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Higher Education e-Learning Usability Analysis Using System Usability Scale

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Abstract

The COVID-19 pandemic encourages almost every institution to optimize the use of information and communication technology to maintain consistency and competitive advantage. One of the efforts made by Higher education is developing and optimizing online-based learning (e-learning) models. E-learning plays an important role for the success of achieving learning objectives at Telkom Institute of Technology Purwokerto (ITTP) which is conducted between lecturers and students. The problem faced in optimizing e-learning system at ITTP is related to usability. The purpose of this study is to evaluate the usability level of the ITTP e-learning system using System Usability Scale (SUS) method. Based on the testing of questionnaire instruments using SPSS software, it was obtained the result that the questionnaire used for the study was valid and the reliability rate was 0.758. Based on the results of system tests to 100 respondents or users, it is known that the SUS score is 55.3. The value indicates that the acceptability ranges are in the Marginal Low range. It can be seen from the adjective rating, SUS score from the ITTP e-learning system is in the CATEGORY OK and according to Curved Grade Scale (CGS) is in grade D. Based on Net Promoter Scale (NPS), the score 55.3 indicates that the ITTP e-learning system users tend to be in the Detractor category.

Keywords: *e-learning, usability, SUS, NPS, COVID-19*

1. Introduction

The development of information and communication technology (ICT) encourages every organization to utilize and optimize ICT to achieve a competitive advantage. ICT can change one's lifestyle as well as the business of organizational processes in interacting with others including in learning activities in Higher Education. Since the outbreak of Pandemic Corona Virus Disease 2019 or better known as COVID-19, most Educational institutions ranging from playgroups, kindergartens, elementary schools, middle schools to higher education have had a serious impact [1]. Efforts to prevent the spread of COVID-19 continue to be carried out globally, including policies to regulate or maintain physical distancing that ultimately results in the implementation of online learning systems for educational institutions including universities. This encourages every Educational institution including universities to compete in optimizing ICT-based learning models through the development of various online learning (e-learning) platforms.

The goal of universities developing e-learning as a means of learning is to achieve more effective and efficient learning goals[2]. The development of an e-learning system needs to be aligned with the objectives of the institution, according to the needs and uses both in terms of teachers/lecturers and students. Students are one of the actors who play an important role in the successful implementation of e-learning[3]. Besides, lecturers as educators are also important actors in the implementation of e-learning systems. The readiness of lecturers and students in admissions and utilizing the e-learning system has a profound effect on the successful implementation of e-learning in universities. E-learning

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system in universities today has become a very important medium for both teachers and students, this is because e-learning plays an important role in the learning process[4][5]. E-learning can be defined as a group of teaching and learning activities including training delivered through ICT which is usually in worldwide web technology[6].

The background of this research is based on the observation that until now the e-learning system owned by Telkom Institute of Technology Purwokerto (ITTP) is mostly used as a medium for delivering learning materials by lecturers and collecting assignments from students in the form of text-based documents. Other functions and menus are still rarely optimized such as attendance, quiz/test or multimedia-based assignments, synchronous learning models based on e-learning, questionnaire, survey, virtual programming lab, and workshop, and so on. This problem is part of the usability problem where according to the usability guidelines a website must meet user expectations regarding navigation, content, and website organization.[7]. A product is used by the user to achieve certain goals with effectiveness, efficiency, and satisfaction in a particular usage context[8]. It refers to the definition of usability according to [9] as "the extent to which a system, product or service can be used by specified users to achieve specified goals with effectiveness, efficiency, and satisfaction in a specified context of use".

According to [10] there are five variables Indicator usability of a system or product consists of the following:

a) Learnability reflects the level of ease with which users use the system easily and whether the user can solve problems when first using the system.
b) Effectiveness and efficiency is the level of accuracy of the system obtained by the user as well as the resources used concerning the results (how quickly) the user achieves in completing a particular task.
c) Memorability where users use the system after not using it for a certain time and whether they can use it without difficulty.
d) Error related to the number of errors users encountered when they used the system and whether it was easy to recover from this error.
e) Satisfaction, the extent to which a user's physical, cognitive, and emotional responses result from the use of a system, product, or service meets the needs and expectations of the user.

