individual ratings of feelings, attitudes, perceptions (Harpe, 2015). The average rating scale for the four factors refers to the interval scale: 1.00 - 1.79 (Very Bad); 1.80 - 2.59 (Bad); 2.60 - 3.39 (Enough); 3.40 - 4.19 (Well); 4.20 - 5.00 (Very good). Second, measuring usability and presenting feasibility in usability measurements by comparing the observed score with the maximum score. When the observed score is close to the value of the maximum score, it means that the usability feasibility is getting better, this value is expressed in the eligibility percentage value with a range of values between 0 and 100%. The data obtained will then be converted based on the feasibility category table for a system as shown in table 5 (Arifin & Maharani, 2021).

Table 5. Eligibility Category

No	Number %	Classification
1	<2	Very Unworthy
2	21-40	Not feasible
3	41-60	Enough
4	61-80	Well worth it
5	81-100	Very Worth it

3. Results and Discussion

3.1 Data Findings

The results of the study summarize four aspects of usability and usability feasibility for the use of Cisco applications package Trace in the context of distance learning. The entire data can be seen from Table 6 to Table 10. Statements for each aspect asked can be seen in the instruments used in Appendix 1.

Based on the findings of the data in table 6. Obtained from measurements of the Usefulness factor, criteria US1 and US4 get the highest average score of 4.23, US3 criteria get an average score of 4.22, US2 gets an average score of 3.97, US6 got an average score of 3.92, and US5 got the smallest average score of 3.88. While the average Usefulness factor overall rating of 4.08 is included in the "Good" rating range

Table 6. The average value of Usefulness criteria

No	Criteria	Average
1	US1	4.23
2	US2	3.97
3	US3	4.22
4	US4	4.23
5	US5	3.88
6	US6	3.92
	Average Usefulness	4.08

Based on the findings of the data in table 7. Obtained from measurements of the Ease-of-use factor, EU2 criteria get the highest average score of 4.08, EU1 criteria get an average score of 4.07, EU4 gets an average score of 4.04, EU3 gets an average score of 3.92, and EU5 gets the smallest average score of 3.63. While the average value of the overall Ease of use factor is 3.94, it is included in the "Good" rating range.

Table 7. The average value of the Ease-of-use criteria

No	Criteria	Average
1	EU1	4.07
2	EU2	4.08
3	EU3	3.92
4	EU4	4.02
5	EU5	3.63
	Average Ease of use	3.94

Based on the findings of the data in table 8. Obtained from measurements of the Ease of learning factor, the EL1 and EL2 criteria get the highest average score of 3.82, and the EL3 criterion gets the lowest average score of 3.75. While the overall average of the Ease of learning assessment with an average of 3.79 is included in the "Good" rating range.

Table 8. The average value of the Ease of learning criteria

No	Criteria	Average
1	EL1	3.82
2	EL2	3.82
3	EL3	3.75
	Average Ease of learning	3.79

Based on the findings of the data in table 9. Obtained from measurements of the Satisfaction factor, SA2 criteria get the highest average score of 4.08, SA5 criteria get an average score of 4.00, SA4 gets an average score of 3, 92, SA1 gets an average score of 3.87, and SA3 gets the smallest average score of 3.85. While the assessment of the Satisfaction indicator with an average of 3.94 is included in the "Good" rating range.

Table 9. The average value of the Satisfaction criteria

No	Criteria	Average
1	SA1	3.87
2	SA2	4.08
3	SA3	3.85
4	SA4	3.92
5	SA5	4.00
	Average Satisfaction	3.94

The average results of the 4 measurement parameters show that respondents give a "good" appreciation of Cisco package Tracer of 3.94. Usability factor measurement on Cisco application feature components package Tracer is quite high because it can help in learning computer networks for distance learning.

Usability measurement by calculating the maximum scale score and the observation score for each dimension. The results of each score can be seen in Table 10. Usability measurement results USE questionnaire that is displayed can be seen that the eligibility value of usefulness is 81.50%, ease of use is 78.87%, ease of learning is 75.89% and satisfaction is 78.87%. So based on these results Cisco package Tracer is suitable for use in computer network learning for distance learning.

