Evaluation of expert system application based on usability aspects

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Abstract. Usability usually defined as a point of human acceptance to a product or a system based on understands and right reaction to an interface. The performance of web application has been influence by the quality of the interface of that web to supporting information transfer process. Preferably, before the applications of expert systems were installed in the operational environment, these applications must be evaluated first by usability testing. This research aimed to measure the usability of the expert system application using tasks as interaction media. This study uses an expert system application to diagnose skin disease in human using questionnaire method which utilize the tasks as interaction media in measuring the usability. Certain tasks were executed by the participants in observing usability value of the application. The usability aspects observed were learnability, efficiency, memorability, errors, and satisfaction. Each questionnaire question represent aspects of usability. The results present the usability value for each aspect and the total average merit for all the five-usability aspect was 4.28, this indicated that the tested expert system application is in the range excellent for the usability level, so the application can be implemented as the operated system by user. The main contribution of the study is the research became the first step in using task model in the usability evaluation for the expert system application software.

1. Introduction

From the point of view of people who need to use any interactive software system, usability is the most important aspect of the system. Usability is a quality attribute that assesses how easy user interfaces are to use. One way to evaluate the interface known as usability testing.

Badre provides a definition of usability testing as follows: "Usability testing has traditionally meant testing for efficiency, ease of learning, and the ability to remember how to perform interactive tasks without difficulty or errors."[1]. The ISO 9241 standard defines usability as ‘‘the extent to which a product can be used by specified users to achieve specified goals with effectiveness, efficiency And satisfaction in a specified context of use’’[2].

Usability tests are necessary to obtain interfaces according to the needs and user satisfaction in using the system.
Clairmont defines formal usability testing as, “The observation and analysis of user behavior while user use a product prototype to achieve a goal” [3]. Covey defines as: “a structured, exploratory observation of clearly defined aspects of the behavior of an individual performing one or more design at the tasks” [4].

From the description above can be concluded that the formal usability testing method is to observe the use of systems or prototypes by the user, by giving the user a series of tasks that have been made by researchers.

Any researchers have used the aspects of usability in their testing for some application software. In previous studies, Ardito et. al, has evaluated the usability of e-learning application. Usability dimension for e-learning platform namely: presentation, hypermediality, application proactivity and user activity [5]. Chrisna et. al, has evaluated the usability of Business Intelligence (BI) application at a coal mining organization. For usability criteria, Chrisna confirms the importance of efficiency, effect, learnability, helpfulness and control but he adds another criteria, namely: information architecture, learnability and operability which relates to reporting format, data quality, accessibility and processing speed as required in the mining context [6]. Shafinah et. al, has evaluated the usability of Decision Support Systems (DSSs). Eight usability factors (efficiency, understandability, operability, attractiveness, error prevention, learnability, accuracy and effectiveness) have been identified for the evaluation process [7].

This study discussed the system evaluation for an Expert System (ES) application based on usability aspects. Five usability factors have been identified for the evaluation process, namely: learnability, efficiency, memorability, errors, and satisfaction. This evaluation aimed to determine how much the ease of an interface can be used by the user so that the system can be received in the operational environment.

The main contribution is the research became the first step in using task model in the purpose of usability measurement of expert system application software. The advantage of this research is the usability evaluation criteria for expert system applications presented as guidelines for another researchers in their study using other expert system applications.

2. Literature Review

2.1 Basic Concepts of Expert System

Expert system is a piece of software programmed using Artificial Intelligence (AI) techniques. Such systems use databases of expert knowledge to offer advice or make decisions in such areas as medical diagnosis and trading on the stock exchange. Expert systems development requires knowledge acquisition from people, involving both knowledge engineers and application domain experts in specialist interactions with computing systems. Expert systems may be used to provide support and advice to a user of any complex information system and hence to improve the human-computer interface [8].

2.2 Usability Testing

Usability ensures that interactive products are easy to learn, effective to use and enjoyable from the user's perspective. This culminates in the goals of effectiveness, efficiency, safety, utility, learnability and memorability [9]. The measurement of usability depends on the users, their needs (goals) and the context – three variables that are inconsistent and unstable in themselves [10].

