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Exploring Research and Service Information System Usability by Heuristic Evaluation as a Compelement of System Usability Scale

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Abstract: The Research and Community Service Information System of LPPM University Lancang Kuning is a web-based application designed to facilitate research and community service activities at the university. This study incorporated two methodologies: a descriptive approach with qualitative analysis for heuristic data collection, and the System Usability Scale (SUS) method, employing quantitative analysis. The research process included stages of problem analysis, literature review, data collection, data analysis, and formulating recommendations based on the findings and discussions. The heuristic evaluation, the first method applied, revealed that aspects H1, H3, and H4 scored 1 when rounded, indicating these were merely cosmetic issues not requiring immediate attention unless spare time was available. Conversely, aspects H2, H5, H6, H7, H8, H9, and H10 scored 2 when rounded, categorizing them as minor usability issues needing resolution, albeit with low priority, to prevent potential user difficulties. Recommendations for these seven heuristic aspects scoring 2 encompassed improvements in system information clarity, feedback processes, image utilization, color selection, grammar quality, and writing consistency. The second method, the SUS, indicated that most users demonstrated adequate skills in terms of learnability, efficiency, memorability, error management, and overall satisfaction with their system usage experience.

Keywords: Heuristic Evaluation; System Usability Scale (SUS); The Research and Community Service Information System

Introduction

The rapid advancement of information and communication technology has significantly impacted various institutions and organizations, making technology an essential component for their operations (Okundaye et al., 2019). Information technology, particularly website (Sina et al., 2023) technology, has played a crucial role in enhancing business efficiency and effectiveness. Websites (Chercules et al., 2023) enable institutions and organizations to disseminate information, promotions (Cristobal-Fransi et al., 2020), and multimedia content over the internet, thereby facilitating communication with users (Molina Rodríguez-Navas et al., 2021).

However, despite the benefits of website technology, it is not without its challenges (Donaghy et al., 2019). Poor development and lack of user-friendliness can lead to numerous problems in websites (Saad et al., 2022; Myhre et al., 2021). Therefore, it is imperative for system developers to prioritize user-friendly design to ensure ease of use for the end-users (Ishak & Ahmad, 2023).

Usability, a key concept in Human-Computer Interaction (HCI), is essential in the development of websites (Somya Khatri & Ritu Sharma, 2022) (Kivijärvi & Pärnänen, 2023). Usability Evaluation Methods (UEMs) encompass various models and techniques (Gupta et al., 2023), categorized into analytical and empirical methods (Zardari et al., 2021). The analytical method, also known as the inspection method (Sukardjo

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et al., 2023), includes evaluation techniques such as Heuristic Evaluation, Cognitive Walkthrough, and Guidelines (Kumar et al., 2022; Cho et al., 2022). On the other hand, the empirical method is based on user experience (Hayati, 2022), involving direct user testing, User Performance Test, Remote Usability Testing, Beta Test, Forum Test, Cooperative Evaluation, and Coaching Method (Afrizon & Hadi Putra, 2023; Baig et al., 2020). Additionally, User Evaluation methods encompass user statements through questionnaires, field observations, focus group discussions, and interviews (Afrizon & Hadi Putra, 2023; Wahyuningrum et al., 2020; Yanarti et al., 2022).

The Research and Community Service Information System (SIPP) of Universitas Lancang Kuning is a web-based application designed to support research and community service activities at the university. Despite its recent release in early 2021, the system has encountered several issues, including naming errors and profile updates requiring logout.

Several studies have been conducted on usability analysis using different methods, such as the heuristic method on an education marketplace platform (Mertha et al., 2021), A comprehensive analysis of healthcare websites usability features, testing techniques and issues (Saad et al., 2022), usability testing on a mobile-based multifinance application (Andriawan et al., 2020), usability testing analysis on an e-commerce application (Aziz et al., 2022), analysis of the Muslimah e-commerce website using the heuristic method and usability analysis in e-commerce applications in Nigeria (Mertha et al., 2021). Usability evaluation of a comprehensive national health information system: A heuristic evaluation (Rangraz Jeddi et al., 2020). Usability Analysis of the Peduli Protect Application as a Covid-19 Information and Tracking Application Using Heuristic Evaluation (Sudiarsa & Wiraditya, 2020). Usability of smart infusion pumps: A heuristic evaluation (Klarich et al., 2022).

Given the background, this study aims to conduct a usability analysis of the Research and Community Service Information System of Universitas Lancang Kuning using the heuristic evaluation method and System Usability Scale. This research will contribute to the understanding of the system's usability and provide insights for potential improvements.

