

# **Physical and Interactive Products Usability Evaluation Method**

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## **Abstract**

The aim of this work is to develop a reliable method to evaluate the usability of electronic mobile products in the end-user market. The method proposed in this work is based primarily on subjective usability assessments using questionnaires. This paper followed a systematic approach to develop a “*questionnaire*” and “*software tool*” which is tailored to measure the usability of physical and interactive products. Mobile Phone is taken as a case study in this work. Mobile Phone Usability Questionnaire (MPUQ) is developed to evaluate the usability of mobile phones for the purpose of making decisions among competing variations in market, and hence finding the weak points in a certain product to strengthen these points in the next release. Another yield of this work is a statistical model derived from well programmed software “*Usability Evaluator*” to generate a composite score of usability based on the response data from the usability questionnaire. The developed method was implemented and tested against its validity to evaluate usability of both software and physical products represented by mobile phones. The proposed method can serve as a diagnostic tool that provides information about the usability of specific dimensions of physical products and interactive products and related interface elements.

## **Keywords**

Usability evaluation, interactive products, physical products, user satisfaction, usability questionnaires.

## **1. Introduction**

Usability has been an important criterion of decision making for end-users, consumers, product designers and software developers for their respective purposes. In addition to the effort of defining usability concepts and dimensions to be evaluated and quantified, many usability evaluation methods and measurements have been developed and proposed. It is considered to be one of the most important and most widely used methods to evaluate product designs (Lewis, 2006). However, each method has advantages and disadvantages such that some usability measurements are difficult to apply, and some others are overly dependent on the evaluators’ levels of expertise. Observational techniques are now well established as tools for evaluating the usability and acceptability of desktop systems such as interactive applications and web sites, whether in the user’s own setting or in a usability lab. In televisions context the word “interactive” is understood to include video on demand, t-commerce, interactive program guides and enhanced broadcast television. This interactive elements need to be usable by viewers. This brings new challenges for television program producers. A usability lab for domestic products such as interactive television is described and set up by Pemberton and Griffiths (Pemberton L. & R. N. Griffiths. 2003). They proposed a usability evaluation method of these interactive elements considering their potential new implications.

According to a recent survey from International Data Corporation (IDC), personal use of mobile devices, technology, applications, and services is on the rise and mobile phones continue to be a big part of consumers’ lifestyles. The survey indicated that 36% of the respondents’ personal calls are made from their mobile phones, and that they spend more on cellular service per month than on broadband, cable/satellite TV, and landline telephone services (Ryu, 2005). In addition to the importance and popularity of mobile devices in consumers’ life styles, mobile products introduce new usability requirements or dimensions such as mobility and portability not possible with desktop computers. Thus, electronic mobile products were chosen here as the target product among electronic consumer products to develop a subjective usability assessment method.

As one of the effective methods of evaluating usability, various usability questionnaires have been developed by the Human Computer Interaction (HCI) research community. While these questionnaires are intended for the evaluation of computer software applications running on desktop computers, the need for a usability questionnaire for electronic consumer products has increased for various reasons; one of the reasons is that the interface of electronic consumer products is different from that of the software products.

Interfaces that feel very easy and natural in their use, without having the user going through a lengthy learning process when he/she wants to interact with this system is called intuitive interfaces. It was found that intuitive interaction does depend on past experience with similar features. More standardization of location on products - similar to the standardization of location of various key features of software- may make location more important. Some products do have standard positions for some functions; for example, mobile phone power buttons are almost exclusively located on the top face or the very top of the front face, which makes them easy to find. More features located consistently in this way would allow location to play a more important role in intuitive interaction. People in their twenties and thirties achieving significantly faster times and more intuitive uses than people over forty. Likewise, people in their twenties and thirties are unlikely to be behaving in the way children do in their approach to new technology (Blackler, and Popovic 2010). The experimental results showed that participants using the highly appealing phone rated their appliance as being more usable than participants operating the unappealing model. Furthermore, the visual appearance of the phone had a positive effect on performance, leading to reduced task completion times for the attractive model (Sonderegger and Sauer, 2010).

