

CHAPTER 3

A REVIEW & ANALYSIS OF USABILITY IN USER INTERFACE DESIGNING

3.1 Introduction

Human Computer Interaction is about designing computer systems so that the user can carry out their activities productively and safely. It is not how easy something is to use, it is about designing computer systems so the user can carry out their activities productively. The goals with HCI are to develop usable, safe and functional computer systems [18]. It is a wide variety of different kind of users and not just professionals, so it is important to design HCI that supports the needs, knowledge and skills of the target users. Literature on user interface design frequently uses the term usability. The term ‘usability’ came into general use in the early 1980s.

Methodology, theory, and practice in the field of HCI all share the goal of producing interactive software that can be used efficiently, effectively, safely, and with satisfaction. Developing usable products is no longer seen as a “nice-to-have” in the world of product development, but rather as a “must-have.” Usability has now grown to be part of every good effort to release a product that consumers can easily learn and use [1].

3.2 Role of usability in User Interface Designing

Usability is a main concern for final users and also for software organizations that intend to satisfy their customers. Usable systems are easy to learn, easy to remember, how to use it, efficient to use, and reliable, thus, leading to users' overall satisfaction [11][2].

3.2.1 Definition

There are several definitions of the term usability. Shackel defines usability of a system as “*the capability in human functional terms to be used easily and effectively by the specified range of users, given specified training and user support, to fulfill the specified range of tasks within the specified range of environmental scenarios*” [14].

The definition is then operationalized by using four criteria; effectiveness, learnability, flexibility and attitude. This definition already shows the importance of the context of use and that usability is depending on it.

“Usability” is often thought of as referring to a single attribute of a system or device. However, it is more accurately characterized as referring to a large number of related attributes. Nielsen provides the following definition [11]: Usability has multiple components and is traditionally associated with these five usability attributes:

Learnability: The system should be easy to learn so that the user can rapidly start getting some work done with the system.

Efficiency: The system should be efficient to use, so that once the user has learned the system, a high level of productivity is possible.

Memorability: The system should be easy to remember, so that the casual user is able to return to the system after some period of not having used it, without having to learn everything all over again.

Errors: The system should have a low error rate, so that users make few errors during the use of the system, and so that if they do make errors they can easily recover from them. Further, catastrophic errors must not occur.

Satisfaction: The system should be pleasant to use, so that users are subjectively satisfied when using it; they like it.

“Usability evaluation” can be defined as the act of measuring usability attributes of a system or device with respect to particular users, performing particular tasks, in particular contexts. The reason that users, tasks, and contexts are part of the definition is that the values of usability attributes can vary depending on the background knowledge and experience of users, the tasks for which the system is used, and the context in which it is used.

“Usability data” is any information that is useful in measuring (or identifying potential issues affecting) the usability attributes of a system under evaluation.

A similar definition is given by Shneiderman(1998). Shneiderman does not call his definition a definition of usability but he calls it “five measurable human factors central to evaluation of human factors goals”.

Usability is 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” [3][4].

The context of use defined by the standard includes the following factors:

3.2.1.1 Description of users

Characteristics of the users need to be described. These can include knowledge, skill, experience, education, training, physical attributes, and motor and sensory capabilities. It may be necessary to define the characteristics of different types of user, for example users having different levels of experience or performing different roles.

3.2.1.2 Description of tasks

Tasks are the activities undertaken to achieve a goal. Characteristics of tasks which may influence usability should be described, e.g. the frequency and the duration of the task. Detailed descriptions of the activities and processes may be required if the description of the context is to be used as a basis for the design or evaluation of details of interaction with the product. This may include description of the allocation of activities and steps between the human and technological resources. Tasks should not be described solely in terms of the functions or features provided by a product or system. Any description of the activities and steps involved in performing the task should be related to the goals which are to be achieved.

For the purposes of evaluating usability, a set of key tasks will typically be selected to represent the significant aspects of the overall task. User tasks and sub-tasks can be identified by task analysis.

3.2.1.3 Description of equipment

Relevant characteristics of the equipment need to be described. The description of the hardware, software and materials may be in terms of a set of products, one or more of which may be the focus of usability specification or evaluation, or it may be in terms of a set of attributes or performance characteristics of the hardware, software and other materials.

3.2.1.4 Description of environments

Relevant characteristics of the physical and social environment need to be described. Aspects which may need to be described include attributes of the wider technical environment, the physical environment, the ambient environment and the social and cultural environment.

