An Analysis of User Interface and User Experience Using System Usability Scale and GOMS Method

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ABSTRACT

This study aims to examine user interface and user experience of Lumbung Media, online media storage of Universitas Negeri Semarang. Data were collected through a questionnaire technique by using the System Usability Scale (SUS). The obtained data were then analyzed using Goal, Operator, Methods, Selection Rules (GOMS) Analysis. SUS was used to obtain usability values and GOMS was employed to predict the time spent by users to achieve a goal on a website with a sequence of steps. The study results revealed that there is a significant improvement of Lumbung Media website before and after developed. The aspects of improvement include searching and production process. The new Lumbung Media is now more efficient and effective to be used to document instructional media.

1. Introduction

The ubiquitous of the Internet has changed the learning paradigm. Online learning becomes more popular and gets more intention from scholars to be a topic of study. Lumbung Media is a website consists of collection instructional media products from elementary school to college level. The learning media is available free of charge to be used for learning. The Lumbung Media is developed by the Center for Curriculum Development, Educational Media, and General Courses and Basic Education Courses (*Pusat Pengembangan Kurikulum, Media Pendidikan, MKU, dan MKDK*). The previous Lumbung Media has some technical issues. One of which is the usability of the website. In this regard, system usability consists of user interface, usability, and user experience. These three things do not have a definite scale because they are subjective and dynamic, changing according to the user's desires and feelings. The users will feel comfortable with a website that easy to use, has an attractive appearance, and easy to learn. These three things ultimately become the main elements of the user experience. User interface and user experience can affect user convenience (Lestari, Hardianto & Hidayanto, 2014).

Limited publication of the product is also one of the obstacles in the Lumbung media website. In the website, only admin can add a new product, meanwhile, users can only see it. So, if a user wants to share their learning media in Lumbung Media, they must contact the admin. Furthermore, the searching process features also not available in the system. It also makes users difficult to find a certain product. Given these facts, this study aims to analyze user interface and user experience of Lumbung Media UNNES website using SUS and GOMS methods.

2. Methods

This current study evaluated a Lumbung Media website of Universitas Negeri Semarang (UNNES). The subject of this study is students of UNNES. The students were asked to use the Lumbung Media website and then asked to rate the usability of the website. The total number of UNNES students is

32,947 students. The sample size was determined using the Slovin formula (Sugiyono, 2006) as shown in (1).

$$n = \frac{N}{1+N\alpha^2}$$ (1)

Note:
n	: Sample size
N	: Total number of populations
α	: Significant level

The significant level used in this study is 0,15. Using the Slovin formula, 45 respondents are considered enough for analysis purposes. The calculation process can be seen below.

$$n = \frac{N}{1 + N\alpha^2}$$

$$n = \frac{32,947}{1 + 32,947(0.15)^2}$$

$$n = \frac{32,947}{1 + 32,947(0.0225)}$$

$$n = 44.38$$

$$n \approx 45$$

The number of stratified samples is taking by proportional random sampling using a proportional allocation formula (Nurhayati, 2008). The proportional allocation formula is presented in (2).

$$n_h = \frac{N_h}{N} . n$$ (2)

Note:
n_h	: Number of sample members by stratum
n	: Sample size
N_h	: Number of population members by stratum
N	: Total of population members

Based on the formula (2), the number of respondents from each study program is summarized in Table 1. Sampling was selected by scrambling the respondents each study program by using Microsoft Excel so that every member has the same opportunities.

Table 1. The number of respondents for each study program

No	Faculty	Study Program	Proportional allocation calculation	Total
1	FIP	Education technology	0.741469542	1
		Guidance and counseling	0.694578187	1
		primary teacher education	3.081641197	3
		Psychology	0.956876701	1
		Teacher education for early childhood education	0.731212058	1
2	FBS	Indonesian language and literature education	0.696896934	1
		Indonesian literature	0.590875508	1
		English language education	1.036941263	1
		English literature	0.517177687	1
		Dance Art Education	0.50554119	1
		Music Art Education	0.584410787	1
		Education Language and Literature Javanese	0.655522719	1
3	FIS	History Education	0.548540394	1
		Geography Education	0.688391039	1
		Pancasila and civic education	0.604209097	1
		Sociology and Anthropology Education	0.655804481	1
4	MIPA	Mathematics education	0.855209743	1
		Physical education	0.596752368	1
		Chemistry Education	0.549391069	1
		Chemistry	0.51556157	1
		Biology Education	0.610284168	1
5	FT	Civil Engineering	0.505927764	1
		Mechanical engineering education	0.548662807	1
		Automotive Engineering Education	0.599669148	1
		Electrical engineering education	0.508684864	1
		Informatics and Computer Engineering Education	0.518334712	1
6	FIK	Physical Education, Health, and Recreation	1.195469799	1
		Teacher Education Physical Education Elementary School	0.655760626	1
		Sport Science	0.918624161	1
		Sport Coaching Education	1.194071588	1
7	FE	Public health	0.67114094	1
		Economic Education, Accounting Education	0.981260647	1
		Economic Education, Cooperative Education	0.696519835	1
		Economic Education, Educational Administration Office	0.714042346	1
		Accounting	1.337551716	1
		Management	0.749087369	1
		Economic development	0.825018253	1
8	FH	Legal Science	1.958148383	2
9	PPS	Counseling guidance	0.514569126	1
		English language education	0.504649721	1
		Mathematics education	0.518288903	1
		Sports Education	0.512089275	1
		Total		45

