Usability Evaluation of “Inventory Information System” Design of Disaster Management in Yogyakarta Province - Indonesia

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ABSTRACT

"Inventory Management System" is a website-based information system for disaster relief goods inventory designed for the Sleman Regency Regional Disaster Management Agency. Usability interface measurement has not been done when designing the information system. The usability interface is a quality attribute that is used to evaluate the convenience of people in obtaining information on a product, system, or service. This study aims to measure the usability of the existing website design interface and compare the usability value with the improved website design interface. Heuristic evaluation and usability testing methods are used to determine the usability interface design, both before and after repair. The results show that there were 18 problems found by evaluators. After interface improvements, the level of efficiency, effectiveness, satisfaction on all tasks, and usability values based on web-use have increased.

CCS CONCEPTS

Human-centered computing ~ Human computer interaction (HCI)

Keywords

Usability; heuristic evaluation; efficiency; effectivity; satisfaction, WEBUSE.

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1. INTRODUCTION

"Inventory Management System" is an information system compiled by the Disaster Logistics research team at the Department of Industrial Engineering, University of Diponegoro, regarding logistical inventories Website-based natural disasters for BPBD Sleman, Yogyakarta Province, Indonesia. This information system is designed to provide information to the entire community regarding the availability of logistics in the main warehouse (BPBD Sleman) and all refugee camps so that the logistical needs in each refugee place will be met as needed (Lawrence, 2012; Kovacs and Spens, 2007).

A website must not only contain useful information but also provide information efficiently and quickly accessible (Djamasbi et al., 2012). According to ISO 9241-11 2018, usability is a benchmarking tool used to determine the extent to which a system, product, or service can be used by specific users to achieve the expected goals with effectiveness, efficiency, and user satisfaction. Measurement of website usability can be done by several methods, namely usability inspection, and usability testing.

Usability inspection is a usability measurement to identify problems regarding usability and the improvement of usability interface design by examining each element, whether it is by the principles of usability (Holzinger, 2005). Heuristic evaluation is used to find usability problems in the user interface design, carried out using an evaluator (Nielsen, 1994). The benchmarks that can be used in heuristic evaluations is Nielsen's usability principle. Nielsen's heuristic principle is the most widely used measure in heuristic evaluation (Penha et al., 2014).

Usability testing is a measure of usability by involving user representatives to do specific predetermined tasks. The benchmarks that can be used in the usability testing method is ISO 9241-11: 2018. ISO 9241-11: 2018 is an international standard regarding guidelines on usability. These standards should be used more in measuring usability because they can define the right practice, are objective, can ensure consistency in work, and can

provide benchmarks for intervention by designers (Bevan, 2009). However, the use of these standards as benchmarks does not reflect what factors must be considered on a website a what users feel so that additional benchmarks are needed. Website sability Evaluation Tool (WEB USE) is a website-based usability evaluation method that allows users to assess the usefulness of the website being evaluated (Chiew & Salim, 2003).

Although the two methods have the same goal, namely, to identify usability problems in the user interface, the results produced by each method are very different. Both methods have their strengths and w nesses. Usability testing shows problems that recur during tasks, whereas heuristic evaluations explicitly identify the causes of problems and gest solutions to those problems (Ahmed, 2008). The use of heuristic evaluation and usability testing methods together can provide better results than using only one of these methods (Ahmed, 2008). At the design stage, this information system has not measured usability in interface design to prospective website users, so it is not yet known whether the Website has provided information clearly and efficiently for the public in obtaining information on the availability of logistical assistance in the Sleman BPBD. These measurements can use the method of usability testing and heuristic evaluation (Mazumder and Das, 2014).

This study aims to conduct usability testing and heuristic evaluation of the Inventory Management System in order to know the level of effectiveness, efficiency, user satisfaction, and overall website usability. The survey on the tendency of rejection or acceptance of the website is expected to provide input for the improvement of this website in the future.

2. LITERATURE REVIEW

2.1 Usability

Usability, according to ISO 9241: (2018), is a benchmarking tool that can be used to determine the extent to which a system, product, or service can be used by specific users to achieve the goals determined by the effectiveness, efficiency, and satisfaction of its users. According to Nielsen (2012), usability is a quality attribute that assesses the ease of user interface.