Usability can also be defined as the lack of usability problems in using a product or website; this is important, as in measuring usability, one can either measure effectiveness, efficiency and so on, or one can measure the problem that a user encounters or might encounter (for example usability inspection methods tend to concentrate on identifying usability problems)[4]. Similarly, accessibility can be defined as the lack of accessibility problems. But this is not the same as saying that usability problems are only encountered by people

without disabilities and accessibility problems are only encountered by users with disabilities. The relationship between accessibility and usability, and, accessibility and usability problems are rarely explicitly analyzed, either in the context of the Web or other computer-based systems [17].

3.2.2 The usability principles of interface

3.2.2.1 Principle of Consistency: It allows the human computer interface to be uniform and unitary. So designers must provide feasible and internally consistent environment [12][14].

3.2.2.2 Principle of Concision: It does not mean simplicity. It tells that the interface must not contain any hard understanding elements which are unaware of the user. So that the efficiency of the interface can be improved and it can be easily operated [12][14].

3.2.2.3 Principle of Memory: It makes the interface easy to understand and more efficient to use, so that the users can operate the interface conveniently. So in order to achieve this designer must use the familiar symbols, objects in particular places and also group objects and functions in accordance to the usual thinking of users[13][14].

3.3 Usability measures

Usability measures include effectiveness, efficiency and satisfaction. These are measured in user trials of the product [5]. Evaluating with users is a good method for obtaining data about the actual usage. Using scenarios and other techniques, data about the number of errors or speed

of performance can be obtained which should provide a good indication of the usability of the product.

3.4 Benefits of Usability

A high degree of usability could bring several potential benefits. These include:

Increased Efficiency: Systems are often introduced to get more work done in less time. When the system is not usable the user will waste time struggling with the interface, making them less efficient in their work.

Increased Productivity: A usable interface allows users to concentrate on the work rather than the tools they use.

Reduced Errors/Increased Safety: A significant portion of the errors humans make can be related to poor design. In some cases, these errors may cause dangerous situations for both humans and the environment.

Reduced Training: When a system closely matches the tasks humans have to perform and care has been taken concerning memorability, the need for extensive training is reduced. Hence, the time and costs are reduced.

Reduced Support: A usable product may cause fewer problems for users and hence the need for product support is reduced.

Improved Acceptance: When users like the system because it is very usable, they are more likely to accept and use it.

Savings in Development Costs: Making changes early in the design life cycle is much cheaper than making changes late in the life cycle.

Increased Sales: A system can have a competitive edge over other systems because of its usability [6].

3.5 Improving usability

Every day many people get frustrated with systems that do not adequately support them in their work. Often the software is of high internal quality, but when the system does not match the users' needs and requirements the software is almost useless. The ease with which a user interface can be navigated strongly contributes to its usability [16]. Many books such as [7][8] are dedicated to describing and analyzing the problems users are nowadays facing when they use interactive systems. Although understanding these problems is very important, they often constitute a "postmortem" analysis that does not contribute to improvements of the design processes. The system is not a robust tool, but rather a proof of concept that can exhibit interesting behaviors [16].

The study of human-computer interaction and user interface design is fundamentally based in quantifiable usability research. For years, many usability professionals have been planning, conducting and reporting on usability tests and their findings in order to determine how useful a system really is. Usability testing largely tests how successful users are at completing predetermined tasks or finding pieces of information with a computer system [9]. The strongest link is the fact that if you know more about the user and his work you can build a more usable system. The role of a software application is largely determined by the way it looks on the outside, i.e., the User Interface. User Interfaces continues to be an important aspect of the Human Computer Interaction, and is the implementation of the same in the Interactive Software. Better the design of a User Interface, higher is the success rate and acceptability of the Software in the market.

A well designed software application has a consistent user interface with which user interacts with the system. Advances in computer science have significantly increased but Human factor consideration is still missing. Each designer must have a good understanding of how humans learn and work with the system. Usability testing discovers the user's needs and requirements for specific interfaces [15].