2.1 System Usability Scale (SUS)

A SUS questionnaire developed by Broke (1996) was adapted in this current study. The questionnaire consisted of 10 statements. The statement covers various aspects of usability system, such as user support, training, and system complexity. Figure 1 shows the SUS questionnaire.

System Usability Scale

© Digital Equipment Corporation, 1986.

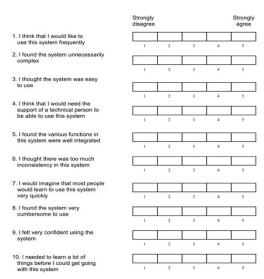|	Strongly disagree				Strongly agree
1. I think that I would like to use this system frequently	1	2	3	4	5
2. I found the system unnecessarily complex	1	2	3	4	5
3. I thought the system was easy to use	1	2	3	4	5
4. I think that I would need the support of a technical person to be able to use this system	1	2	3	4	5
5. I found the various functions in this system were well integrated	1	2	3	4	5
6. I thought there was too much inconsistency in this system	1	2	3	4	5
7. I would imagine that most people would learn to use this system very quickly	1	2	3	4	5
8. I found the system very cumbersome to use	1	2	3	4	5
9. I felt very confident using the system	1	2	3	4	5
10. I needed to learn a lot of things before I could get going with this system	1	2	3	4	5

Figure 1. SUS questionnaire

In the questionnaire, the answer of each statement using a Likert scale from strongly disagree to strongly agree (scored from 1 to 5). Measurement of SUS was performed by summing the score of each statement. For statements 1, 3, 5, 7, and 9 (odd statements), the statement score was the result of the user's judgment for that statement subtracted by one. For statements 2, 4, 6, 8, and 10 (even statements) the statement score was a result of 5 (five) deducted by the value of the user for the statement. The total score of 10 statements was then multiplied by the number 2.5 resulting in a final score in the range 0 - 100 (Bangor, Kortum & Miller, 2009).

After the average SUS score is obtained, then the score is compared to the value range (Sharp, Rogers & Preece, 2007). Table 2 presents a range of SUS scores and their interpretations.

Table 2. SUS score range and interpretation

SUS Score	Interpretation
< 50	*Not acceptable*
50 – 70	*Marginal*
> 70	*Acceptable*

2.2 Goals, Operators, Methods, and Selection (GOMS) Rules

GOMS is one of the methods used to examine a task. GOMS was developed by Card, Moran, and Newell (2018). GOMS Analysis will be combined with the Keystroke Level Model (KLM) in predicting execution time. GOMS uses the same operator as the KLM. Then base operators are calculated based on Sharp research (Sharp et al., 2007). Table 3 shows the fixed requirements for basic operators.

Operator "K - Keystroking" means pressing a key on the keyboard. Operator "P - Pointing" refers to moving the mouse to the target or pressing a button on the mouse. Operator "H - Homing" means moving the hand from the mouse to the keyboard. Operator "D - Drawing" means to draw with the mouse. Operator "M - Mental Preparation" means to prepare a mental attitude for physical action. Operator "R - Response" means the system response in the time when the user must wait in an attempt to complete a task. The predicted time required to run the task is then calculated by summing up all the time estimates on each operator. The formula is shown in (3).

$$T_{execute} = T_K + T_P + T_H + T_D + T_M + T_R \tag{3}$$

Note:

$T_{execute}$	: Predicted execution time
T_K	: The amount of time on the operator K
T_P	: The amount of time on the operator P
T_H	: The amount of time on the operator H
T_D	: The amount of time on the operator D
T_M	: The amount of time on the operator M
T_R	: The amount of time on the operator R

Table 3. Fixed rules for basic operators

Operator name	Description	Time
K	Pressing a single key or button	0.35 (average)
	Skilled typist (55 wpm)	0.22
	Average typist (40 wpm)	0.28
	User unfamiliar with the keyboard	1.20
	Pressing shift or control key	0.08
P	Pointing with a mouse or other device to a target on a display	1.10
P_1	Clicking the mouse or similar device	0.20
H	Homing hands on the keyboard or other devices	0.40
D	Draw a line using a mouse	Variable depending on the length of the line
M	Mentally prepare to do something (e.g., make a decision)	1.35
$R_{(t)}$	System response time--counted only if it causes the user to wait when carrying out their task	T

3. Results

The testing phase is known as verification and validation which is a process to check that the software meets the original requirements and accomplishes set a goal. In fact, verification is a software evaluation process to determine whether a product of a given development stage meets the conditions imposed on the initial analysis (Hardyanto, Purwinarko, Sujito, & Alighiri, 2017).