2.2 Usability Testing

Usability testing is a usability evaluation method that involves user representatives to do specific tasks. Usability testing is the most comfortable and most basic usability evaluation approach. Usability testing will help researchers determine how to improve the design (Ahmed, 2008; Bevan, 2009; Dix et al., 2004; Few, 2006; Satzinger, et al., 2012).

Heuristic Evaluation

uristic evaluation is a method of Usability inspection to find Usability problems in user interface design so that they can be part of the iterative design process and carried out by involving evaluators (Nielsen, 1994;). There are 10 Nielsen heuristic principles, namely:

1. System status visibility
2. Conformity between the system and real conditions
3. User control and freedom
4. Standards and consistency
5. Support for users to make an introduction, diagnosis, and correction of errors
6. Error prevention
7. The introduction, rather than remembering
8. Flexibility and efficiency
9. Aesthetic design and minimalism

WEBUSE

Website Usability Evaluation Tool (WEBUSE) is a usability evaluation method in the form of a Web-based questionnaire that allows users to assess the usefulness of the website being evaluated. Chiew and Salim (2003) divide the usability category in the WEBUSE method based on content, organization, and readability, navigation and links, user interface design, performance, and effectiveness.

3. RESEARCH METHODS

This study uses the usability testing method and heuristic evaluation. This research variable is determined based on ISO 9241: 2018, WEBUSE, and the heuristic principle proposed by Nielsen (1993, 2006). The ISO 9241: 2018 variable is used as a benchmark for user context specifications that must be possessed by a website. Nielsen's heuristic principle is used as a reference in classifying problems found by evaluators.

The study uses the results of evaluations from evaluators, observations when users run information systems, and filling out questionnaires by users. Observations on users are made to determine the level of efficiency, effectiveness, and user satisfaction based on user experience when using information systems. Observations are made by observing the user when running an information system. It requires a scenario regarding the tasks that the user must complete (Cooper and Chindler, 2006).

Scenario preparation is based on the tasks available to users on the information system. The number of respondents neede s 20 people, where each person does 12 tasks. The tasks include Task 1 (Registration), Task 2 (Login), Task 3 (Data Warehouse), Task 4 (Data Post), Task 5 (Data Unit Goods), Task 6 (Data Category), Task 7 (Inventory), Task 8 (Profile), Task 9 (Change Profile), Task 10 (Add Donations), Task 11 (Donation Status), Task 12 (Proof of Donation), and Task 13 (Logout).

The questionnaire was prepared based on the WEBUSE questionnaire consisting of 24 questions. Samples and evaluators in this study are those who are considered to know the Usability principles. Based on Nielsen's (2006) research, quantitative research requires 20 respondents to obtain results that are not much different from a larger sample size. The 20 respondents were selected with the following criteria: Have completed a minimum education of Diploma-III, have their income, have a permanent job, have worked for at least one year. Table 1 shows the indicators for each variable.