Based on this background, this research aims to evaluate the usability of the ITTP e-learning system. These results can then be utilized as the basis for continuous improvement for the ITTP e-learning system developers to present an online learning system that is more effective and efficient and also meet the users' needs and expectations (lecturers and students). One of the instruments measuring the usability of a product is the System Usability Scale (SUS). SUS is a "quick and dirty" usability measurement instrument developed by Brooke[11]. SUS is the most popular usability testing tool for testing usability perception (*perceived usability*) [12] [13] and rated valid and reliable[14].

2. Research Methodology

This stage of research is illustrated in Figure 1 and follows iteratively from analysis, formulation of problems to drawing conclusions.

2.1. Problems Analysis and Formulation Stage

Problems analysis and formulation aim to identify the problems faced or the background of the research. This stage is done through observation of problems in research objects and also literature studies relevant to the problem to determine the scope, the right method of problem-solving.

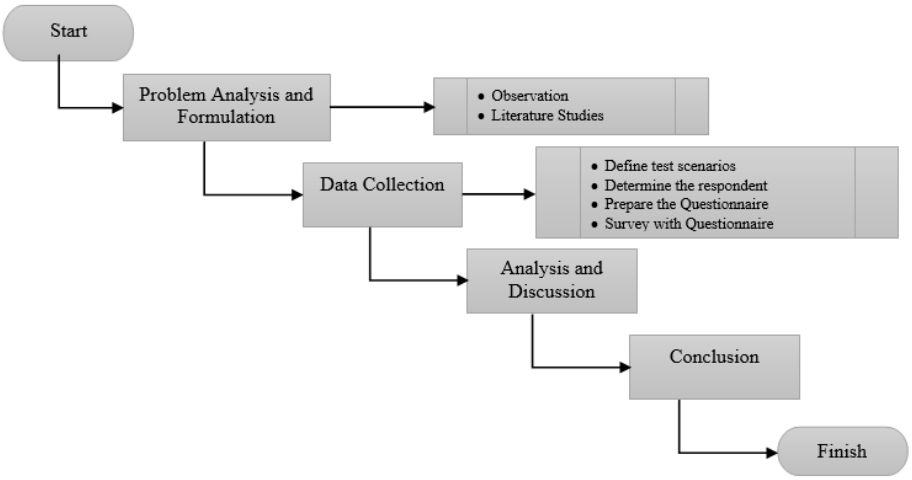

Figure 1. The Stage of the Research

2.2. Data Collection Stage

The data collection stage is divided into several stages. The first step is to determine the test scenario conducted by explaining the ITTP e-learning system to be tested and a questionnaire. The next stage is the determination of respondents consisting of lecturers and students as users of the e-learning system. The total number of respondents is 100 people consisting of lecturers and students. According to Roscoe in [15] the decent sample size in the study was between 30 to 500. The next stage is the preparation of questionnaires.

Questionnaire to measure the usability of the ITTP e-learning system from the subjective side of the user using the System Usability Scale (SUS) questionnaire. SUS has been developed by John Brooke in 1986. Reasons for the use of SUS in this study include that SUS has several advantages such as ease of use and usability results are shown in the form of scores of 0 – 100 [11], the analysis calculation process is not difficult[16], and SUS proved valid and reliable[17]. Based on [11] The SUS questionnaire consists of 10 indicator statements as shown in Table 1. The assessment scale was used using the Likert scale from numbers 1 to 5 where 1 means strongly disagree and 5 means strongly agree to each of SUS statement items [18]. The questionnaire was compiled in the form of google form which was then distributed for 1 month from December 28, 2019, to January 30, 2020.