Program testing involves verifying that each process has been fulfilled specifications (Purwinarko & Sukestiyarno, 2014). Evaluation is needed to find out how far the disseminated material is acceptable to the user (Hardyanto, Adhi, & Purwinarko, 2016).

In addition, evaluated whether the finished website is in accordance with the original purpose. If yes, then the process will continue to the next stage, but if the finished website is not in accordance with what is expected, it will be revised (Nugroho & Arifudin, 2014). In this research, two tests i.e., usability testing and the effectiveness of the predicted execution time.

3.1 Usability Testing Results

The questionnaires were administered to 45 respondents and all of them has returned the questionnaires. The questionnaires were completer and eligible to be processed. Data obtained from the survey were analyzed using the SUS method. The result of SUS testing shows that the average value of SUS is 46.8. It can be considered as unacceptable. Further, SUS test results by the respondents after Lumbung Media is developed has an average SUS 75.8. It is considered acceptable. Table 4 summarizes the SUS test results.

Table 4. SUS analysis results by respondents

No	Lumbung Media	SUS	Category
1	Before developed	46.8	Not Acceptable
2	After developed	75.8	Acceptable

In terms of SUS analysis by gender, there are also significantly different before and after the development of Lumbung Media. The SUS results after development are higher than before the Lumbung Media is developed. Female respondents slightly gave a higher score of usability of the Lumbung Media. Table 5 present the SUS

Table 5. Results of analysis by gender

No	Gender	SUS (Before Developed)	SUS (After Developed)
1	Male	47.7	74.7
2	Female	46.2	76.9
	Average SUS score	46.9	75.8
	Category	Not Acceptable	Acceptable

The analysis was also conducted on the basis of the respondent's semester. The results of the analysis by semester can be seen in Table 6.

Table 6. Results of analysis by semester

No	Semester	SUS (Before Developed)	SUS (After Developed)
1	2	46	76
2	4	47.4	76.3
3	6	52.5	75
4	8	43.75	75.4
	Average SUS score	46.8	75.8
	Category	Not Acceptable	Acceptable

3.2 Testing the Result of Time Prediction

In the analysis of time prediction, GOMS rules were applied. The analysis was performed only on the main process, namely product search and product manufacturing. The results of the analysis were calculated using the time prediction by KLM. Table 7 shows the results of GOMS and KLM analysis of product search before development of the Lumbung Media website and Table 8 shows the result of GOMS and KLM analysis of product search after development Lumbung Media website.

Table 7. Results of GOMS and KLM analysis of product search before Lumbung Media website development

Description	Operator	Duration (s)
Moves the cursor to the product menu	P	1.1
Click the product menu	P1	0.2
Mental preparation to select product category	M	1.35
Moves the cursor to the product button	P	1.1
Click the product button	P1	0.2
Predicted Time Count		3.95

Table 8. Results of GOMS and KLM analysis of product search after Lumbung Media website development

Description	Operator	Duration (s)
Moves the cursor to the product button	P	1.1
Mental preparation to select product category	M	1.35
Click the product button	P1	0.2
Predicted Time Count		2.65

The result of GOMS and KLM analysis of product creation before website development is shown in Table 9 and the result of GOMS and KLM analysis of website product creation after website development is shown in Table 10.