Table 1 Indicator Variables from the Research Model

No	Main Criteria	Indicators
1	Efficiency	The time needed to complete a task (task time)
2	Effectiveness	Number of errors the user makes while performing a task scenario (error)
		Website user success rate completing the given Task based on the standard usage rate (completion rate)
4	User Satisfaction	The level of user satisfaction in using the Website
3	Content, Organization, and Readability	This web site contains most of the material and topics that are of user interest and they are up-to-date.
		Users can easily find what they want on this website.
		The content on this website is well managed.
		Users can find the content / contents on this website easily.
		Users feel comfortable and familiar with the language used.
		Users do not need to use scroll left and right when browsing this website.
5	Navigation and link	Users can easily find their position on this website when browsing the website
		This website provides instructions and links that are useful for users to get the desired information.
		It is easy for users to browse this website by using the link or back button in the browser.
		The links on this website are well maintained and updated.
		This website does not open too many new windows when users browse the website.
		Link or menu placements are arranged by default and users can easily recognize them.
6	User Interface Design	Attractive / attractive website interface design.
		Users feel comfortable with the colors used on this website.
		This website does not contain features that interfere with users such as scrolling or blinking text and repetitive animations.
		This website has a consistent look.
		This website does not contain irrelevant and disturbing information
		Web site design makes sense and is easy to learn how to use it.
7	Performance and Effectiveness	Users do not wait too long to open a page.
		Users can easily distinguish links that have been visited and those that have not yet been visited.
		Users can access this website all the time.
		This web site responds to all actions that users take in accordance with their expectations.
		Users feel this website can be used efficiently.
		This website always gives a clear and useful message when the user doesn't know how to process / do something.
8	System Status Visibility	The system must always provide information to users about what is happening, through appropriate feedback in a reasonable time
9	Match between System and the Real World	The system must speak in the user's language, with words, phrases and concepts that are familiar to the user, not system-oriented terms
10	User Control and Freedom	Users often choose system functions accidentally and will need a clearly marked "emergency exit" to leave unwanted conditions without having to go through extended dialogue
11	Standards and Consistency	Users do not need to wonder whether different words, situations, or actions have the same meaning.
12	Error Prevention	Eliminate error-prone conditions or check them and provide confirmation options to users before they commit to action
13	An introduction, rather than remembering	User memory load is reduced by making objects, actions and options visible
14	Flexibility and efficiency	The system can serve both inexperienced and experienced users.
15	Aesthetic Design and Minimalism	Each additional bit of information in the dialog competes with the relevant unit of information and reduces its relative visibility
16	Support for users to make recognition, diagnosis, and correction of errors	Error messages must be stated in plain language (without code), pinpoint the problem precisely, and constructively suggest a solution.
17	Help and Documentation Features	Every such information must be easy to find, focused on the user's job, a list of concrete steps that must be done, and not too large

The problems found by evaluators will be grouped into 10 Heuristic principles that have been set. The results of the grouping will be managed using a statistical analysis approach using a percentage so that the heuristic principle points are found with the most significant percentage.

The efficiency level is calculated based on the time needed by the user to complete each task. The level of user satisfaction is calculated based on the score given by the user on each task. The effectiveness is calculated based on the number of mistakes made and the number of tasks that can be completed and when working on the scenario. The level of effectiveness based on the number of tasks completed can be represented by the Successful Completion Rate (SCR). A task is considered good enough if 70% of users complete the task on the first try (Holzinger, 2005; Sauro & Lewis, 2016). SCR value can be calculated using the formula:

$$\text{scr} = \frac{number\ of\ successful\ respondents}{number\ respondents} x100\%$$

In the WEBUSE questionnaire, there are five answers available for each questi[illegible]. The results of the questionnaire will be changed into a merit relationship of choice, and merit can be seen in Table 2.

Then the merit results are accumulated based on 4 Usability categor[illegible]. The results of the accumulation of each category (mean value) are considered as Usability points for each category. Usability points for each category, x, are defined in the formula:

$$x = \frac{\sum merit\ for\ each\ question\ in\ the\ category}{number\ of\ questions}$$

Usability Points determine the Usability level of each category, namely:

- If point x is greater than 0, and x is less than 0.2, the Usability level is terrible.
- If point x is more significant than 0.2, and x is less than 0.4, the Usability level is reduced.
- If point x is more significant than 0.4, and x is smaller than 0.6, the Usability level is moderate.
- If point x is more significant than 0.6, and x is less than 0.8, the Usability level is right.
- If point x is more significant than 0.8, and x is less than 1, the Usability level is excellent.

Efficiency states the length of time a user takes to complete an entire task. All the work on the task in the repair design has a faster time compared to the old design. This is due to the unavailability of information regarding the restrictions on filling the registration requirements on the registration page; use the "+" button to access detailed refugee information on the post page; information about categories; unit of goods; and supplies are displayed on different pages; absence of information regarding filling restrictions on the profile data changes page; and the use of the "Manage Donations" label on the submenu used to access the status and proof of donations.

