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# Usability testing: a review of some methodological and technical aspects of the method

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## ARTICLE INFO

### Article history:

Received 11 March 2008

Received in revised form

20 August 2008

Accepted 15 December 2008

### Keywords:

User centered design

User testing

Usability testing

Empirical user test

Users

Remote usability evaluation

Diary

Automatic capture

User events

Log files

User traces

Usability testing tools

Mobile applications

## ABSTRACT

The aim of this paper is to review some work conducted in the field of user testing that aims at specifying or clarifying the test procedures and at defining and developing tools to help conduct user tests. The topics that have been selected were considered relevant for evaluating applications in the field of medical and health care informatics. These topics are: the number of participants that should take part in a user test, the test procedure, remote usability evaluation, usability testing tools, and evaluating mobile applications.

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## 1. Introduction

As indicated by Saintfort et al. [1], health care informatics “comprise the generation, development, application, and testing of information and communication principles, techniques, theories, and technologies to improve the delivery of health care with a focus on the patient/consumer, the provider, and, more important, the patient–provider interaction” (p. 811). In addition to improving the delivery of health

care, these technologies are meant to increase patient safety by reducing medical errors. The field of health care informatics thus defined, comprises a wide variety of technologies and applications that may be used, in different contexts by different kinds of people having their own objectives. The patients/consumers interact with different online services and web sites in order to find medical information to understand their health and make health-related decisions for themselves. They also use the Internet for discussing

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doi:10.1016/j.ijmedinf.2008.12.004

health matters with other people. Handheld devices and smart phones are used to engage in more healthy behaviors (i.e., to access to tailored nutrition information [2], to boost physical activity [3], or to manage chronic diseases such as asthma, diabetes [4]).

Health care providers already use medical devices [1,5] that incorporate human–computer interfaces: infusion pumps, bar coding medication systems (BCMA), computerized physician order entry (CPOE), clinical decision support systems (CDSS), monitors, surgical robots, electronic medical records (EMRs), radiology systems, etc.

To fulfill the goals of improving the delivery of health care and increasing patient safety, these technologies must be demonstrated as not being error prone. Unfortunately, as indicated by Beuscart-Zépher et al. [5] a number of cases have been documented that show that medical devices (i.e., infusions pumps [6], handheld e-prescribing application [7], CPOE [8–11], etc.) are in fact error prone.

Usability evaluation is one way of ensuring that interactive systems are adapted to the users, their tasks and that there are no negative outcomes of their usage. Usability evaluation is a fundamental step in the user centered design process [12] of any interactive system be it a software, a web site or any information and communication technology or service. The goal of a usability evaluation is to assess the degree to which a system is effective (i.e., how well the system's performances meet the tasks for which it was designed), efficient (i.e., how much resources such as time or effort is required to use the system in order to achieve tasks for which the system was design), and favors positive attitudes and responses from the intended users [13].

The three standard approaches for evaluating user interfaces are *Inspection-*, *User-*, and *Model-Based Evaluations*. Although these evaluation methods were not originally developed for medical interactive systems, their use in the health care settings has increased during the last 10 years. The first two approaches are the most widely used by usability practitioners [14,15] and have been extensively documented. The model-based approaches are considered limited or immature, expensive to apply and their use is largely restricted to research teams [16].

When one look at the books and articles on usability testing, one gets the impression that everything has been said, and that no research questions are left unanswered. However, the standard usability test as is currently applied to test most computer software applications show some limitations or at least raises some questions when applied to some specific domains in which users surf the Internet or use mobile devices. The purpose of this article is not to present the three approaches in details. It neither aims at providing a framework for evaluating healthcare applications. In this respect, the reader should look at the book chapter by Sainfort et al. [1]. The aim of this paper is to review some work conducted in the field of user testing that aims at specifying or clarifying the test procedures and at defining and developing tools to help conduct user tests. This review is not exhaustive. The topics that have been selected were considered relevant for evaluating applications in the field of medical and health care informatics mentioned previously. These topics are: the number of participants that should take part in a user test, the test

procedure, usability testing tools, remote usability evaluation and user testing mobile applications.

## 2. User-based evaluation

User-based evaluations are usability evaluation methods in which users directly participate. Users are invited to do typical tasks with a product, or simply asked to explore it freely, while their behaviors are observed and recorded in order to identify design flaws that cause user errors or difficulties. During these observations, the time required to complete a task, task completion rates, and number and types of errors, are recorded. Once design flaws have been identified, design recommendations are proposed to improve the ergonomic quality of the product.

The user test or empirical usability test is well documented [17–22]. The implementation of a user test generally goes through a certain number of steps such as:

- the definition of the test objectives,
- the qualification and recruitment of tests participants,
- the selection of tasks participants will have to realize,
- the creation and description of the task scenarios,
- the choice of the measures that will be made as well as the way data will be recorded,
- the preparation of the test materials and of the test environment (the usability laboratory),
- the choice of the tester, and the design of the test protocol per se (instructions, design protocol, etc.),
- the design and/or the selection of satisfaction questionnaires, the data analyses procedures,
- and finally the presentation and communication of the test results.

Some of these steps, as we will see, raise some questions that are still difficult to answer while others are still waiting for the development of useful and usable tools. The topics that will be addressed are: the number of participants one has to recruit for conducting a user test, the test procedure, conducting user test remotely, the tools available and needed to conduct usability tests, and the evaluation of mobile applications and services.

### 2.1. How many users do we have to test?

Deciding how many users to recruit has both practical/economic and scientific implications. When inviting users to participate in a user test, the aim is to find the most design flaws a user interface may have, at the lowest cost (cost of participants, cost of observers, cost of laboratory facilities, and limited time to obtain data to provide to developers in a timely fashion [23]). In this respect, one must ensure, based on experimental evidence, that the number of tests participants will allow a complete evaluation of the interface being evaluated and that no superfluous users will be recruited. This point has been studied since the nineties and has not find a final answer yet [23,24].

In the nineties, it was said that with four or five participants, 80–85% of the usability problems of an interface could

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