Table 1. System Usability Scale (SUS) Statement Item [17]

Code	*Statement Items*	*Scale*
P1	I thought that I would like to use the e-learning system of ITTP frequently.	1 to 5
P2	I found that the e-learning system of ITTP was unnecessarily complicated.	1 to 5
P3	I thought that the e-learning system of ITTP was easy to use.	1 to 5
P4	I thought that I would need the support of a technical person to be able to use the e-learning system of ITTP.	1 to 5
P5	I found the various functions in the e-learning system of ITTP were well-integrated.	1 to 5
P6	I thought there was too much inconsistency in the e-learning system of ITTP.	1 to 5
P7	I would imagine that most people would learn to use the e-learning system of ITTP very quickly.	1 to 5
P8	I found that the e-learning system of ITTP is very complicated to use.	1 to 5
P9	I felt very confident using the e-learning system of ITTP.	1 to 5
P10	I needed to learn a lot of things before I could get going with the ITTP e-learning system.	1 to 5

2.3. Analysis and Discussion Stage

This stage is done to calculate the results of the ITTP e-learning system assessment with the SUS framework. At this stage, there is a rule whereby the statement item with odd numbers (P1, P3, P5, P7, and P9) then the respondent's assessment score is reduced by 1 while each statement item with even numbers (P2, P4, P6, P8, and P10) then 5 minus the assessment score of the respondent the next number of scoring scores multiplied by 2.5 [8]. Here's the calculation formula for individual SUS scores:

$$Score\ of\ SUS = (((P1-1)+(5-P2)+(P3-1)+(5-P4)+(P5-1)+(5-P6)+(P7-1)+(5-P8)+(P9-1)+(5-P10))*2{,}5) \quad (1)$$

The calculation of the individual's SUS score is carried out as many as a number of respondents and then calculated the average overall scoring score of each SUS assessment of the individual. This stage of analysis and discussion was also conducted testing the statistical validity and reliability from respondent data that had been obtained using SPSS software.

2.4. Conclusion Stage

Once it is known the average overall assessment score of SUS and the results of the validity and reliability test, the next stage is to conclude from the outcome of usability research from the ITTP e-learning system.

3. Result and Discussion

3.1. Conclusion Stage

The data that were obtained were 100 assessment data from users of the ITTP e-learning system. Table 2 shows the profile of respondents of the ITTP e-learning system. Based on the distribution, respondents came from two Faculties in ITTP namely the Faculty of Industrial Engineering and Informatics (FTII) is about 70% and the Faculty of Telecommunication and Electrical Engineering (FTE) is about 30% distributed into 8 (eight) majors in both faculties with the frequency and percentage of respondents of each major from the highest to the lowest as shown in Table 2. Based on their role as users of the system, respondents consisted of lecturers, and students with a proportion of 32% were lecturers and 68% were students.

Table 2. Respondents Profile and Distribution

Scope	*Frequency*	*Percentage*
FTII	70	70%
FTE	30	30%
TOTAL	**100**	**100%**
S1 Information System	45	45%
S1 Informatics	16	16%
S1 Software Engineering	5	5%
S1 Telecommunication Engineering	13	13%
S1 Electrical Engineering	7	7%
D3 Telecommunication Engineering	10	10%
S1 Industrial Engineering	3	3%
S1 Visual Communication Design	1	1%
TOTAL	**100**	**100%**
Lecturer	32	32%
Students	68	68%
TOTAL	**100**	**100%**

Table 3 represents one example of data generated from the usability questionnaire of the ITTP e-learning system with the SUS framework. The table data consists of respondent columns that are worth 1 – 100 respondents, P1 to P10 is the code for

each statement of the SUS framework of 10 statement items. Meanwhile, the Score column is the column of the calculation of the assessment of each respondent against each statement item using formula (1). The values in the Score column obtained from calculation by using the formula (1), as follows:

$$Score = (((5-1)+(5-4)+(4-1)+(5-2)+(4-1)+(5-2)+(4-1)+(5-2)+(4-1)+(5-2))*2{,}5)$$
$$= (4+1+3+3+3+3+3+3+3+3)*2{,}5 = 72{,}5$$

The score is calculated from respondents who have conducted an assessment of the ITTP e-learning system. After 100 respondents' data in the assessment score calculated, the next stage is to calculate the average SUS assessment score of 100 respondents that is 55.3.