For the purposes of this paper, the term electronic mobile products refer to mobile phones, which support wireless connectivity and mobility in the user's hands. Electronic mobile products have become personal appliances, similar to TVs or watches, and representative of users' identities because the usage of the product involves personal meanings and private experiences. The primary objective of this paper is to evaluate the usability of electronic mobile products in the end-user market. The method was based primarily on subjective usability assessments using questionnaires. Thus, the output was a set of questionnaire items integrating existing usability questionnaires adapted especially for electronic mobile products and therefore connected systematically with relevant usability attributes and dimensions for electronic mobile products. Another important output is a software tool to generate a composite score of usability based on the response data from the usability questionnaire. The objective of this study can be achieved via two main steps; 1) the identification of usability attributes and dimensions covered and not covered by existing usability questionnaires and suggest measurement dimensions relevant to the evaluation of *electronic mobile, physical and interactive products*, 2) calculate an overall average usability score of products under study using a sample population which represents the whole users' population.

## **2. Usability Evaluation for Mobile Phones**

Mobile phones were chosen here as the target products among consumer products to develop a usability assessment method, because of the importance and popularity of mobile phones in consumers' life styles. Our usability studies for mobile phones focused on performing basic functions and facilitate services. To measure the overall usability of a mobile phone, five factors are suggested to be evaluated. These factors are learnability, memorability, efficiency, effectiveness and satisfaction (Nielsen 1993).

## **3. Usability Evaluation Model Sequence**

Before describing the evaluation model sequence, different aspects of the evaluation model should be considered. The test results accuracy will depend on several aspects;

- **Questionnaire:**  
Questions should be formulated in order to conduct specific information from the participants about one or more factors of usability and about one or more feature the mobile phone.
- **Participants:**  
To perform this comparative evaluation project, 10 participants were tested five male and five female, their age ranges from 13 to 52. All contestants were chosen because of their experience or lack of experience

with these kinds of phones, some have experience and some have none.

- **Tasks:**

The tasks to be carried out plays a very important role in the judgment on the mobile phone, in the proposed test advanced functions available on the phone are not targeted, only the basic functions are tested, these functions are considered as the most important functions for any mobile phone user, for example; making a call, saving contact information. The evaluation model sequence will be mainly divided into three phases:

**Pretest Phase:**

In this phase; the questionnaire is constructed, the tasks to be carried out are defined and the software is prepared by the administrator for this specific test.

**Test Phase:**

In this phase participants are gathered, mobile phones and their main features are introduced to the participants, how to use it how to carry out the tasks they are requested to perform using this phone.

Testers also show the users other functions which may be further than the basic functions of the phone, for example; using the camera, listening to music or even playing games. These functions are not a part of the test; they are only elucidated to make the user more comfortable using the device which may indirectly affect the performance of the participants during the test and this is highly recommended in order to have accurate results.

Next, the participants asked to get their hands on the phone, they are requested to freely explore the phone, try to carry out the tasks, play some games or have some photos taken, they are free to ask each other or the testers any question about using the phone. After that the participants are asked to carry out the tasks throughout specially tailored software for the purpose of this study “The Usability Evaluator”. This software is based on several time based questions; each group of questions is related to some usability dimension in the mobile phone.

**Results Phase:**

After participants are finished with the questionnaire on the Usability evaluator, the score of each dimension of usability is calculated, the overall usability score of the mobile phone, and the score of each feature are calculated as well. The analysis of these scores shows which phone feature(s) need to be developed.

The evaluation model sequence is explained in Figure 1.