Method

In this study, there are two methods used, namely descriptive method with qualitative approach to obtain data (Suryani et al., 2022)from the heuristic method and secondly with the system usability scale (SUS) method with a quantitative approach. The stages of this research consist of, data collection, heuristic evaluation and System Usability Scale (SUS) (Husna et al., 2023).

Data Collection

In this stage, data is collected using two methods: data collection through the heuristic evaluation method, which is carried out by several competent evaluators of software interface development (Mulder et al., 2023)(Berlian et al., 2023). Meanwhile, data collection through the system usability scale (SUS) method is done by providing a questionnaire to information system users to obtain data, with a minimum data of >50% of users overall. A list of questionnaire questions based on the 10 questionnaire questions on SUS is made through Google Form for users according to what was developed by John Brooke (1986) as shown in Table 1 (Damayanti et al., 2022; Hidayat et al., 2023).

Table 1. Questionnaire List

Number	Questions
1	I would frequently use this system
2	I found that the system does not have to be as complex as this
3	I think the system is easy to use.
4	I think that I would need the support of a technical person to be able to use this system.
5	I found that some functions in the system are well integrated
6	I think there are too many inconsistencies in the system
7	I imagine that most people would easily learn to use this system very quickly.
8	I found the system very complicated to use
9	I feel very confident using this system.
10	I need to learn a lot before I can start using this system

Heuristic Evaluation

Heuristics are general principles used to evaluate software interfaces (H. Turhangil Erenlergil Erenler, 2018). According to Nielsen, most usability can be identified using a set of heuristics (Nielsen & Molich, 1990). In this study, the heuristic evaluation was performed by a usability expert. These experts have background knowledge and experience in usability evaluation (Nazar et al., 2022). A list of heuristics with examples was provided to the experts for their reference when conducting usability evaluation. The heuristic evaluation was performed by the experts using the 10 well-known usability heuristics from Nielsen (Nielsen & Molich, 1990).

System Usability Scale (SUS)

In this stage, the level of usability will be analyzed and the SUS questionnaire will be calculated. The

usability analysis serves to measure the level of usability aspects, which consist of efficiency, effectiveness, learnability, errors, and memorability. Meanwhile, the questionnaire will be calculated using the SUS scoring system.

According to Tom Tullis (2013), research that focuses on evaluating a set of criteria uses at least 40 respondents. The respondents are faculty members of Lancang Kuning University. In the pre-test questionnaire, users' answers about their identity, such as name, gender, age, education level, were collected as part of the research. Like the expert respondents, they performed the same tasks and then completed the post-test questionnaire. This research uses SUS as a perceived usability metric that represents user experience. SUS metrics are widely used in post-test surveys in industrial usability studies. SUS has also been shown to be a very flexible questionnaire, unaffected by word and language changes (Lewis, 2018). SUS is the sum of all contribution scores for ten items multiplied by 2.5, as shown in (1), where U_i refers to the rating of the i-th item. SUS scores range from 0 to 100 in 2.5 point increments, with higher values reflecting higher user satisfaction.

$$SUS = 2.5x\left[\sum_{n=1}^{5}(U_{2n-1}-1)+)5-U_{2n)}\right] \quad (1)$$

Based on Lewis (2018), the average SUS score for public-facing websites was 67 (grade C), so the above values were considered good enough. Table 1 shows the Sauro-Lewis Curved Grading Scale (CGS) to constitute a website with low, medium and high perceived usability.

Table 2. Sauro Lewis CGS

SUS Score Range	Grade	Percentile Range
84.1-100	A+	96–100
80.8–84.0	A	90–95
78.9–80.7	A-	85–89
77.2–78.8	B+	80–84
74.1–77.1	B	70–79
72.6–74.0	B-	65–69
71.1–72.5	C+	60–64
65.0–71.0	C	41–59
62.7–64.9	C-	35–40
51.7–62.6	D	15–34
0.0–51.6	F	0–14

Result and Discussion

Heuristic evaluation

In the process of analysis using the heuristic method, this study used 10 heuristic aspects and developed them into several questions tailored to the case study of the Research and Community Service Information System at the Lancang Kuning University's Research Institute (Schrepp et al., 2017). The following are the evaluation results from 3 expert respondents using severity rating scale for the 10 heuristic aspects calculated using the equation in the heuristic method as shown in Table 3.

Table 3. Result of Heuristic Evaluation Analysis

Heuristic Aspect	Average Severity Rating	Value Rounding Scale 0-4
H1	1.33	1
H2	1.67	2
H3	1	1
H4	1.33	1
H5	2	2
H6	1.67	2
H7	2	2
H8	2	2
H9	1.67	2
H10	2	2
Average Severity Rating	1.7	1.7 (2)

Based on Table 3, the average Severity Rating of the 10 heuristic aspects is 1.7, which rounds up to a score of 2 on the scale, indicating Minor usability problem category. This means that there is a potential for users to experience difficulties in performing activities in the system, thus requiring improvements with low priority level. The following is the result of the heuristic evaluation based on the research conducted on the SIPP application as shown in Table 4.