All calculation results will be used as a basis for improvement in website design. In the improvement design, the same questionnaire will be observed and distributed. The results of the design improvements will be compared with the old design fatherly to find out whether these improvements provide functional changes to the website.

Table 2 Suitability of Merit and Answer Options

Choice	Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree
Merit	0.00	0.25	0.5	0.75	1

4. RESULTS AND DISCUSSION

4.1 Heuristic Evaluation

From the evaluation results by the evaluator, 18 problems were found on the website. The evaluation data are then grouped into heuristic points. The results of grouping the problem into heuristic points are presented in Table 3. Based on Table 3 we get a percentage of each heuristic point to find out the problem spread on the website. Aesthetic design and minimalism are the biggest problems.

4.2 The Comparison of Efficiency Levels between Old Design and Design Improvement

Table 3 The Result of Heuristic Evaluation

Heuristic Nielsen	Problems
System Status Visibility	There is no notification whether the user successfully made a donation
Match between System and the Real World	The language used "setting" for the profile data is not quite right
	The use of the language "manage donations" is not appropriate
	The "refugee details" button symbol does not match
Standards and Consistency	Password information when registering and changing a new password is not hidden
	The donation menu and the category menu are not continuous
Error Prevention	Information about the minimum command characters when filling registration information is not displayed
	Error information filling registration data is displayed when the user has finished filling
An introduction instead of remembering	Users cannot see the supplies needed when adding donations
Flexibility and efficiency	Login is still using the email where when registration there is filling in the username
Aesthetic Design and Minimalism	There is an "edit" symbol on the "post" page
	There is a delete symbol on someone else's donation list
	On the "proof of donation" sheet there is information about "prices" that are not related to donations from users
	The "item units" and "category" sub menus are not needed
	On the "warehouse" and "post" pages, there is an "active status" that confuses users
	The donor's name and mobile number can be accessed by other donors
	On the "view inventory" page there is "price" information and is not required
Support for users to make recognition, diagnosis, and correction of errors	There is no notification when there is an error filling out the registration data

In the new design, information about filling restrictions for each registration requirement on the registration page is added, a button to display information on refugee details on the post page is denoted by "Refugee Details," unit item information and categories are displayed on the inventory menu, information about filling restrictions on the change data page a profile has been displayed, and information about the status of donations and proof of donations given by respondents can be seen in the profile menu.

These changes result in the time required by respondents to complete the task in the design of the repair faster than the old design. Then the design improvement has a level of efficiency that is better than the old design. The comparison of efficiency levels between old design and design improvements is presented in Figure 1.

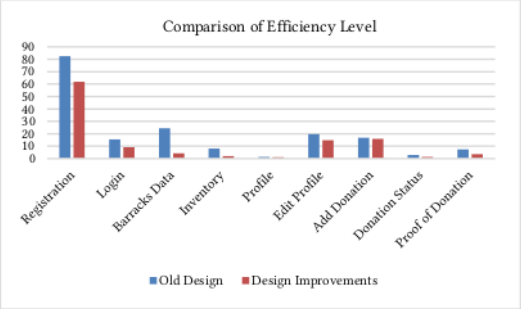

Figure 1 The Comparison of Efficiency Levels between Old Design and Design Improvements

4.3 The Comparison of Effectiveness Level between Old Design and Design Improvement

Effectiveness is expressed by the number of errors made by the user and the level of user success. A task is said to be effective if 70% of users can complete it (Sauro & Lewis, 2016). In the old design, there were still tasks with success of less than 70% of users, namely task posts with a success rate of 15%, whereas all tasks in the improvement design have more than 70% success. The number of errors in the repair design on each task has a smaller amount than in the old design.

Based on the design changes that have been mentioned in the discussion of efficiency levels, these changes also affect the effectiveness of the website. These changes result in a decrease in the number of errors in each task and increase the success rate of the task post on design improvement. So, it can be said that the improved design has a better level of effectiveness than the old design. The comparison of success levels between old designs and improved designs as is shown in Figure 2. Whereas, the comparison of number of errors between old design and design improvements as is shown in Figure 3.