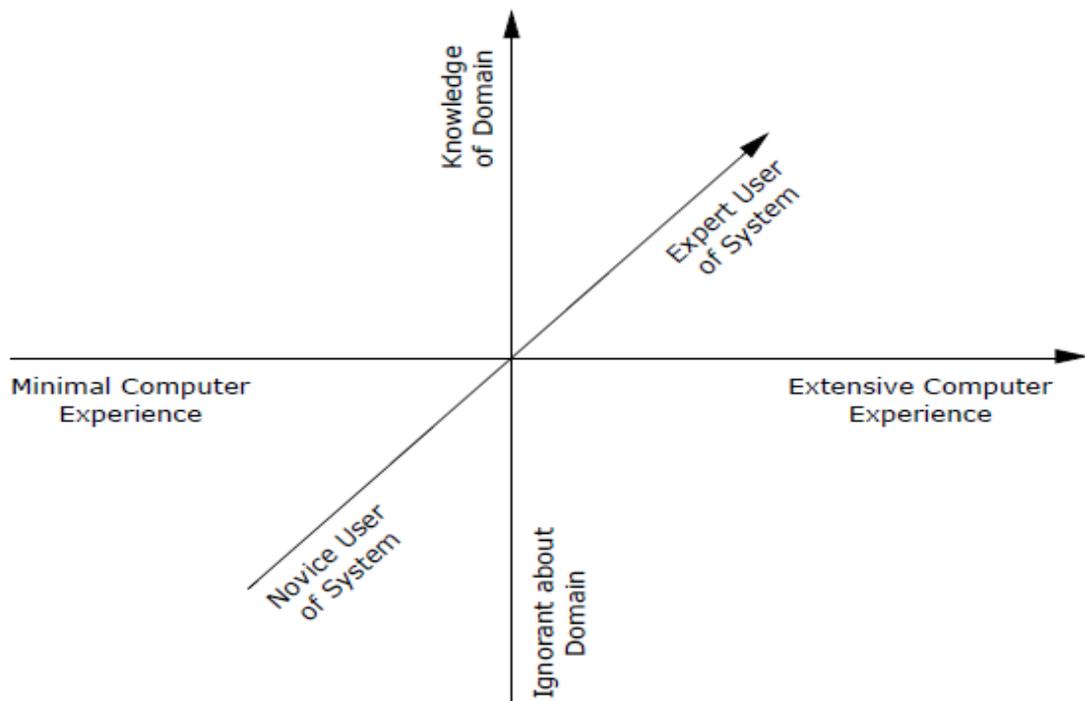
3.5.1 Know the User

Ideally, collecting questionnaires would be the initial step in getting to know the individual users. These questionnaires help the designers to know more about the users. To know the user means to understand human behavior. More particularly, it means to know the characteristics of the classes of users that will be using a particular interface. Designers should give early and continual attention to the user throughout the development process. They need to understand, not just identify, and describe users of the system. Designers can further understand users by interviewing or interacting with them and observing them at work both before and during interaction design. Techniques to get to know the user are the user analysis, task analysis, and information flow analysis. Collecting information regarding type of education, training, skills, and experience is also important. Dr. Keith Andrews summarizes users can be classified according to their:

- Experience
- Educational level
- Age

- Amount of prior training, etc.

Figure 3.1: The three main dimensions on which user experience varies: experience of computers in general, understanding of the tasks domain, and expertise in using the specific system from Figure 3 of [11]



3.5.2 Categories of User Experience

User experience can be thought of along three dimensions, as shown in Figure 3.1.

- Some systems are designed to focus on learn-ability.
- Others emphasize efficiency for proficient users.

- Some support both ease of learning and an “expert mode” (for example rich menus and dialogues plus a command/scripting language), and thus attempt to ride the top of the curves in figure 3.2.