Based on Table 3, the average Severity Rating of the 10 heuristic aspects is 1.7, which rounds up to a score of 2 on the scale, indicating Minor usability problem category. This means that there is a potential for users to experience difficulties in performing activities in the system, thus requiring improvements with low priority level. The following is the result of the heuristic evaluation based on the research conducted on the SIPP application as shown in Table 4.

Based on Table 4, it can be concluded that there are several heuristic aspects that do not require improvement such as Aspect H1, H3, H4 as shown in Table 5 because they have a scale of 1 which means Cosmetic problem. There are also several heuristic aspects that need improvement such as H2, H5, H6, H7, H8, H9, H10, although with low priority because the evaluation results have a scale of 2 (Minor Usability Problem), meaning there is a potential for users to experience difficulties in performing activities in the system.

Table 4. Recap of the Evaluation Results of the Heuristic Method

Code	Heuristic Aspect	Evaluation Result	Category and Description
H1	Visibility of System Status	1	Cosmetic Problem
H2	Match between system and the real world	2	Minor Usability Problem
H3	User control and freedom	1	Cosmetic Problem
H4	Consistency and standards	1	Cosmetic Problem
H5	Error prevention	2	Minor Usability Problem
H6	Recognition rather than recall	2	Minor Usability Problem
H7	Flexibility and efficiency of use	2	Minor Usability Problem
H8	Aesthetic and minimalist design	2	Minor Usability Problem
H9	Help users recognize, diagnose and recover form errors	2	Minor Usability Problem
H10	Help and documentation	2	Minor Usability Problem

System Usability Scale (SUS) Questionnaire Results

From the list of SUS questions in Table 3, the questionnaire assessment results were obtained from 40 respondents according to the criteria specified in this study. The results of the SUS questionnaire assessment using the Likert scale will be processed based on the guidelines provided in the SUS method. The following are the calculation results from the collected questionnaire data as shown in Table 5.

Table 5. Score of SUS Calculation Results

Respondents	SIPP User SUS Data Calculating Score										Value
	Q1	Q2	Q3	Q4	Q5	Q6	Q7	Q8	Q9	Q10	(Number x 2.5)
R1	3	2	4	1	3	1	3	1	4	2	60
R2	4	3	4	2	4	1	4	2	3	4	78
R3	3	3	3	3	3	3	3	2	3	3	73
R4	4	1	4	1	4	1	4	1	4	1	63
R5	4	1	4	1	4	1	4	1	4	1	63
R6	4	4	4	3	4	3	4	1	4	4	88
R7	4	1	4	3	4	1	4	1	4	2	70
R8	4	1	4	2	4	1	2	1	4	3	65
R9	4	2	4	1	2	2	3	2	4	3	68
R10	3	2	3	2	3	2	3	2	3	2	63
R11	3	3	4	1	2	2	4	1	4	1	63
R12	4	4	4	3	3	3	4	1	3	1	75
R13	3	3	3	3	3	3	4	1	3	2	70
R14	4	2	4	1	4	3	3	3	4	1	73
R15	4	1	4	1	4	1	4	1	4	1	63
R16	4	2	4	2	4	2	4	1	4	1	70
R17	3	4	3	3	2	4	2	4	3	2	75
R18	4	3	3	3	4	3	3	1	3	4	78
R19	4	2	4	1	3	2	3	2	3	2	65
R20	2	2	2	2	2	2	2	2	2	2	50
R21	3	3	2	3	3	3	3	3	3	3	73
R22	4	1	4	1	4	1	4	1	4	1	63
R23	3	2	4	1	3	1	4	1	4	2	63
R24	3	1	3	2	3	1	4	1	4	3	63
R25	3	2	3	2	3	2	3	2	3	2	63

Respondents	SIPP User SUS Data Calculating Score										Value
	Q1	Q2	Q3	Q4	Q5	Q6	Q7	Q8	Q9	Q10	(Number x 2.5)
R26	3	2	3	2	3	2	4	2	3	3	68
R27	2	4	2	3	2	3	2	3	1	4	65
R28	3	2	3	2	3	2	3	2	3	2	63
R29	4	2	4	2	3	2	3	2	3	2	68
R30	4	1	4	3	3	2	4	1	2	3	68
R31	4	3	4	2	3	2	3	2	4	2	73
R32	4	1	4	2	4	1	4	1	4	2	68
R33	4	3	3	3	3	3	3	2	3	3	75
R34	4	3	3	2	3	2	3	2	3	2	68
R35	4	3	3	1	4	3	3	3	3	2	73
R36	4	3	3	2	3	2	3	2	2	3	68
R37	4	2	3	1	2	2	3	3	3	1	60
R38	3	2	3	2	3	2	3	2	3	2	63
R39	3	2	3	2	3	2	3	2	3	2	63
R40	3	2	3	2	3	2	3	2	3	2	63
								Average Score (Final Result)			68