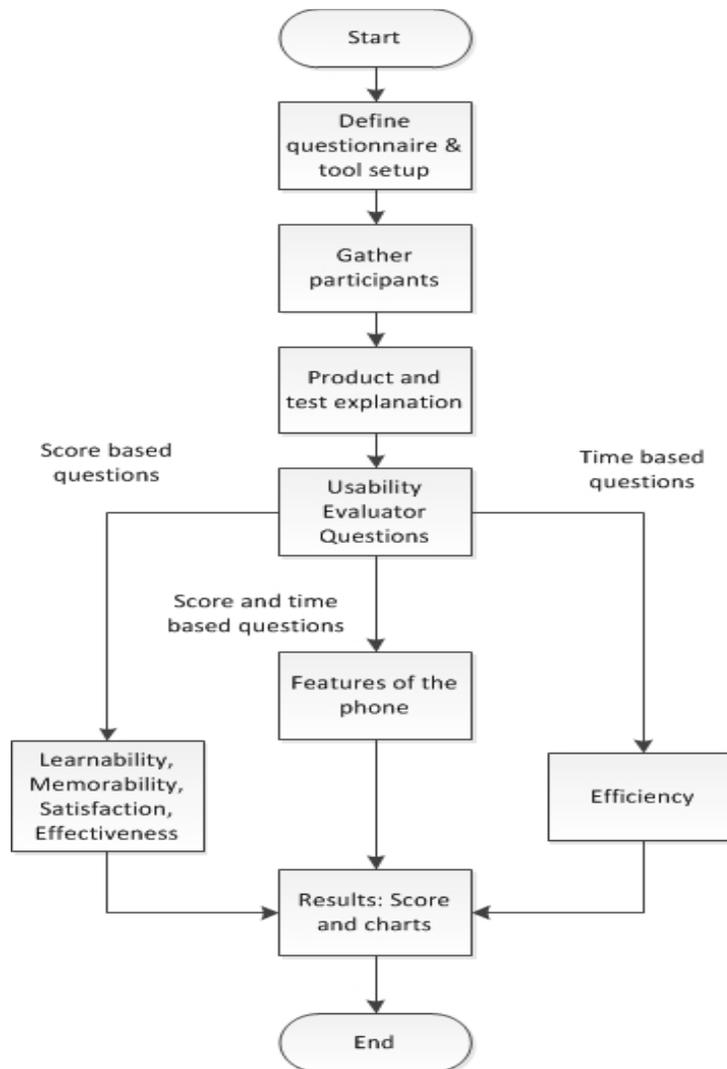


Figure 1 Usability Evaluation Model Sequence

#### 4. Test Scenario

Three different models of mobile phones are evaluated in terms of overall usability in order to reduce the variance across participants. This choice of within-subject design is also compatible with the idea that users or consumers make recommendations. The three different mobile phones are: Samsung E250, Nokia N70, and LG Kf-510.

#### 5. Testing Environment

Usability researchers and practitioners have been concerned that laboratory evaluations do not simulate the context where mobile phones are used (Johnson 1998) and lack the desired ecological validity. Interruptions, movement, noise; multitasking etc. (Tamminen et al. 2004) that could affect the users' performance are not present in laboratory tests. The surrounding environment and mobility are assumed to set special requirements for mobile applications. Usability testing should take these requirements into account. So, all participants are asked to use the phone in a noisy and crowded environment to test the capacity of this device. They are also asked to complete tasks with the selected phones.

## 6. Summary of testing Scenario

The participants are assigned to the mobile phones and the identical sets of the developed usability questionnaire. Participants are asked to complete a predetermined set of tasks for the mobile phones. The tasks are those which are frequently used in mobile phone usability studies. This session is intended to provide a basic usage experience with each phone to make the task of answering the questionnaire easier. After completing this session, the participant is asked to provide an absolute answer of five answers graded from “*strongly agree*” to “*strongly disagree*” throughout the questionnaire, which is designed to fulfill the rest of the Usability factors needed so that the overall score of the product features can be determined as well as the usability factors.

