

A User-centered Design for Redesigning E-Government Website in Public Health Sector

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A User-centered Design for Redesigning E-Government Website in Public Health Sector

An Approach to Improve the User Experience

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Abstract— The rising awareness of information transparency and the increasing citizen participation in “healthy living for healthy societies” campaign have promoted the effectuation of e-government service in public health sector. As one of the government agencies, Surabaya Health Department (SHD), Indonesia, is responsible to provide public health services and to administer health-related policies in Surabaya city. The department has been utilizing an official website to deliver its tasks and responsibilities. However, the website was built mostly based on the department’s perspective and internal consensus, without a proper requirement gathering from users and stakeholders. This subjectivity has caused some essential unfulfilled, thus nullified the website goals.

This study aims to redesign the official SBD website to improve the information dissemination quality and the user experience. The website development follows user-centered design (UCD) methodology. The output consists of user requirements, user task analysis, and a redesigned SHD website prototype. The heuristic evaluations between the existing and the new redesigned websites demonstrate the improvement of user experience. The UCD also enables the user identification and the corresponding requirements more comprehensively. One of the examples is the inclusion of specific requirements for person with color-blind and person with dyslexia in the redesigned SHD website.

Keywords—user-centered design; UCD; usability; public health website; heuristic evaluation; user experience

I. INTRODUCTION

The World Wide Web is arising as one of the major health information sources. Consumers of non-medical professionals, have been extensively utilized health websites to fulfil their health information needs, including access to government policy on health and social care information. The increasing citizen participation in “healthy living for healthy societies” campaign, especially via electronic system, has promoted the effectuation of e-government services in public health sector. Government agencies have developed official websites as one of the core media to deliver the public health services, such as informing verified public health information, promoting healthy life style,

preventing the spread of communicable disease, and assuring adequate local public health services.

Delivering public health information electronically requires meticulous and advanced information processing, rigorous evaluation, and strict compliance to standards. To effectively facilitate the presentation of health information, it is essential to design the system based on the user’s needs and to incorporate interaction design and usability principles [1]. Previous works also mentioned that usability positively influenced the user satisfaction on mobile-based applications [2], perceived usability affected the continuance usage intention of Internet Banking [3]. In mobile health applications, implementing adequate usability on its development is crucial to ensure the correct exchange of health messages [4]. Delivering accurate health information in the correct presentation is important to avoid misunderstanding of health information as it may lead to harmful consequences [5], e.g., affecting a person’s health, or worsening the patient’s condition.

Incorporating usability principles and interaction design in a system development is mostly conveyed via its interface design. A good interface enables the users to perform their intended tasks effectively and efficiently without too much distraction. Some of the interface system design methodologies are User-Centered Design (UCD) and Activity-Centered Design (ACD). UCD works based on the needs and the interests of users with a focus of making the system usable and understandable [6], while ACD focuses on the activities that the users will carry out or should be able to perform by using the designed system [7]. ACD is mostly used to design a system where the user groups are heterogenous and the usage goals are varied, but the activities that the users carry out are more common [7]. This study applies UCD because a health-related system must accommodate users’ requirements thoroughly to ensure the delivery of relevant and correct health. Therefore, involving user throughout the system development is essential [8]. The UCD design process consists of specifying the context of use, specifying the user and organizational requirements, designing the solution, and evaluating the solution against the requirements [9].

As one of the government agencies, Surabaya Health Department in Indonesia is responsible to provide public health services and to administer health-related policies in Surabaya city. The department has been utilizing an official website to deliver its tasks and responsibilities to Surabaya society. However, the website was built mostly based on the department's perspective and internal consensus, without a proper requirement gathering from users and stakeholders. This subjectivity has caused some essential requirements in a public health system unfulfilled, thus nullified the website goals. Often times, the users were unable to find the public health information they were looking for. Given the current problems in the existing official website, this research aims to redesign the website of Surabaya Health Department to improve the information dissemination quality and the user experience. The proposed solution is developed based on UCD methodology.