Based on the data processing results above, the final SUS score obtained follows the guidelines for calculating SUS, and the SUS score obtained is 68. In the context of the given study, the SUS questionnaire was used to assess the validity of statements related to the usability of a particular system or application. The results showed that all r values were greater than the r table, indicating that the majority of statements (6 out of 10) were valid in terms of usability. This conclusion is consistent with the results of previous studies that have demonstrated the reliability and validity of the SUS questionnaire in assessing usability (Sevilla-Gonzalez et al., 2020; Mohamad Marzuki et al., 2018).

Validity Test

Validity test aims to determine the accuracy and precision of the measurement in the measuring instrument used. The validity test in this study was obtained from testing using Microsoft Excel to obtain the value of r count. Then, the results of the r count from the validity test can be seen in Table 6.

The value of the r table in the study with a sample size (N) of 40 and a significance level of 5% (0.05) is 1.68. Based on the results of the validity test of the SUS questionnaire, it can be concluded that all r values are greater than the r table. Therefore, it can be inferred that 6 statements are valid and 4 are invalid.

Table 6. Result of SUS Questionnaire Validity Test

Questions	^{r}count	^{r} table	Status
1	3.04	1.68	Valid
2	3.28	1.68	Valid
3	1.54	1.68	Valid
4	2.81	1.68	Valid
5	2.72	1.68	Valid
6	2.73	1.68	Valid
7	1.82	1.68	Valid
8	0.45	1.68	Valid
9	1.29	1.68	Valid
10	3.40	1.68	Valid

Reliability Test

Reliability test is conducted to examine the degree of consistency or stability of the instrument within a certain interval by looking at the result of Cronbach's Alpha formula. Reliability test was obtained from testing using Microsoft Excel application with the same data as in the validity test, the results can be seen in Table 7.

Table 7. Reliability Test Results of SUS Questionnaire

Reliability Coefficient	Number of Items	Interpretation	Information
5.6725	40	Hight	Reliable

Table 6 explains that with 10 items in the SUS questionnaire with a reliability coefficient or Cronbach's

alpha value of 5.6725 > 0.70, it can be concluded that if it has a value greater than 0.70, all questionnaire items are considered reliable.

Interpretation of System Usability Scale (SUS) Score Results

From the System Usability Scale questionnaire that has been validated and proven reliable through the distribution process, and has obtained a final score of 68. The following is the interpretation of the results, as shown in Figure 1.

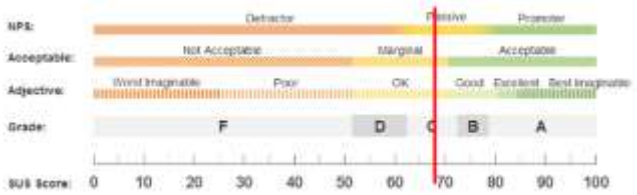

Figure 1. SIPP Application SUS Score

Based on the final score obtained, which is 68, it can be inferred that the interpretation of the usability level of the SIPP application is C for Grade, OK for Adjective, which means it has a good enough usability, MARGINAL for Acceptable, which means it is acceptable by users, and "Passive" (users provide fairly good responses, in terms of NPS, users have the potential to become promoters or Passive, which are neutral response givers. With a score of 68, the research results obtained are quite good. From the process of analyzing the SUS score with several interpretations, it can be concluded that the SIPP application is still good, efficient, and satisfying for users. Therefore, with the recommendations for improvements given in the heuristic method above, it is expected that improvements can be made to improve the SUS score of the SIPP application.

Conclusion

The research combining the heuristic evaluation and the System Usability Scale (SUS) on system usability gives insightful results. The heuristic evaluation shows minor cosmetic problems in aspects H1, H3, and H4, while aspects H2, H5, H6, H7, H8, H9, and H10 show minor usability problems requiring improvements in clarity, feedback, and design. The SUS results indicate satisfactory learnability, efficiency, and memorability among users, with a final score of 68, which categorizes the system's usability as "OK" and "MARGINAL," suggesting fair usability with potential for improvement.

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Author Contributions

G.N.T; contributes to conceptualizing the research idea, developing products, analyzing data, and writing articles, L.W; validation, and L.C; formal analysis. All authors have read and agreed to the published version of the manuscript.

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Conflicts of Interest

No conflict of ineterest

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