## 7. The list of Performed Tasks

These are the identical tasks that the participants asked to carry out on the Nokia mobile phone, Samsung mobile phone, LG KF-510.

- Saving contact info.
- Making a call.
- Receiving a call.
- Sending message.
- Receiving message.
- Deleting contact info.
- Assembling and turning power on.

## 8. Questionnaire

According to (Kirakowski, 1996), a questionnaire is defined as “a method for the elicitation, the recording and the collecting of information”. Method in this definition implies that a questionnaire is a tool rather than an end in itself. Elicitation means the bringing out of information from respondents through questioning. The answers or responses of the participants to the questionnaire are usually recorded in various ways, such as written text, voice, or video. Collecting implies that by administering them to more than one respondent, evaluators of questionnaires usually expect a compilation of the outcome of the questionnaires. In order to achieve higher validity in the outcome of the questionnaires, higher numbers of collections are generally recommended. The most important characteristic of a typical questionnaire is involving all usability dimensions into considering the overall usability score, these dimensions and their related tasks are shown in figure 2. There have been many efforts to develop a questionnaire that examines the previously mentioned characteristic, references such as the Software Usability Measurement Inventory (SUMI), Questionnaire for User Interaction Satisfaction (QUIS), and Post-Study System Usability Questionnaire (PSSUQ) are developed and used. As a result, the questions below are the typical elements of the questionnaire used in the evaluation model addressed by this paper.

- Saving contact info task completion time.
- Making a call task completion time.
- Receiving a call task completion time.
- Sending message task completion time.
- Receiving message task completion time.
- Deleting contact info task completion time.
- Assembling and powering on task completion time.
- Characters on the screen are easy to read
- Amount of information that can be displayed on screen is adequate.
- Progression of work related tasks is clearly marked.
- The backlighting feature for the keypad and the screen are helpful.
- Error messages are helpful.
- Getting started is easy.
- Exploration of features by trial and error is encouraging.
- Number of steps per task is just right.
- It is easy to restart this phone when it stops unexpectedly.
- The phone's size is convenient to carry around.
- It is easy to send and receive short messages using this phone.

- The call is clear between you and Joe.
- It is easy to assemble and install the product.
- The phone looks pleasant

### 9. Usability Evaluator Tool

For the purpose of this study, a programmed software ‘The Usability Evaluator’ was developed. The Usability Evaluator provides the capability of calculating the overall usability score of the mobile phone addressed by this work, and any physical or interactive end-user product. It can also identify the most unappealing or unsatisfactory features in the evaluated product using the power of statistical analysis methods.