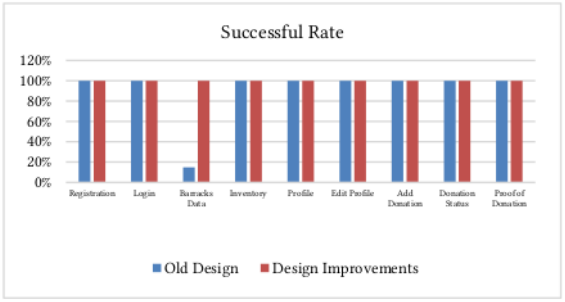

Figure 2 The Comparison of Success Levels between Old Designs and Improved Designs

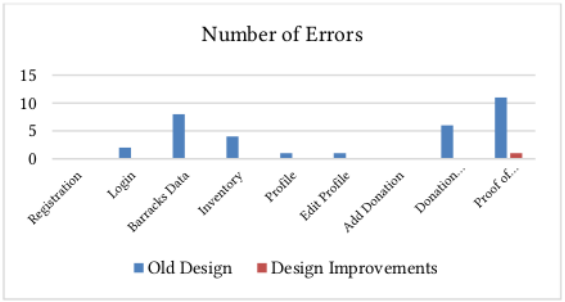

Figure 3 The Comparison of Number of Errors between Old Design and Design Improvements

4.4 The Comparison of Satisfaction Level between Old Design and Design Improvement

The level of satisfaction is expressed by how satisfied the user is in using the website. All levels of satisfaction increase in design improvement when compared to the old design. This is caused by changes that have been discussed in the discussion of the level of efficiency. So, it can be said that the improved design has a better level of satisfaction than the old design. The comparison of satisfaction level between old design and design improvement is presented in Figure 4.

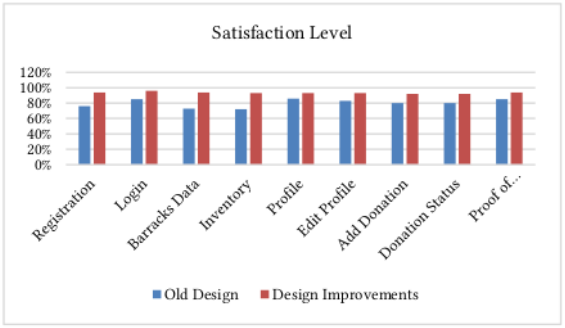

Figure 4 Comparison of Satisfaction Level between Old Design and Design Improvement

4.5 The Comparison of WEBUSE Results between Old Design and Design Improvement

WEBUSE is a usability evaluation method in the form of a Web-based Usability evaluation questionnaire that allows users to assess the usefulness of the website being evaluated. There are 4 Usability categories in the WEBUSE method based on Usability evaluation criteria, namely Content, Organization, and Readability, Navigation and Links, User Interface Design, Performance, and Effectiveness with a usability value of 0.76; 0.77; 0.79 and 0.79. In the improvement design, the criteria for Usability Content, Organization, and Readability, Navigation and Links, User Interface Design, Performance, and Effectiveness have a value of 0.89; .86; 0.85 and 0.86.

Based on the value of each category, the overall usability value of the website in the old design is 0.79, and the design is 0.87. So it can be said that changes to the design of improvements provide a good chance for the website as a whole.

5. CONCLUSION

Based on the results of data processing and analysis obtained the following conclusions. There are 18 problems found by evaluators with a scattered percentage, which is 39% in the design aesthetic and minimalist heuristic points. The entire working time on the repair design has a faster time compared to the old design. Task post in the old design is the only task that has a success rate of less than 70%, which is 15%. In the improvement design, all tasks have a success rate of above 70%, which is 100%. All levels of satisfaction in the design of improvements have a higher value than in the old design, so changes to the design of improvements increase the level of efficiency, effectiveness, and satisfaction and provide a good chance for the website. Older websites have a usability value of 0.78 and are categorized as having good usability. In the design of improvements, the website has a usability value of 0.87 and is categorized as having excellent usability. Based on this value, changes to the design of improvements enhance the value of website usability.

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