Table 3. Data generated from the SUS Questionnaire

Respondents	P1		P2	P3	P4	P5	P6	P7	P8	P9	P10	Score
1	5		4	4	2	4	2	4	2	4	2	72,5
2	4		4	3	5	5	5	4	5	1	5	32,5
3	4		3	3	4	3	4	2	4	4	4	42,5
4	3		3	3	3	3	4	4	4	4	4	47,5
..	..		..	..	..	..	..	..	..	..	..	..
..	..		..	..	..	..	..	..	..	..	..	..
100	5		3	3	5	3	2	4	3	1	5	45
	Average Score of SUS											**55,3**

3.2. Result of Validity Test

Validity tests were conducted to determine the validity or suitability of questionnaires used in measuring and obtaining research data from respondents. This validity test conducted using SPSS software with a correlation of coefficients using Pearson (2 tail) and a significance value of 5%. For the data of 100 respondents, the table R value is 0.195. Validity test results show that the suitability of the questionnaire used is valid because $R_{count} > R_{table}$, which the score of R_{count} from each items above 0,195 (R_{table}), as shown in table 4.

Table 4. Statistical Validity test results

Item	R_{count}	R_{table}	Description
P1	0,442	0,195	Valid
P2	0,386	0,195	Valid
P3	0,480	0,195	Valid
P4	0,376	0,195	Valid
P5	0,426	0,195	Valid
P6	0,510	0,195	Valid
P7	0,474	0,195	Valid
P8	0,608	0,195	Valid
P9	0,584	0,195	Valid
P10	0,476	0,195	Valid

3.3. Result of Reliability Test

Reliability tests were carried out to see if the questionnaire had consistency or reliability if measurements are carried out using the questionnaire repeatedly. According to[19], a questionnaire instrument considered to be reliable if it meets criteria such as Table 5 below:

Table 5. Reliability Interpretation

Correlation Coefficient	Reliability Criteria
0,81 < r ≤ 1,00	Very High
0,61 < r ≤ 0,80	High
0,41 < r ≤ 0,60	Enough
0,21 < r ≤ 0,40	Low
0,00 < r ≤ 0,20	Very Low

Based on statistical reliability test results using SPSS software, data obtained that Cronbach's Alpha shows a value of 0.758, as shown in Table 6. It refers to Table 5 that this test questionnaire has a high level of reliability.

Table 6. Statistical Reliability test results

Cronbach's Alpha	N of Items
.758	10

3.4. SUS Score Analysis

After obtaining the average score of the assessment of 100 respondents, the next stage is to determine the Acceptance Score Grade. There are two ways to determine the Acceptance Score Grade[17]. Firstly, it can be seen from the acceptability ranges consisting of "Not Acceptable"; "Marginal Low"; "Marginal High"; and "Acceptable" and secondly, from the Adjective Rating consisting of "Worst Imaginable"; "Poor"; "OK"; "GOOD"; "Excellent"; and "Best Imaginable". The average SUS score is considered to represent the value or level of user acceptance of the system tested for usability. To consider that the system has a usability level within the "Acceptable" range, the SUS score must be above 70[17]. Based on the results of the study, the SUS score from the ITTP e-learning system is rated 55.3, as shown in Figure 2. The result indicates that the system is still in the range of receiving "Marginal Low" and Adjective rating "OK".

Besides, to use these two Acceptance Score Grade approaches, the SUS scores can also be interpreted in the Curved Grading Scale (CGS) assessment version[20]. Based on the grade scale, the ITTP e-learning system SUS score of 55.3 is included in the grade scale D category, as shown in Table 7.

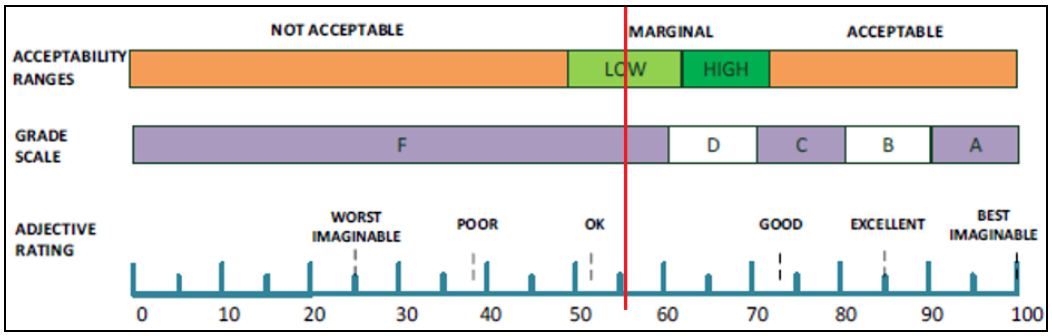

Figure 2. Acceptance Rate of the ITTP e-learning System Users[17].