There are some experts who provide the definition and quality components of usability, including [11]:

1) Dix et al, (2004): The system can help users to solve their problems is a system that:
   - Useful: a system which functions as desired by the user.
   - Usable: a system that is easy to operate
   - Used: a system that motivates the user to use, appealing to the user, fun, and etc.
2) Jakob Nielsen (2003): Usability is a quality attribute that assesses how easy user interfaces are to use. The word "usability" also refers to methods for improving ease-of-use during the design process. Usability is defined by 5 quality components [12]:
1. Learnability: How easy is it for users to accomplish basic tasks the first time they encounter the interface?
2. Efficiency: Once users have learned the design or application, how quickly can they perform tasks? (system has the simple steps (fewer steps) to support the users in performing their work, example: a single button on the automatic answering machine, one-click shopping: Amazon.com)
3. Memorability: When users return to the design or application after a period of not using it, how easily can they reestablish proficiency?
4. Errors: How many errors do users make, how severe are these errors, and how easily can they recover from the errors?
5. Satisfaction: How pleasant is it to use the design or application?

3) Palmer (2002): Viewing other quality attributes of usability, namely: the download time, navigabilitas, interactivity, responsiveness, content quality.

3. Expert System Application Software
The application software that used in usability testing is the expert system application to diagnose skin disease in human. Some interfaces from the system are shown in Figure 1, Figure 2 and Figure 3.

The main page interface of the application (Figure 1) consist of five Menus (Home, Daftar Penyakit, Konsultasi, Login Pakar dan Kontak).

Interface of admin page (Figure 2) consist of eight Menus (Input Penyakit, Input Gejala, Input Relasi, Ubah Penyakit, Ubah Gejala, Laporan Penyakit, Laporan Gejala dan Logout).

Figure 3 displays Analysis Result of Skin Disease after the user answered the questions on the system.
Figure 3. Result of Skin Disease Diagnosis
4. Research Method

The methodology in this study is shown in Figure 4.

Figure 4. Procedure of Research

4.1. Identifying Problems Statement
Firstly, the issues related to usability especially focused on Expert System application were identified.

4.2. Preliminary Study
Consist of two parts: First, study of literature about expert system and concept of usability. Second, study of the observed object, in this case Expert System application to diagnose skin disease in humans. Some of interfaces are shown in Figure 1, Figure 2 and Figure 3.

4.3. Usability Testing
In this stage, the respondents were asked to perform the tasks. Questionnaires were later carried out and they were to be filled in and completed by the respondents based on experience of each respondent when performing the tasks. This stage consist of two activities: giving task to respondents and distributing usability questionnaire.

4.3.1 Providing the set of tasks that have been prepared by the researcher
The tasks were given to 30 respondents. The respondent were chosen among students of PTIK (Pendidikan Teknologi Informasi dan Komunikasi) and medical personnel who have knowledge in using the web browser features or having a computer science background. The tasks are used as a interaction media in the measurement of usability [13].

Table 1. Tasks of usability testing

| No.  | Tasks                                                                 |
|------|-----------------------------------------------------------------------|
| 1.   | Log in as a admin, log out, and then log in again.                   |
| 2.   | Sign up as a patient in "Konsultasi" Menu                           |
| 3.   | Answer the displayed questions on the system                         |
| 4.   | Add, modify and delete the data of type and symptoms of the skin disease on admin page. |
| 5.   | Search information about the names and symptoms of skin diseases.    |
The set of usability testing tasks are displayed in Table 1. There are five tasks. Each task in Table 1 can be explained as follows:

Task 1. Login as admin, logout and then login again.
Users are required to login as admin, starting from finding and filling the login form to log into the admin page, then asked to looking for the logout button, and then login again. The task is considered completed if the user has login and logout of the system.

Task 2. Signup as a patient in Konsultasi Menu
Users are required to register as a patient in “Konsultasi” menu. The task is considered completed when the user has filled the data and then click “Daftar” button.

Task 3. Answer the displayed questions on the system
Task 3 relates to task 2. Once the user clicks the “Daftar” button on the task 2, patients as the user can directly answer option true (YES) or False (NO) of the questions displayed by the system, regarding the symptoms felt by patient. The task is considered completed if the system has shown the type of disease suffered by the patient, the symptoms, disease information and solutions, as seen in the Skin Diseases Analysis Result (Figure 3).

Task 4. Add, modify and delete the data of type and symptom of skin disease on admin page
The users are asked to enter the admin page and search the forms of adding, editing and deleting type and symptoms of skin diseases. The task is considered completed if the user has been succeeded to add, edit and delete data of type and symptoms of skin diseases.