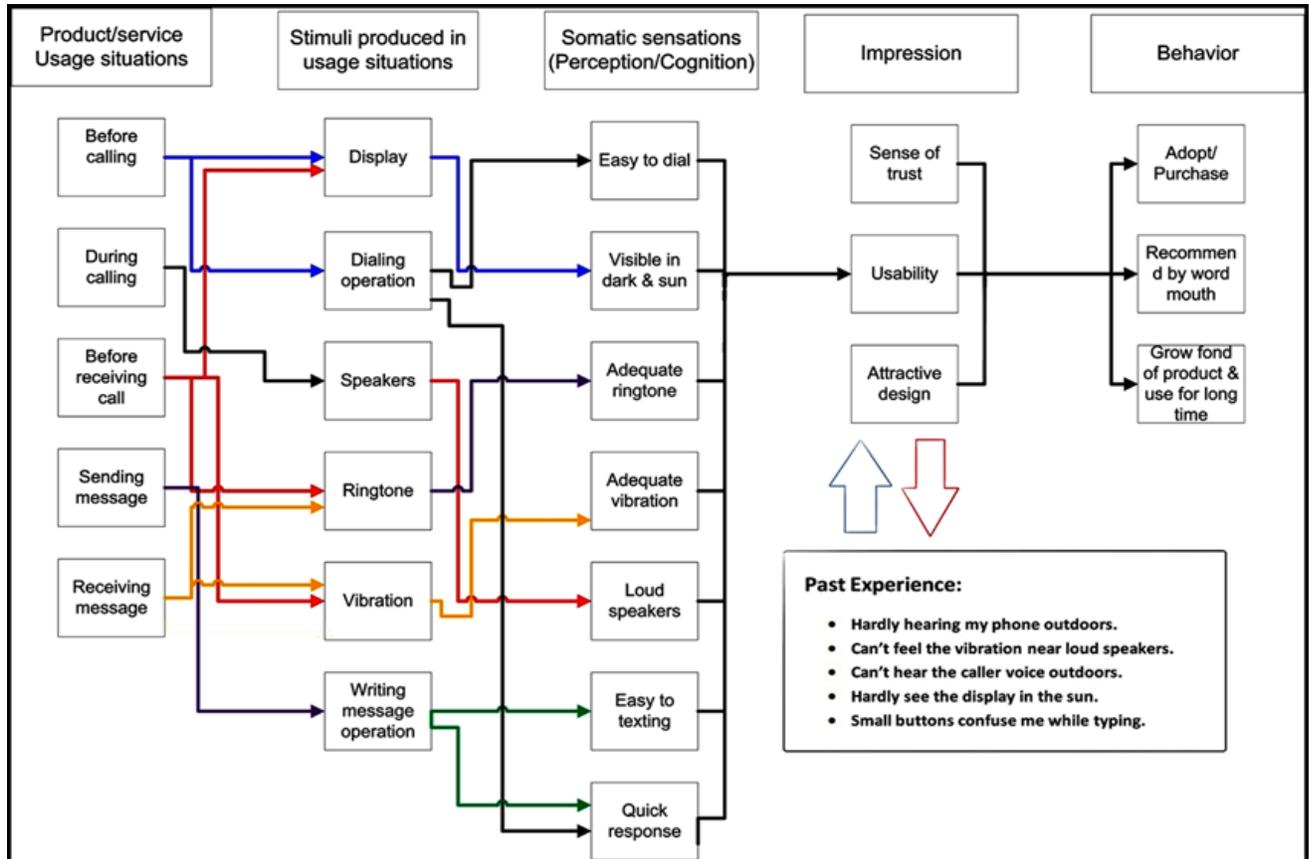


Figure 2: Mobile Phone Usability-related Task Analysis

### 10. Results

The outputs for the all mobile phones given by the Usability Evaluator, come as the following. Figure 3 indicates that the Nokia N70 has the highest Usability Score.