According to[17], as it has been explained that the ten items of the SUS statement are categorized into two. Statement items number 1, 3, 5, 7, and 9 are positives statement items, while statement items number 2, 4, 6, 8, and 10 are negative statement items. Based on the data obtained, it indicates that the percentage and average of each category of positive statements and negative statements shown in Table 8, Figure 3, and Figure 4. Based on the data, it shows that the test results showed that the average respondent rated positives statement items higher than

negative statement items of 3.51 and 3.09. The result indicates that respondents are still giving a more positive assessment of the ITTP e-learning system.

Table 7. Curved Grade Scale (CGS) SUS[20]

Grade	SUS	Percentile range
A+	84.1 – 100	96 – 100
A	80.8 – 84.0	90 – 95
A-	78.9 – 80.7	85 – 89
B+	77.2 – 78.8	80 – 84
B	74.1 – 77.1	70 – 79
B-	72.6 – 74.0	65 – 69
C+	71.1 – 72.5	60 – 64
C	65.0 – 71.0	41 – 59
C-	62.7 – 64.9	35 – 40
D	51.7 – 62.6	15 – 34
F	0 – 51.6	0 – 14

Table 8 shows some of the problems that occurred in the use of the ITTP e-learning system as follows:

a) The average respondent stated that the ITTP e-learning system is still complicated,
b) The average respondent stated that they still need support from technical people to use the ITTP e-learning system
c) The average respondent stated that they need time to learn many things before continuing the ITTP e-learning system

Average respondents of the test dealt with these problems as a user of the ITTP e-learning system.

Table 8. Percentage and Average Score of Questionnaire Results

Category	Item	score					Average	
		1	2	3	4	5		
Positive Items	P1	3%	4%	27%	47%	19%	3,75	3,51
	P3	6%	6%	35%	39%	14%	3,49	
	P5	3%	11%	48%	23%	15%	3,36	
	P7	4%	10%	28%	41%	17%	3,57	
	P9	4%	12%	38%	32%	14%	3,40	
Negative Items	P2	5%	10%	35%	36%	14%	3,44	3,09
	P4	10%	22%	23%	24%	21%	3,24	
	P6	10%	22%	44%	20%	4%	2,86	
	P8	15%	30%	34%	18%	3%	2,64	
	P10	9%	16%	29%	31%	15%	3,27	