Table 10. Maximum score and observation score

No	Criteria	Number of Valid Items	Max Score	Observation Score	Percentage (%)
1	Usefulness	6	1800	1467	81.50
2	Ease of use	5	1500	1183	78.87
3	Ease of learning	3	900	683	75.89
4	Satisfaction	5	1500	1183	78.87
	Total	19	5700	4516	

3.2 Discussion

This study will answer how to evaluate the usability of computer network simulations using simulation software in distance learning. The usability evaluation is grouped based on the 4 usability factors in the USE *Questionnaire* (Lund, 2001). The findings show that the use of simulation software in distance learning is based on 4 factors, namely *usefulness, satisfaction, ease of use,* and *ease of learning. The following* is a discussion of the findings we got.

Usefulness: The findings show that the use of simulation software in distance learning helps students learn material and exercises related to computer network courses. Students disclose the use of Cisco simulator software package Tracer can help in simulating existing material on a computer network. This is in line with research conducted by (Akilli, 2007) in which simulators can assist in the delivery of learning content and can be used to evaluate and test without having to disrupt the real network (Elias & Ali, 2014). Students also revealed that computer network courses which require simulation practice using physical network devices can be replaced with simulation software so that they do not require computer network lab facilities and infrastructure. This shows that the use of simulation software is the same as providing direct experience (Ruiz-Ramos et al., 2017); (Lopreiato, 2016). Computer network courses can be well simulated using Cisco package Tracer because this simulation software has complete features for learning computer networks. Students can easily recognize objects related to computer network courses because the device symbols used are also the same as computer network material in general. This makes use of Cisco package This tracer makes it easier for students to simulate material as well as computer network experiments and exercises even though virtually. This is in accordance with research conducted by (Javid, 2014); (Noor et al., 2018). In distance learning in this study, modules are the media used to convey material. Distance learning models certainly have their own challenges compared to conventional learning models (Rovai & Jordan, 2004). However, the findings reveal that the use of Cisco simulator software package Tracer can be used in the distance learning process. This is an interesting finding because there are still few who have conducted research on measuring the usefulness of simulator software, especially for computer network courses in distance learning. Use of Cisco simulator software package Tracer based on the usefulness factor on the USE *Questionnaire* (Lund, 2001) shows that this simulator software is effective in learning computer networks for distance learning. Where previously research was carried out by (Khoiri, 2018)which explained that student learning outcomes are module-based in Cisco learning package Tracer has better results compared to Cisco package Desktop tracer in a hands-on learning context .

Ease of use : From the *Ease of use factor* based on the USE *Questionnaire* (Lund, 2001), the findings show that the Cisco simulation software package Tracer is easy and precise to use. The simulator is easy to run and is open source so students can easily get a simulator on the internet to download and install independently. The simulator has a simple and light appearance to use on low spec computers. Use of Cisco simulation software Packets are appropriate for use as distance learning media which can replace the role of virtual computer network labs in network simulation, visualization and collaboration capabilities in line with what was stated by (Zhang et al., 2012). Through this simulator software students can also complete the exercises that have been written in the module according to the directions. The next finding is that the use of this simulator software is in accordance with the wishes needed by students, even though the value is lower than the other findings regarding the *Ease-of-use factor*. Another interesting finding was that students stated that it was easy to use this computer network simulation software without having to

get help from other people. This is an important point because it supports distance learning where students must be able to do independent learning according to what was proposed by (Rovai & Jordan, 2004).

Ease of learning : Further findings regarding the *Ease of learning factor* based on the USE *Questionnaire* (Lund, 2001) is Cisco simulator software package Tracer is easy to learn, easy to remember, and students can use it fluently. Even though this finding is contrary to what was put forward by (Elias & Ali, 2014), however, the case put forward by Elias was carried out in a conventional learning class where lecturers and students were in the same time and room. Distance learning requires students to be able to carry out classroom and laboratory learning independently at home as stated by (Quan, 2000). This causes students in several areas that have geographical barriers to demand that they be able and able to use simulator (Syahruddin et al., 2021).

