Usability evaluation to approve an information system design (case study: Immunization monitoring interface design)

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Usability evaluation to approve an information system design (case study: Immunization monitoring interface design)

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Abstract. Prototyping is a useful technique to support the development process of building a software application. It is beneficial particularly when the developer focus on the user. However, in the requirements phase, the developer has problems to give visualization about the task that should be done when the user interacts with the information system. So, this paper aims to demonstrate that with the usability evaluation in the requirements phase, it can help the IS developer to achieve approval from the potential user of the IS. This paper employs a case study in the process of developing Immunization Monitoring Information System (IMIS) at the Srondol Community Health Centre (*Pusat kesehatan Masyarakat*/ PUSKESMAS), Semarang, Indonesia. For the experiment, this paper only uses two potential IMIS users. The IMIS interface will be tested for its usefulness with variable effectiveness, efficiency, and easy use. The output generated from the experiment was an effective, efficient and easy-to-use interface design for IMIS from the perceptions of child guardians and the perspective of Community Health Centre staff. This paper provides recommendations, that in the requirement process, usability tests can be used to get approval and recommendations from potential user of information systems.

Keywords: **interface design; usability evaluation; requirements process; user validation.**

1 Introduction

Employing the principle of good design, it gives an assumption that systems should be easy to learn, can increase user productivity and satisfaction, can increase user acceptance, decrease user errors, and decrease user training time [1]. It is mentioned, that software developers of health information systems often ignore interface features, user duties, user preferences, and usability problems [2]. It can lead to systems that reduce health care staff productivity.

A number of factors could be attributed to the bad design of systems such as limitations of the developer about the knowledge of user-centred design. In U.S, shows only 61% of health care system projects that fulfill the specifications of the customer [3].

Recently, the health care providers (or community health care centre) are being challenged to present and handle data effectively with the use of the technology. They need technology that can embrace and enforce the data on their ease of use.

Information technology is altering the way patient data is collected and collected and can affect clinicians ' decision-making procedures. There are several valid user-centred design methodologies, however, none address the requirement in the process of design. This paper aim is to show the process of designing user-centred interfaces using usability evaluation to get user approval in the health information system.

2 Literature Review

User interface design is associated with designing a system to perform tasks that fit together, suit the context in which the system is used, and meet the task aims of the user, and as a response, human-computer interaction task analysis should be concerned with describing and evaluating the task environment of the user.

Usability testing is a technique to understand all functions that can work within an interface of a system, that focus on user that will be using the system [4]. When applying the concept of usability to sustainable behavior, it could say that the user-centre of a sustainability solution can be assessed by evaluating how efficiently the side effects of the use of a product are lowered, what the expenses are (money, time, effort) and how satisfied the user group [5]

Table 1. Matriks Usability ISO 9241 [6]

Usability Objective	Effectiveness Measures	Efficiency Measures	Satisfaction Measures
Suitability for the task	Percentage of goals achieved	Time to complete a task	Rating scale for satisfaction
Appropriate for trained users	Number of power functions learned	Relative efficiency compared	Rating scale for satisfaction

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Usability Objective	Effectiveness Measures	Efficiency Measures	Satisfaction Measures
		with an expert user	with power feature
Learnability	Percentage of functions learned	Time to learn criterion	Rating scale for ease of learning
Error Tolerance	Percentage of error corrected successfully	Time spent on correcting error	Rating scale for error handling

2.1. User Task Analysis

The aim of the task analysis is to gather enough data about the task set to be supported by the user interface to allow user interface design. Task analysis is used in three distinct ways within Human-Computer Interaction, each happening at a particular stage in the design process[7].

The first and most popular knowledge of task evaluation at the beginning of the design phase is the description of the tasks and task setting of the user, the existing task condition. Task assessment (appropriate) is the subject of this section in this sense [8].

The second interpretation of the task analysis relates to the assessment within the fresh model of the suggested user assignments. In this sense, task analysis relates to ongoing reflection on the effects of design decisions and should be referred to as simple design or task design [8].

Third, task analysis can also involve analyzing the duties as they are or should be conducted with a specific user interface. In this sense, task analysis relates to the assessment of user interface elements and should be called user interface assessment [8].

User interface design is associated with designing a system to perform tasks that fit together, suit the context in which the system is used, and meet the task aims of the user, and as a response, human-computer interaction task analysis should be concerned with describing and evaluating the task environment of the user. To create the user task this paper used the structure of the navigation system.