Task 5. Search information about the names and symptoms of skin diseases
The users are asked to find information about the name list and the symptoms of skin diseases. The task is considered completed if the user has found the information.

4.3.2 Distributing the usability questionnaire
After the task was given to respondents, the next step distribute the questionnaire to get an assessment of the thirty respondents to know how much the interface of expert system application is understood, learned, remembered, and etc.

The questionnaires were designed using Likert scale values 1 to 5 (1 = very difficult; 2 = difficult; 3 = fairly easy; 4 = easy; 5 = very easy). The questionnaire to evaluate the usability of Expert System application is presented in Table 2. Respondents fill out the questionnaire in Table 2 based on their experience when performing the tasks (Subsubsection 4.3.1).

| Number | Question | Scale |
|--------|----------|-------|
| 1      | From the initial interface (Home Menu), did you recognize that this is an application of expert systems to diagnose skin disease in humans? | VD | D | FE | E | VE |
| 2      | Could you register as a patient via the Consultation Menu? | VD | D | FE | E | VE |
| 3      | Could you answer the questions about the symptoms of disease displayed by the system after registering as a patient via the Consultation Menu? | VD | D | FE | E | VE |
| 4      | Could you obtain the final results regarding the type of disease, symptoms, description of disease, prevention and treatment offered by the system? | VD | D | FE | E | VE |
| 5      | Are the letters easy to read? | VD | D | FE | E | VE |
| 6      | Are the picture symbols easy to understand? | VD | D | FE | E | VE |
| 7      | Does the color design of this application comfortable viewing? | VD | D | FE | E | VE |
| 8      | Could you find the login form? | VD | D | FE | E | VE |
| 9      | Could you access the information on each page? | VD | D | FE | E | VE |
| 10     | Could you recall menus and page views once you exit the application? | VD | D | FE | E | VE |

Table 2. Questionnaire Questions
The questionnaire consists of 10 questions. Each question has a separate section to represent each aspect of usability. Each question of the questionnaire aimed to demonstrate the usability levels according to user acceptance, which will be assessed on the scale values 1 to 5 [14]. Table 3 shows the contributions of questionnaire question for each aspect of usability.

| No. | Question                                                                 | Aspect of Usability |
|-----|---------------------------------------------------------------------------|---------------------|
| 1.  | From the initial interface (Home Menu), could you recognize that this is an application of expert systems to diagnose skin diseases in humans? | Learn, Eff, Mem, Err, Sat |
| 2.  | Could you register as a patient via the Consultation Menu?                 | Learn, Eff, Mem     |
| 3.  | Could you answer the questions about the symptoms of disease displayed by the system after registering as a patient via the Consultation Menu? | Learn, Eff, Mem, Err, Sat |
| 4.  | Could you obtain the final results regarding the type of disease, symptoms, diagnosis of disease, prevention and treatment offered by the system? | Learn, Eff, Mem, Err, Sat |
| 5.  | Are the letters easy to read?                                             | Learn               |
| 6.  | Are the picture symbols easy to understand?                              | Eff                 |
| 7.  | Does the color design of this application make it comfortable to view?    | Mem                 |
| 8.  | Did you find the login form?                                             | Eff                 |
| 9.  | Could you access the information on each page?                           | Mem                 |
| 10. | Could you recall menus and page view once you exit the application?      | Learn, Eff, Mem, Err, sat |

As can be seen from Table 3, question number 1 represents learnability and satisfaction aspects of usability. Question number 2 represents learnability, efficiency, memorability, and satisfaction aspects of usability. Question number 3 and number 4 represent learnability, efficiency, and satisfaction aspects of usability. Question number 5 and number 6 represent errors and satisfaction aspects of usability, etc.

It can be said that **Learnability** aspect was represented by questions number 1, 2, 3, 4; **Efficiency** aspect was represented by question number 2, 3, 4, 8, 9; **Memorability** by question number 2, 8, 10; **Errors** by question number 5 and 6; and **Satisfaction** by question number 1 until 10.

4.4. **Data Collection and Analysis**

After filled by the user, the questionnaires were collected and then make the recapitulation based on questionnaire results. Table 4 displays the questionnaires recapitulation that shown in percentage.

As can be seen from Table 4, for question number 1, there were 60% of respondents answered very easy, 30% of respondents answered easy, and 10% of respondents answered fairly easy, there was none answered difficult or very difficult.