Satisfaction : A practice-oriented education requires teaching activities that have complete competence in supporting their profession (Johansen, 2023). According to (Kolb, 1984), learning with a simulator platform can provide students with an understanding and sense of responsibility in the learning process. The findings we get from the *Satisfaction factor* based on the USE *Questionnaire* (Lund, 2001) revealed that students were satisfied with the use of Cisco simulator software package Tracer in computer network courses. This is shown by the survey results which show that students feel happy, the use of simulators is in accordance with the wishes and expectations of students in distance learning. Satisfaction and a sense of comfort are expected to increase student learning outcomes in accordance with what was stated by (Bossman & Agyei, 2022) which states that satisfaction with learning media has a close relationship with student learning outcomes in distance learning as practiced in Ghana.

4. Conclusion

In general, this study aims to evaluate the effectiveness of simulator applications (Cisco package Tracer) has been widely used in conventional classes. However, in the context of using the simulator application in this study it is used in distance learning, which is still little done, especially in computer network material. The use of modules that contain theoretical information, examples, exercises, and tests to measure students' understanding of the material is used as a medium that connects lecturers with students in this study. Evaluation of usability in this study used the USE questionnaire with 4 usability dimensions, namely *Usefulness, Ease of use, Ease of learning, and Satisfaction.* The results showed that the use of Cisco simulator applications package Tracer in distance learning shows a positive value and can be accepted by students. Based on the *Usefulness* factor, *research* shows that this application is especially useful for students in doing practicum and implementing material in the module to be simulated. Based on the *Ease-of-use* factor, *research* shows that the application is easy to use according to the steps in the module. Based on *Ease of learning, students* state that the application is easy to learn without having to have a companion so that students can study independently according to the characteristics of distance learning. Based on the *Satisfaction* factor, *research* shows that students feel satisfied in using the Cisco simulator application package Tracer on computer network material.

Usability studies using simulator applications in distance learning. The success of distance learning, especially in the field of computer science, especially computer networks, is a challenge for the organizers. Expected learning outcomes and competencies must be the same as face-to-face conventional learning which is currently widely used. With the hope that distance learning can be more popular and can make the same contribution in building the next generation of professionals.

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Appendix

Table 1 is the questions that are grouped in the *Usefulness factor.*

No.	Code	Question
1	US1	Does using Cisco Packet Tracer allow material about computer networks to be simulated properly?
2	US2	Can Cisco Packet Tracer replace network computer lab facilities and infrastructure?
3	US3	Is Cisco Packet Tracer useful for distance learning?
4	US4	Does the Cisco Packet Tracer feature make it easy to simulate a computer network properly?
5	US5	Does the Cisco Packet Tracer simulation represent the real situation for computer networking practices?
6	US6	Is using Cisco Packet Tracer more effective in learning?

Table 2 is the questions grouped under the *Ease-of-use factor.*

No.	Code	Question
1	EU1	Does using Cisco Packet Tracer make it easier to complete lecture exercises?
2	EU2	Are the features and components of Cisco Packet Tracer easy and precise to use?
3	EU3	Is it when using Cisco Packet Tracer as you wish?
4	EU4	Does Cisco Packet Tracer look very clear and easy to understand?
5	EU5	Is Cisco Packet Tracer easy to use without any help from friends?

Table 3 is the questions grouped into the *Ease of Learning factor.*

No.	Code	Question
1	EL1	Is using Cisco Packet Tracer easy to learn quickly?
2	EL2	Is using Cisco Packet Tracer easy to remember?
3	EL3	Is it very easy to use Cisco Packet Tracer fluently?

Table 4 is the questions grouped into the *Satisfaction factor.*

No.	Code	Question
1	SA1	Am I satisfied using Cisco Packet Tracer for lecture material about computer networks?
2	SA2	Is using Cisco Packet Tracer in distance learning enjoyable?
3	SA3	Is the way Cisco Packet Tracer works as desired?
4	SA4	Is this Cisco Packet Tracer a great help in distance learning?
5	SA5	Is it convenient to use Cisco Packet Tracer for remote lectures?