2.2 The importance of selecting respondents for Usability testing

The selection of respondents is very important in an evaluation of usability. The chosen respondents are expected to be able to represent the entire population of users because testing carried out with respondents who do not represent the user population will not be of any use [6].

According to Rubin [9], research respondents must be taken from those who actually use the product so that the results obtained are valid and can be justified. The number of respondents 4 or 5 already represents all existing users to find 80% of the deficiencies of a product. However, if there is enough time and resources to do the testing with more than 4 or 5 participants it is better to do it because there will be a possibility of finding another 20% errors.

Whereas according to [10] the best number of respondents in each usability test is 5 people, respondents who number 5 are considered able to represent most usability problems without involving many resources.

2.3 Usability variable

According to Kirwan [8], a product can be said to be efficient if the user can use the product by specific time to meet their objectives accurately and completely when using the system. According to [11] usability is the level of usability of a product from the user's perspective to achieve an objective effectively, efficiently, and satisfactorily. Usability evaluation needs to be done to ensure that a product can be run without giving confusion to the user.

3 Method

To get approval for good design, this study following steps : First, identify the user's characteristic that potential used the system. Then, defining the user task by using the navigation structure of the web. Next is defining the usability variable. Then finally, measuring the usability of the IMIS to get approval from the user.

3.1 Understand the user that potential used the system

In this stage, it is necessary to know the characteristics of the user according to their duties in the system. In the Srondol community health centre, those who will use IMIS are health workers and parents. The two users above are users who play an active role in the continuation of immunization monitoring. To understand the ease of use and user satisfaction. The user recognized based on the education level.

Table 2. User on IMIS based on the level of education

No	User IMIS	Frequency	Level of Education
1	Health Care staff	2	Diploma
		3	Under Graduate
2	Children Guardian	2	elementary school
		2	Junior high school
		7	Senior high School
		3	Diploma
		7	Undergraduate

3.2 Define the User Task

Preparing the user's task is essential, so, in the requirements, process can be identified what will be user should do by using the system.

Table 3. User task on IMIS

No	User	Task
1	Health care staff	a. Manage the system user b. Manage vaccine data (view, add, change and delete) c. Manage data children's (see, add and change) d. Manage immunization data (view and recapitulating the number of immunizations)
2	Children guardian	a. Manage child data (see, add, and change) b. Manage immunization data (see, add and change) c. Manage growth data (see and change)

According to Dix et al. [6], the design object is not just a computer system or device, but overall technical intervention. System navigation is defined as a page in a system and how they are interconnected. Navigation in the information system must be able to explain what will happen when a button is pressed so that users can understand where they are in the interaction that occurs.

According to Dix et al. [6] there are two structures in a web namely local structure and global structure which are explained as local structure is a comprehensive explanation of a page to achieve the desired goal of the user. The task of IMIS users created using the local structure or navigation. The local structure of health care staff and children guardian is in Figure 1 and Figure 2.

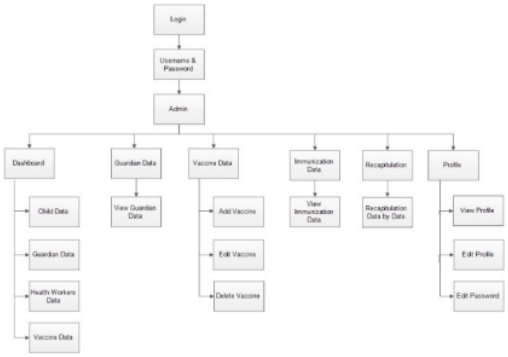

Fig. 1. Local Structure for Health Care staff

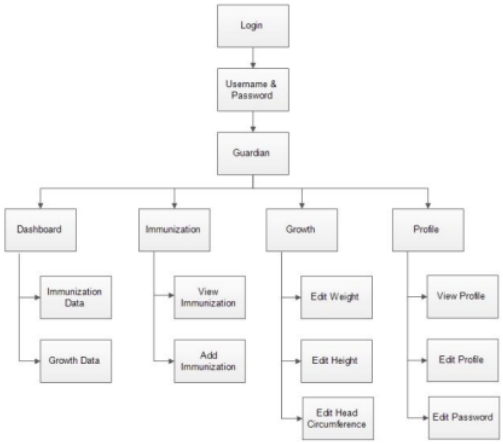

Fig. 2. Local Structure for Children guardian Group

3.3 Preparing the Dashboard

The health care staff dashboard page contains a summary of information in the information system. The admin dashboard page contains child data, parent data, health worker data, and monthly immunization delivery charts. The administrator dashboard page can be seen in Figure 3.