II. RESEARCH METHODOLOGY

This research adopted user-centered design methodology to redesign the official website of Surabaya Health Department. The method consisted the following four phases. The first phase was specifying the context of use by identifying the user and assigning the context of use. To identify the user, we conducted literature study and interviewed the manager of the website from Surabaya Health Department. The purpose of the interview was to gather requirements from the public health service provider's perspective. To assign the context of use, we evaluated the existing websites based on the users' and experts' perspectives using heuristic evaluation. The questionnaire for the heuristic evaluation was developed based on the application of heuristic evaluation in [10], [11]. The questionnaire consisted of ten heuristic indicators, i.e., aesthetic and minimalist design; visibility of system status; match between system and the real world; recognition rather than recall; consistency and standards; flexibility and efficient of use; use control and freedom; error prevention; help users recognize, dialogue, and recovers from errors; and help and documentation. The indicators were measured using 4-point Likert scale, i.e., strongly disagree (1), disagree (2), agree (3), and strongly agree (4). The participants were the users of the existing website, two information system analysts, two public health practitioners, two visual communication designers, and two psychology students.

The second and the third phases were related to the UCD system development. The second phase, specifying the user requirements, identified the user needs and analyzed the user tasks from a public health website. The output of this phase included requirements specification, user tasks analysis, use case diagram, and sequence diagram. The third phase, designing the solution, transformed user requirements into the system blueprint that consisted of the layout design, a storyboard design, and the user interface mock-up. The solution in this study focused on the interaction design via the system interface.

The last phase was evaluating the proposed solution against the requirements using heuristic evaluation method. The evaluators were the same participants who assessed the existing website of Surabaya Health Department in the first phase. The research methodology in this study is depicted in Figure 1.

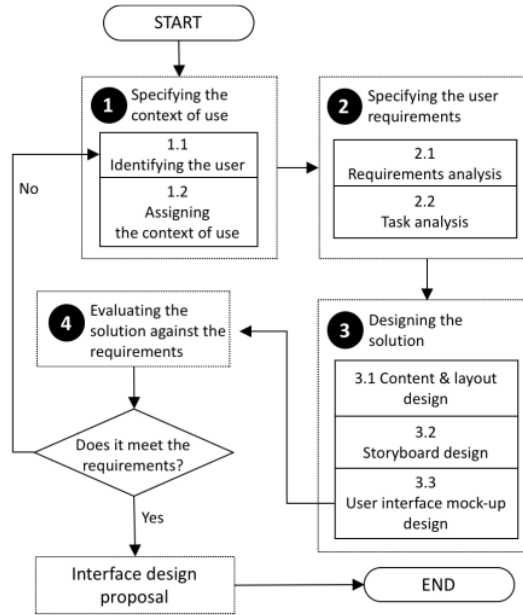


Fig. 1. Research methodology

III. RESULTS: THE WEBSITE DESIGN BASED ON UCD

A. User Identification

Based on the interview with the manager of Surabaya Health Department website and literature study in public health, there were three user classes as elaborated in Table I. Each user classes used the website for specific purpose and carried out different tasks.

TABLE I. USER IDENTIFICATION

User class	Profession	Organizational Environment	Usage Purpose
Health service provider	1. Hospital staff 2. Community Health Center staff	Hospital, CHC, Specialist Clinics, Drugstore, University	Input health report
	3. Physician / midwife 4. Pharmacist 5. Nutritionist 6. Health analyst 7. Academics		Verify health information, provide public health service, administer online health-related license application
Government stakeholder	1. City government 2. City council	Government office	Monitor the health service provider performance, draw and issue public health policy
Society	1. Citizen 2. Journalist	The city of Surabaya, TV studio, Radio station, News agency	Access public health and healthcare facility information, consult public health matter, download health data.

B. Assigning the Context of Use (Heuristic Evaluation 1)

Assigning the context of use involved collecting the user feedback and evaluating the usage of the existing Surabaya Health Department website. Each heuristic indicator consisted specific questions. All answers from all participants for each question was tabulated using the behavior measurement scale [12]. The result of each question was then interpreted based on four interval scales, as shown in the Likert scale. The result of the heuristic evaluation is elaborated in Table II.