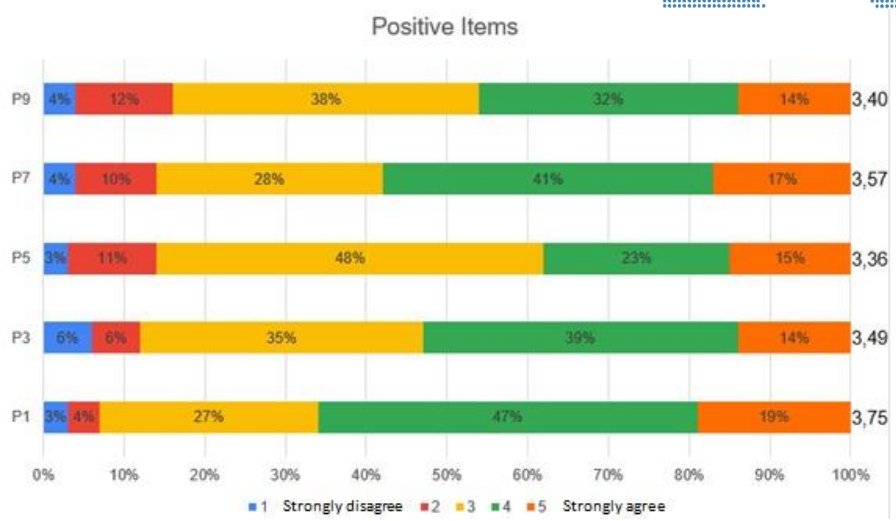

Figure 1. Percentage Spread and Average Value of Positive Statement Items

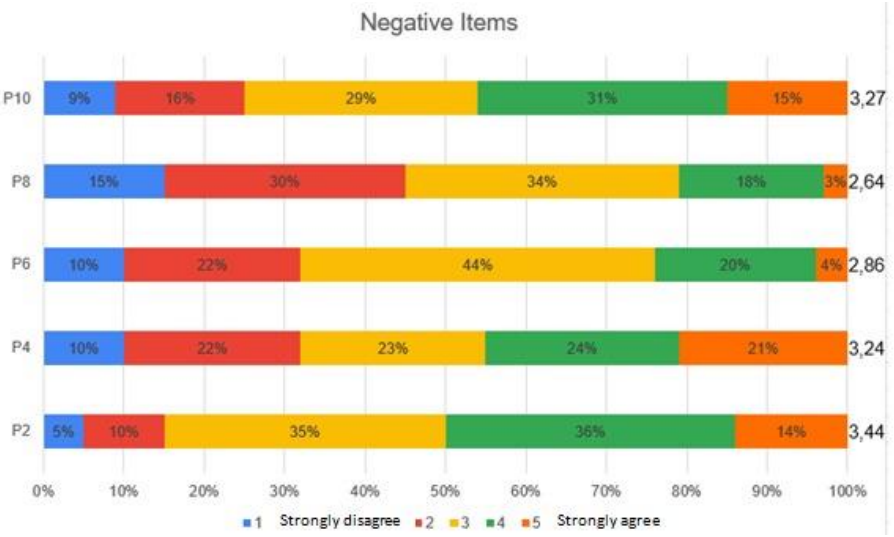

Figure 2. Percentage Spread and Average Value of Negative Statement Items

The SUS scores can also interpret the user's tendency to become a Promoter, Detractor, or Passive[21]. According to[22], to determine the Net Promoter Scale (NPS) is calculated from the proportion of respondents' assessment of a product. If the assessment score ≤ 60, then the Detractor category, if the assessment score is between 90 to 100, then the Promoter category, and if the assessment score ranges from 70 to 80, then the passives category. The three characteristics show that for promoters, the user is satisfied with the system used and will continue to use it. Meanwhile, the detractor is a user who has less experience of the given system or product and is likely to spread negative news about the system if there is an opportunity.

4. Conclusion

Testing the usability level of the ITTP e-learning system using the System Usability Scale (SUS) method tested to users obtained results of 55.3. The SUS score shows that based on the acceptability ranges, the system is in the Marginal Low acceptance range. While if reviewed from an adjective rating, the ITTP e-

learning system is in the category of "OK" rating. Besides, the ITTP e-learning system is also included in grade D when viewed from the curved grade scale (CGS) criteria. Currently, users still rate quite positively against the ITTP e-learning system. Besides, there are still some problems faced by users. These problems require the ITTP e-learning system developers and managers to continuously improve the system to meet the needs and facilitate users. Some improvements include minimizing the complexity of the system from the functional aspect, organizing menus on the system, and platforms can make it easier for users to be more responsive when the system is opened both in the web browser and on mobile devices. Besides, it is necessary to provide additional information and socialization of the use of the system by technical personnel to users who can be video tutorials or manual books or even directly. This improvement is necessary to anticipate users to become detractors who will tend to spread negative assessments due to their dissatisfaction with the ITTP e-learning system.

Further research that can be done is through the investigation of variables that affect the assessment based on expectations of different users (customer satisfaction). There must be a different expectation from lecturers and students on the services of the e-learning system (service quality) provided by the ITTP. It can then be used as a basis to support decisions to improve the quality of service of each service system provided by the organization.

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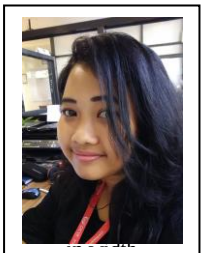

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