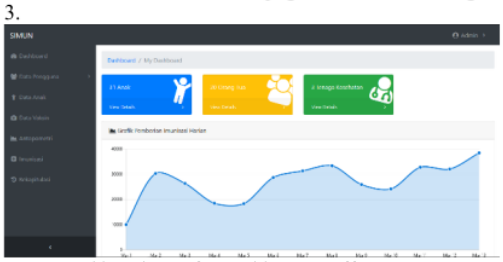

Fig. 3. Dashboard page for Health Care staff

The parent dashboard page contains a summary of the information Children guardian needs in the information system. This page contains data on the child's gender, child's age, the number of immunizations the child has received, height, weight, and head circumference of the child. The Children's guardian dashboard page can be seen in Figure 4.

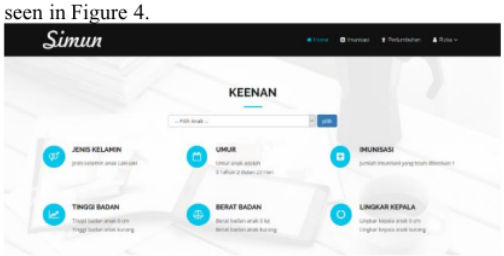

Fig. 4. Dashboard page for Children guardian Group

3.4 Define the Usability Variable

First, Effectiveness or effectiveness describes how well users can use the system to achieve the goals they want.

Effectiveness is measured based on the level of user success in completing a given task.

To know the aspects of effectiveness is based on the level of success of respondents in carrying out a list of tasks on each menu (Table 2). In the effectiveness calculation, the usability matrix is used with the success rate measure proposed by [12] because this matrix is easier to measure. The assessment is not only absolute on the success and failure but also used the condition of half-successful or when the user is only able to complete part of the given task. The success rate is defined as the percentage of tasks completed by the respondent correctly. Following is the success rate formula [12]:

$$Success\ Rate = \frac{(S+(P\times 0{,}5))}{N} \times 100\% \quad (1)$$

The process of evaluating task completion is based on the criteria for success in carrying out the assignment, referring to the Sample Success Criteria for Scoring Scenarios, which can be seen in Table 4.

Table 4. Sample Success Criteria for Scoring Scenarios

Value	Criteria
Success	– Respondents complete the task with minimal effort – Respondents reach their goals for a maximum of 2 attempts – Respondents did not receive help from researchers – Respondents did not ask the researcher – Respondents did not find an error message (error message) – Respondents did not give expressions of confusion / frustration
Half Succes	– Respondents complete the task with moderate effort – Respondents reach the goal a maximum of 3 attempts – Respondents received 1 assistance from the researcher – Respondents found 1 to 2 error messages – Respondents expressed little confusion / frustration
Fail	– Respondents did not complete the task or complete the task with difficulty – Respondents reach the goal in 4 or more trials – Respondents receive 2 or more help from researchers – Respondents found more than 2 error messages – Respondents express confusion / frustration – Respondents revealed that the task was completed when the actual task had not been completed.

Second, efficiency describes the resources needed by users to achieve the goals they want. The resources in question can be in the form of mental, physical, time, and cost. In this research, time will be used as a measure of efficiency.

Third, satisfaction is the level of user satisfaction in using information systems. Satisfaction here includes both appearance and functionality. Satisfaction refers to the user's perceptions and opinions about the product both in terms of appearance and functionality. In measuring the aspect of satisfaction, questionnaires are in the form of written and oral questions. According to [13] to determine the value of the satisfaction aspect can be seen from the comparison between the actual score and the ideal score. The actual score is obtained through the calculation of all respondents' opinions according to the given weight classification. While the ideal score is obtained by multiplying the number of questionnaire respondents with the highest weight. Here is the formula for obtaining a total score.

$$\boldsymbol{Skor\ Total} = \frac{skor\ aktual}{skor\ ideal}\ x\ 100\% \quad (2)$$

After finding the results of the calculation of values in each of the aspects obtained then carried out a comparison with Table 5 about the criteria for the interpretation of values.

Table 5. Criteria for the interpretation of values

Percentage (%)	Level of Effectiveness	Level of Efficient	Level of satisfaction
0 % - 20%	Un effective	Un Efisien	Not Satisfy
21% - 40%	Less effective	Less Eficient	Less Satisfy
41% - 60%	Moderate	Moderate	Moderate
61% - 80%	Efektif	Efisien	Satisfy
81% - 100%	Very Effective	Very Efficient	Very satisfy

4 Result

4.1 Usability Testing on Health Care's User

The usability test results on the group of administrator respondents on aspects of effectiveness, efficiency, satisfaction, and ease of use are shown in Figure 5.