TABLE II. THE RESULT OF EXISTING WEBSITE EVALUATION (HEURISTIC EVALUATION 1)

Heuristic Indicator	Question Code	Tabulated Score	Interval Interpretation
Aesthetic and minimalist design	AE1	50%	Disagree
	AE2	55%	Agree
	AE3	46%	Disagree
Visibility of system status	VI1	48%	Disagree
	VI2	53%	Agree
	VI3	58%	Agree
	VI4	65%	Agree
	VI5	48%	Disagree
Match between system and the real world	MA1	56%	Agree
	MA2	43%	Disagree
	MA3	70%	Agree
Recognition rather than recall	RE1	55%	Agree
	RE2	50%	Disagree
Consistency and standards	CO1	53%	Agree
	CO2	48%	Disagree
	CO3	63%	Agree
Flexibility and efficient of use	FL1	46%	Disagree
	FL2	50%	Disagree
Use control and freedom	US1	51%	Agree
	US2	48%	Disagree
Error prevention	ER1	55%	Agree
	ER2	48%	Disagree
Help users recognize, dialogue, and recovers from errors	HE1	56%	Agree
Help and documentation	HD1	45%	Disagree

C. Requirement Analysis

The user requirement analysis incorporated all participants' feedbacks in the heuristic evaluation 1. The result is shown in Table III.

TABLE III. THE PROPOSED REQUIREMENT BASED ON USER'S FEEDBACK FROM THE HEURISTIC EVALUATION 1

No.	Proposed Requirement	Participant
1.	User interface redesign	P1, P3, P4, P7, P8, P9, P10, P11, and P12
2.	Search tools to seek information about health care service	P1, P4, P5, P10, P12, P13, and P15
3.	Direct and real time communication between the user and the staff of Surabaya Health Department	P1, P3, P10, and P11
4.	Inclusion of health data and public health documentation in the website	P2 and P4
5.	Online processing of clinic operating permit	P7, P12, and P15
6.	A user's feedback facility	P4

D. Task Analysis

The users' tasks analysis integrated the user identification from the service provider perspective and the requirements from the user's perspective. Table IV shows the task analysis result for each defined user class.

TABLE IV. THE USERS' TASKS

User Class	Task	
Health service provider	1.1	Access Surabaya Health Department website
	1.2	Supply verified and accurate public health information (including health-related news, health-care facilities, and public health policy)
	1.3	Seek public health information
	1.4	Administer online health-related license application
	1.5	Upload health data and public health report / documentation
Government stakeholder	2.1	Access Surabaya Health Department website
	2.2	Seek public health information
	2.3	Monitor the Surabaya Health Department activities by assessing the posted content related to public health activities in Surabaya city.
Society	3.1	Access Surabaya Health Department website
	3.2	Seek public health information
	3.3	Access public health service
	3.4	Consult public health matter with the staff of Surabaya Health Department
	3.5	Submit feedback related to the website and public health activity
	3.6	Download health data and public health report / documentation

The task analysis also produced use cases, scenario, and the sequence diagram. The use case consisted of three actors and eleven use cases.

E. Designing the Solution: the Content Design

The first activity of designing the solution was constructing the content design. Content should be constructed consistently, it defines the layout, the structure, and the outline of all website

content. In this study, the content design focused on the aesthetics and the navigational design.

1) Aesthetics Design

The aesthetic design included the theme colors, layout, and font-schemes. The selected theme colors for the proposed new website were blue (hex code: #0088cc), black (hex code: #383f48), and white (hex code: #FFFFFF). We selected the theme colors to accommodate the color-blind users in the society of Surabaya. About 95% of color-blind population is unable to distinguish green and red colors. Surabaya Health Department also requested the blue color as it is the institutional color.