Table 9. Results of GOMS and KLM analysis of product creation before developed

Description	Operator	Duration (s)
Move the cursor to the TablePress menu	P	1.1
Move the cursor to the All Tables menu	P	1.1
Click the All Tables menu button	P1	0.2
Prepare mentally to think of words to be typed	M	1.35
Moves the cursor to the product category	P	1.1
Click the button to product category	P1	0.2
Moves the cursor to the Add button	P	1.1
Click the Add button	P1	0.2
Moves the cursor to the Insert Image button	P	1.1
Click the button to Insert Image	P1	0.2
Moves the cursor to the OK button	P	1.1
Click OK button	P1	0.2
Moves the cursor to a table column	P	1.1
Click the table	P1	0.2
Moves the cursor to the Upload Files menu	P	1.1
Click the Uploads Files button	P1	0.2
Moves the cursor to the Select Files button	P	1.1
Click the Select Files button	P1	0.2
Moves the cursor to the Insert into Table key	P	1.1
Click the Insert into Table button	P1	0.2
Moves the cursor to the Insert Link button	P	1.1
Click the Insert Link button	P1	0.2
Moves the cursor to the OK button	P	1.1
Click OK button	P1	0.2
Moves the cursor to a table column	P	1.1
Click the table	P1	0.2
Moves the cursor to the URL field	P	1.1
Click the URL column	P1	0.2
Move hands to keyboard	H	0.4
Type a word http://youtube.com/watch?v=eDqv1iAPcjg(38)	K	13.3
Move hands to mouse	H	0.4
Moves the cursor to the Add Link button	P	1.1
Click the Add Link button	P1	0.2
Moves the cursor to a table column	P	1.1
Click the table column	P1	0.2
Move hands to keyboard	H	0.4
Typing *judul IPA mapel IPA materi IPA*(30)	K	10.5
Move hands to mouse	H	0.4
Moves the cursor to the Save Changes button	P	1.1
Click the Save Changes button	P1	0.2
Predicted Time Count		48.65

Table 10. Results of GOMS and KLM analysis of product creation after developed

Description	Operator	Duration (s)
Moves the cursor to the Product menu	P	1.1
Click the Product menu button	P1	0.2
Moves the cursor to the Add New menu	P	1.1
Click the Add New menu button	P1	0.2
Moves the cursor to the Product Title column	P	1.1
Prepare mentally to think of words to be typed	M	1.35
Move hands to keyboard	H	0.4
Type a word IPA (3)	K	1.05
Move hands to mouse	H	0.4
Move the cursor to Select Subject	P	1.1
Click the Select Subject button	P1	0.2
Mental preparation to think about the maple to choose from	M	1.35
Moves the cursor to Lesson Options	P	1.1
Click the Subject Selection button	P1	0.2
Move the cursor to Select Level	P	1.1
Click the Select Level button	P1	0.2
Mental preparation to think about the level to be chosen	M	1.35
Moves the cursor to the Level Options	P	1.1
Click the Options button	P1	0.2
Move the cursor to Select File Type	P	1.1
Click the File Type button	P1	0.2
Moves the cursor to the Product Description field	P	1.1
Prepare mentally to think of words to be typed	M	1.35
Move hands to keyboard	H	0.4
Type a word *media pembelajaran IPA* (22)	K	7.7
Move hands to mouse	H	0.4
Move the cursor to the Select Cover button	P	1.1
Click the Select Cover button	P1	0.2
Moves the cursor to the Product URL field	P	1.1
Move hands to keyboard	H	0.4
Type a word http://youtube.com/watch?v=eDqv1iAPcjg(38)	K	13.3
Move hands to mouse	H	0.4
Moves the cursor to the Save Button	P	1.1
Click the Save button	P1	0.2
Predicted Time Count		44.85

4. Discussion

Based on the SUS test result on Lumbung Media website before it was developed by the respondents has an average SUS value 46.8 and it is considered unacceptable. Meanwhile, the average value of SUS testing after the development of Lumbung Media website is 75.8 and it is considered acceptable.

The result of GOMS and KLM analyses on the product searching process before Lumbung Media website was developed, has spent time 3.95 seconds. While after development, the predicted execution time is 2.65 seconds. Further, before the development of Lumbung Media website, the process of making the product has spent time 48.65 seconds. While after development has 44.85 seconds of time. The summary of prediction test results of execution time shown in Table 11.

Table 11. Summary of Test Results Predicted Execution Time

No	Activity	Before Developed	After Developed
1	Product search process	3.95 s	2.65 s
2	Product-making process	48.65 s	44.85 s

For further research, it needs to be analyzed by other methods than SUS and GOMS so that it can be known the interface assessment from another point of view. In addition, it is necessary to develop mobile-based applications that facilitate accessing Lumbung Media on smartphones.

5. Conclusion

This study has examined the user interface and user experience of the Lumbung Media website using SUS and GOMS. The results of the study revealed that the score of the SUS Lumbung Media website before developed cannot be accepted because it only has a score of 46.8. While the score after the Lumbung Media website is developed is higher than the previous one. The score is 75.8 and it is acceptable.

In the predicted time effectiveness analysis, the result of GOMS analysis for the product searching process on the Lumbung Media website before developed was 3.95 seconds. GOMS analysis at the searching process on the Lumbung Media after developed website added 2.65 seconds. Besides, the result of GOMS analysis for the process of making products on the Lumbung Media website before developed was 48.65 seconds. After optimization, the process of making a product on the Lumbung Media website increases to 44.85 seconds. So, the results of time effectiveness prediction analysis in searching and manufacturing products can be saved and faster.

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