The effectiveness value obtained is 92.9%, based on observations made, respondents feel less familiar with the use of date picker when entering data in the form of dates. Respondents feel more familiar if you enter it manually.

Based on the time of completion of the task, it obtained an efficiency value of 87.4%. From the results of observations made, the most time was spent by respondents to fill in vaccine data forms.

From the aspect of satisfaction, the value was 86.7%. Based on observations, respondents were satisfied with the whole system, but on the recapitulation page, it was better to differentiate immunization according to sex.

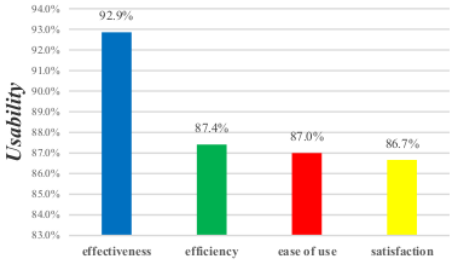

Fig. 5. Result Usability Test Health care staff

4.2 Usability Test Children Guardian based on age

The usability test results on the group of parent respondents based on age in the aspects of effectiveness, efficiency, and satisfaction are shown in Figure 6.

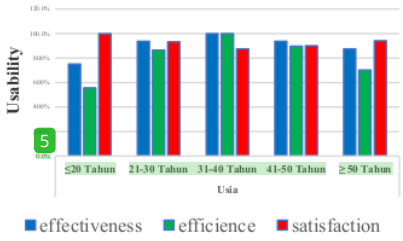

Fig. 6. Result Usability Test Children Guardian Based on Age

The effectiveness aspect of children's guardian user groups based on age has the highest value in the age group of 31 to 40 years. This is because respondents are at a productive age and understand the use of the system well. While the lowest value is under the age of 20 years because respondents are not accustomed to using computers.

Based on the time of completion of the task, obtained the highest value of efficiency of parents respondents at the age of 31 to 40 years. Respondents felt they could use the system properly without needing help. The lowest value for the aspect of efficiency is at the age of fewer than 20 years because respondents are not accustomed to using computers.

The highest aspect value of respondents' satisfaction was at the age of fewer than 20 years because respondents were satisfied with the features offered by IMIS. While the lowest satisfaction aspect value is at the age of 31 to 40 years. Respondents felt the need to add a guide to the use of the system.

4.3 Usability Test Children Guardian based on education level

The results of usability testing in the group of parents respondents based on education on the aspects of effectiveness, efficiency, and satisfaction are shown in Figure 7.

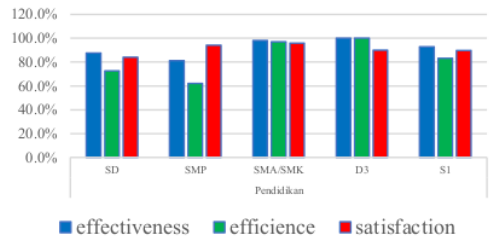

Fig. 7. Result Usability Test Children Guardian Based on Education Level

The effectiveness aspect of children's guardian user groups based on education has the highest value in D3 educated parents. This is because respondents are at a productive age and understand the use of the system well. The value drops in parents with a Bachelor's education because some of the respondents are elderly and have difficulty using a computer. While the lowest scores were parents with a junior high school education of 81.3%.

Based on the time of completion of the task, obtained the highest efficiency value of parent respondents was in parents with D3 education. Respondents felt they could use the system properly without needing help. The value drops in parents with a Bachelor's education because some of the respondents are elderly and have difficulty using a computer. While the lowest value for the efficiency aspect is in parents with junior high school education because respondents are not accustomed to using computers.

In filling out the questionnaire, the highest aspect value of the respondents' satisfaction was among parents with junior high school education because the respondent was satisfied with the features offered by SIMUN. While the lowest satisfaction aspect value is in parents with elementary education with a value of 84.2%.

5 Conclusion

From usability test of each respondent has been conducted shows the usability value of IMIS is very feasible to be used. IMIS has achieved its objectives effectively, efficiently and satisfactorily. From the usability testing the IS developer received the feedback about the Immunization monitoring interface design. From the experiments, we suggest that the usability evaluation should be conducted in the requirements phase to received a feedback when prototyping was used in the process developing of IS.

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