The website layout is presented in Fig. 2. The main menu, that showed the highest level of user interaction, was located on the top of the page and the side menu (if available) was located on the left part. Since the redesigned website belongs to website with specific topics and interest group, placing the top priority content on the top menu enables greater exposure. This allows the user to find the most important website content faster and easier. The submenu on the left page also facilitated quick eye scanning about the overall structure of a website [13]. The submenu position is more preferable on the left side than on the right side because it is more suitable with the reading direction in Indonesian language and English.

In this first website redesign, the user requirements included specific needs for people with color blind and people with dyslexia. According to International Dyslexia Association, around 10% of people have dyslexia [14]. Thus, we selected the font-schemes with the highest readability to facilitate reading for person with dyslexia, i.e., Helvetica, Arial, and Verdana [14].

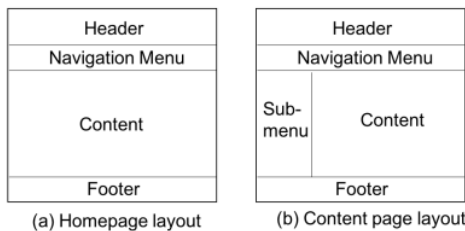


Fig. 2. The layout-design

2) Navigational Design

The website navigation was placed on the top page and constructed based on the hierarchical structure. The top menu consisted of Home, *Tentang Kami* (profile), *Layanan Publik* (public service), *Informasi Publik* (public information), *Download* (health data and report), and *Pojok Kesmas* (Community Health Center Corner). Some of the main menu can be decomposed further into several submenu, such as the *Layanan Publik* menu. *Layanan Publik* consisted of E-health, *Pelayanan Puskesmas* (Community Health Center service), *Pelayanan Sarana Kesehatan* (public health facility service), *Perijinan Online* (online health-related license application). Fig. 3. depicts the hierarchical structure of the web navigation.

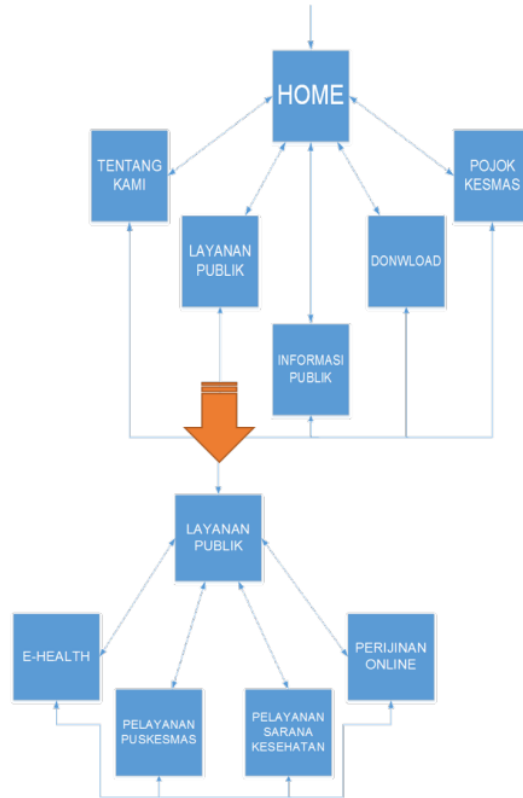


Fig. 3. The web structural navigation. The translation labels in English are the following: *Tentang Kami* (SHD Profile), *Layanan Publik* (Public Service), *Informasi Publik* (Public Information), *Download* (Health Data and Report), *Pojok Kesmas* (Community Health Center Corner), *Pelayanan Puskesmas* (Community Health Center Service), *Pelayanan Sarana Kesehatan* (Public Health Facility Service), and *Perijinan Online* (Online Health-related License Application)

F. Designing the Solution: Storyboard and Mock-Up

The storyboard visualizes the possible scenario of user interaction on each webpage. It also facilitates the exploration of user experience with the website. We developed the storyboard for each webpage based on the user requirement and the task analysis. An example of storyboard for homepage is shown in Fig. 4. The last step on designing the solution was building the website prototype based on the mock-up approach. Fig. 5. shows the example of homepage prototype.