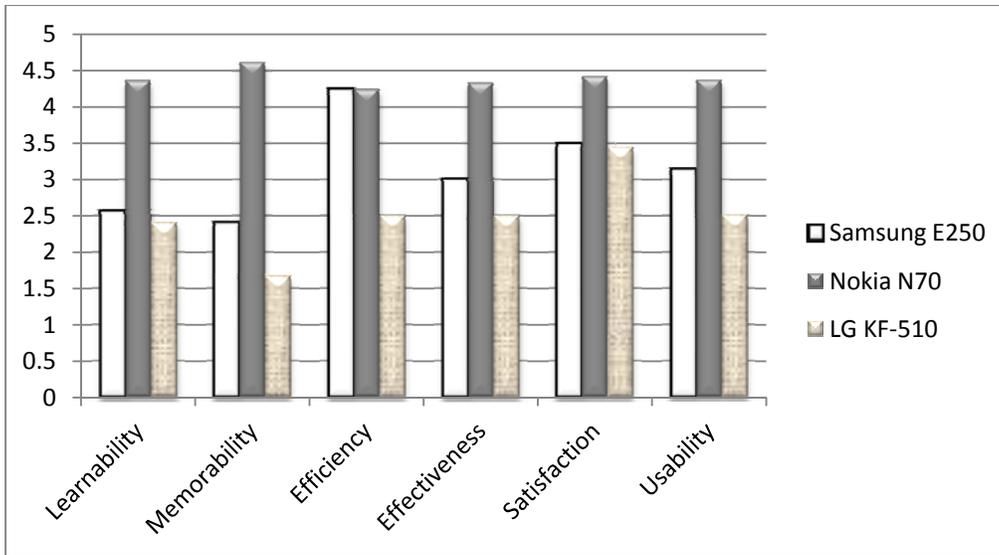


Figure 3: Mobile Phones Usability Dimensions Comparison

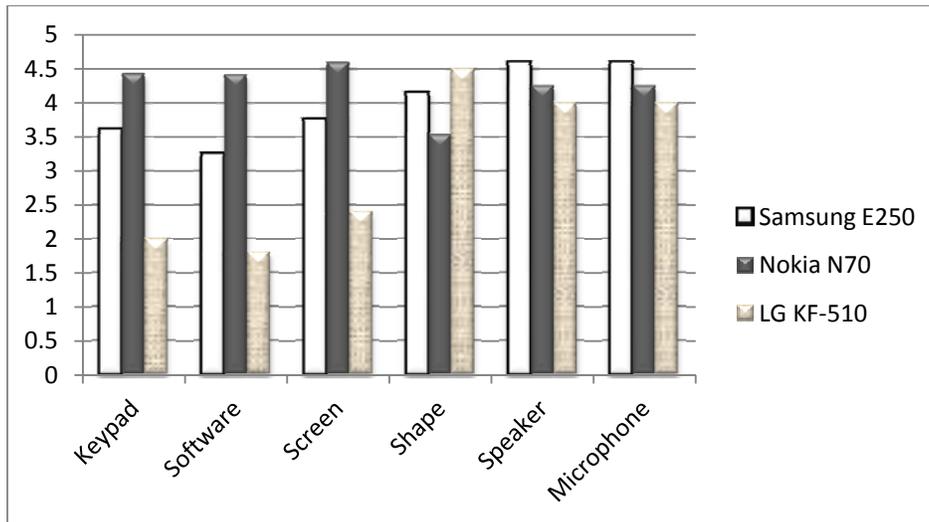


Figure 4: Comparison between Mobile Phones interface components

While figure 4 gives precious information about the reasons behind the Usability lack in each mobile phone. The same questionnaire followed by (Dringus, 2008) used as an input to the “*Usability Evaluation*” tool, logically the same answers obtained from the representative users in (Dringus, 2008) has been used in “*Usability Evaluator*” tool, and the tool showed scores nearly similar to Dringus scores.

## 11. Conclusion

In addition to the importance and popularity of mobile devices in consumers’ life styles, mobile products introduce new usability requirements or dimensions such as mobility and portability not possible with desktop computers. Thus, electronic mobile products were selected as the target products in this study among electronic consumer products to evaluate their usability. This paper followed a systematic approach to develop a “*questionnaire*” and “*software*” tailored to evaluate the usability of the addressed products. The Mobile Phone is taken as a case study in this work. The questionnaire developed throughout this paper evaluates the usability of mobile phones for the purpose of making decisions among competing variations in the end-user market, and finding the weak points in a certain product to strengthen these points in the next release, alternatives of prototypes during the development

process, and evolving versions during an iterative design process. In addition, the questionnaire can serve as a tool for identifying diagnostic information to improve specific usability dimensions and related interface elements. A new group of representative mobile users was employed to develop a statistical model representing the usability dimensions incorporated in the questionnaire and to assign priorities to each dimension. In order to enhance the ease of dealing with these statistics, a reliable software tool "The Usability Evaluator" were developed that could survey large number of users in parallel, this tool could provide designers and manufacturers with precious information such as the score of each usability factor, the average score of a product's usability, along with the effect of these scores on the different interactive components of the product.

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