For the data analysis, the Likert scale values in questionnaires are interpreted to corresponding merit 0.00 until 5.00. Table 5 shows the interpretation from Likert Scale values to the corresponding merit for question 1 to 10. Usability average merit and usability level were depicted in Table 6 [7].
From the data interpretation process in Table 5, the user acceptance value for question number 1 (QQ1) was 4.50 and number 2 (QQ2) was 3.93, its mean that the usability value of attribute “Ease of interface skin disease diagnosis expert system recognized” was 4.50 and the usability value of attribute “Ease of patients registration through the “Konsultasi Menu” was 3.93, etc. These were shown in Table 7.

4.5. Conclusions
From the analysis, will be drawn a conclusion about usability evaluation of the expert system application based on usability aspects and how much the user acceptance value of the application software (usability value and usability level) before being installed in the operational environment.

5. Result and Discussion
5.1 Result
There were two results of usability testing on the expert system application found: the usability value for each attribute (each question of the questionnaire) and the usability value for each aspect of usability. Both of them were shown in Table 7 and Table 8.
5.2 Discussion
There were two results found: the usability value for each attribute (each question of the questionnaire) and the usability value for each aspect of usability.

5.2.1 The usability value and level for each attribute
Each question of the questionnaire aimed to demonstrate the usability levels according to user acceptance value (usability value) [14].

As can be seen from Table 7, the user acceptance value or usability value for the attribute “Ease of interface skin disease diagnosis expert system recognized" was 4.50, according to Table 6, the attribute number 1 is in the range of excellent for the corresponding usability level.

The user acceptance value or usability value for the attribute “Ease of patients registration through the “Konsultasi Menu” was 3.93, according to Table 6, the attribute number 2 is in the range of good for the corresponding usability level.

The user acceptance value or usability value for the attribute “Ease of patients answer the displayed questions about the symptoms of the disease after registering on “Konsultasi” Menu” was 4.60, according to Table 6, the attribute number 3 is in the range of excellent for the corresponding usability level.

The attribute number 4 until 9 is in the range of excellent for the corresponding usability level, and number 10 is in the range of good.

The usability value and usability level for each attribute that explained above was shown in Table 7.

5.2.2 The usability value for each aspect of usability
According to Table 3, Learnability aspect was represented by questions number 1, 2, 3, 4. Usability values of question number 1, 2, 3, 4 were 4.5, 3.93, 4.60, 4.29 (Table 7), the average merit for these question numbers was 4.33, and this indicated that usability value of Learnability aspect was 4.33.

Efficiency aspect was represented by questions number 2, 3, 4, 8, 9. Usability values of question number 2, 3, 4, 8, 9 were 3.93, 4.60, 4.29, 4.53, 4.23, the average merit for these question numbers was 4.31, and this indicated that usability value of Efficiency aspect was 4.31.

Memorability aspect was represented by questions number 2, 8, 10. Usability values of question number 2, 8, 10 were 3.93, 4.53, 3.97 , the average merit for these question numbers was 4.14, and this indicated that usability value of Memorability aspect was 4.14.

Errors aspect was represented by questions number 5 and 6. Usability values of question number 5 and 6 were 4.17 and 4.35, the average merit for these question numbers was 4.35, and this indicated that usability value of Errors aspect was 4.35.

Satisfaction aspect was represented by questions number 1 until 10. Usability values of question number 1 until 10 was depicted in Table 5, the average merit for all question numbers was 4.27, and this indicated that usability value of Satisfaction aspect was 4.27.

The highest average merit was scored by the errors (4.35). This was followed by the aspect of learnability (4.33), efficiency (4.31), satisfaction (4.27) and memorability (4.14). The total average merit for all the five-usability aspect was 4.28 and this indicated that the tested expert system application is in the range of excellent for the corresponding usability level. Usability value for each aspect of usability was shown in Table 8.

6. Conclusion
The software evaluation result of this application indicates that the user acceptance value or usability value of Learnability aspect was 4.33, Efficiency aspect was 4.31, Memorability aspect was 4.14, Errors aspect was 4.35 and Satisfaction aspect was 4.27.

The results also present the usability level for each factor and the total average merit for all the five-usability factor was 4.28, this indicated that the tested expert system application is in the range excellent for the usability level, so the application can be implemented as the operated system by user.
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