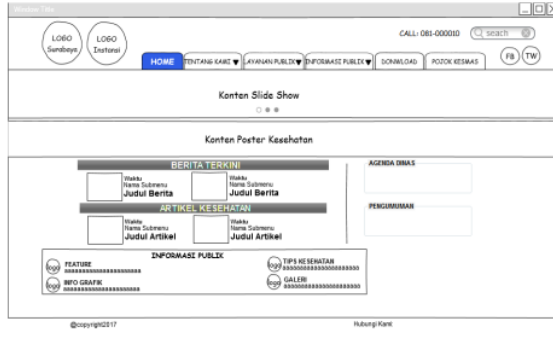


Fig. 4. Storyboard of SHD homepage website



Fig. 5. The homepage mock-up (in Indonesian language)

G. Evaluating the Solution Against the Requirements (Heuristic Evaluation 2)

We conducted heuristic evaluation 2 to evaluate the correctness and the completeness of the developed solution, i.e., the new website prototype. The heuristic evaluation 2 used the same questionnaire and the same participants as in heuristic evaluation 1. Table V shows the heuristic evaluation 2 results.

IV. DISCUSSION

This paper proposes the application of UCD to redesign a public health agency website, i.e., the Surabaya Health Department in Surabaya city. The UCD ensures the website development incorporating all users' needs. This is essential because the Surabaya Health Department website delivers public health information to broad audiences. Error and mistake in health information delivery can cause fatal consequences. Another consideration in the website development is the involvement of experts and practitioners from multidiscipline fields to assure the delivery of accurate health information in the correct presentation.

TABLE V. THE RESULT OF NEW WEBSITE EVALUATION (HEURISTIC EVALUATION 2)

Heuristic Indicator	Question Code	Tabulated Score	Interval Interpretation
Aesthetic and minimalist design	AE1	90%	Strongly agree
	AE2	85%	Strongly agree
	AE3	75%	Agree
Visibility of system status	VI1	85%	Strongly agree
	VI2	90%	Strongly agree
	VI3	90%	Strongly agree
	VI4	80%	Strongly agree
	VI5	90%	Strongly agree
Match between system and the real world	MA1	85%	Strongly agree
	MA2	90%	Strongly agree
	MA3	90%	Strongly agree
Recognition rather than recall	RE1	85%	Strongly agree
	RE2	85%	Strongly agree
Consistency and standards	CO1	85%	Strongly agree
	CO2	85%	Strongly agree
	CO3	70%	Agree
Flexibility and efficient of use	FL1	95%	Strongly agree
	FL2	90%	Strongly agree
Use control and freedom	US1	90%	Strongly agree
	US2	90%	Strongly agree
Error prevention	ER1	85%	Strongly agree
	ER2	80%	Strongly agree
Help users recognize, dialogue, and recovers from errors	HE1	80%	Strongly agree
Help and documentation	HD1	90%	Strongly agree

The new website evaluation (heuristic evaluation 2) exhibits improvements in all heuristic indicators compared to the existing website evaluation (heuristic evaluation 1). Only one question in one indicator scores below 75%, i.e., the question about the content update consistency (OC3). It occurs because the new website is still in the development phase, thus the content is not updated frequently. These improvements confirm that the user-centered development can capture the user requirement more comprehensively, thus increases the likelihood of system success. One of the examples is the inclusion of specific requirement for person with color-blind and person with dyslexia.

While most of the results correspond positively to the purpose of this study, further iterations of user-centered design are necessary to complete the new redesigned website. Further evaluation should be conducted by involving larger participants and representatives from the government stakeholders.

V. CONCLUSION

This study applies the user-centered design to develop a website that can improve public health communication and health information exchange between a government agency (i.e., Surabaya Health Department) and the society of Surabaya. The results of this study support three main contributions, i.e., a detail identification of the targeted users, the inclusion of specific requirements for users with special needs, and the application of UCD to improve the user experience. The enhancement of the user experience is exhibited in the heuristic evaluation scores between the existing website and the new redesigned website.

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PAGE 1

PAGE 2

PAGE 3

PAGE 4

PAGE 5

PAGE 6