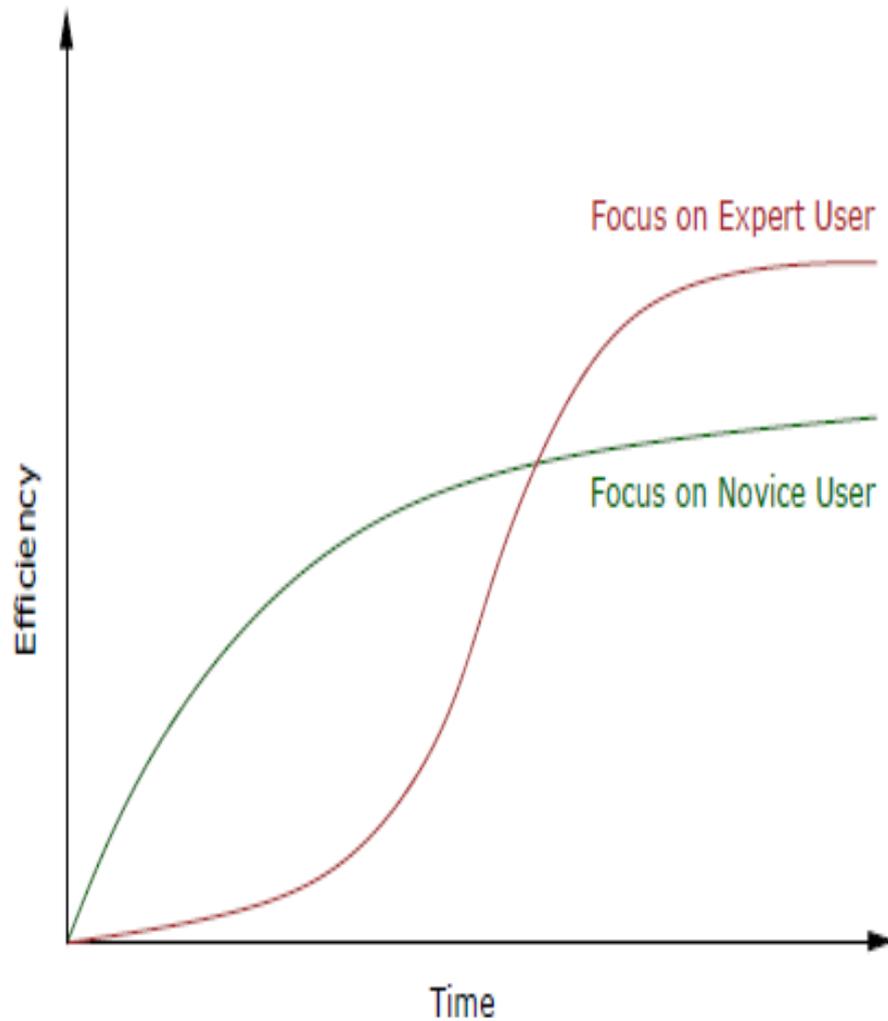
3.5.3 Most Users are Perpetual Intermediates

The experience level of people using computer software tends, like most population distributions, to follow the classical statistical bell curve (normal distribution). In terms of using a software interface, the bell curve represents a snapshot in time:

- Beginners do not remain beginners for long.
- The difficulty of maintaining a high level of expertise means that experts fade over time.
- Most users gravitate over time towards intermediacy.

Most users are neither beginners nor experts: they are perpetual intermediates [10].

Figure 3.2: Learning curves for hypothetical systems focusing on the novice user (easy to learn, but less efficient to use) and the expert user (harder to learn, but then highly efficient), From Figure 2 of [11]



3.6 Usability testing

Methodologies for building usable systems have been introduced and refined over the past fifteen or so years under the discipline of

Human-Computer Interaction. Human Computer Interaction principles include an early and consistent focus on end users and their tasks, empirical measurements of system usage, and iterative development. Much effort has been put into exploring cognitive models of human behavior as it relates to computer usage and developing guidelines for screen layout and system dialogues. These are predictive endeavors whose purpose is to assist the software developer in the initial task analysis and system design.

But, just as comprehensive functional requirements and a detailed design document do not by themselves guarantee that a programmer's final product will be correct, so up-front usability guidelines do not by themselves guarantee a usable end product. In both cases a distinct validation process is required.

Usability testing is the process by which the human-computer interaction characteristics of a system are measured, and weaknesses are identified for correction. Such testing can range from rigorously structured to highly informal, from quite expensive to virtually free, and from time-consuming to quick. While the amount of improvement is related to the effort invested in usability testing, all of these approaches lead to better systems. There are various methods and techniques that are used to test and measure usability. Preece[20] articulates four usability evaluation methods that imply different types of evaluators, different number of users, and different types of data to be collected. These are expert evaluation (also known as heuristic evaluation), observational evaluation, survey evaluation and experimental evaluation. Table 3.1 shows the method and techniques.

'Expert evaluation', also known as heuristic evaluation, is normally carried out by experienced people in interface design and human factors research who are asked to describe the potential problems they foresee for less experienced users.

'Observational evaluation' implies collecting data that provide information about what users do when interacting with educational software. Several data collection techniques may be used.

'Surveys' are employed to know users' opinions or to understand their preferences about an existing or potential product through the use of interviews or questionnaires.

In *'experimental evaluation'* an evaluator can manipulate a number of factors associated with the interface and study their effect on user performance.

Table 3.1 Usability Testing Methods, Techniques and Evaluators [20]

Method	Techniques	Type of Evaluator
Expert / Heuristic	Walk-through Questionnaires	Experts
Observation	Direct Observation Video recording Software logging Verbal protocols (Think aloud)	Experts / Users
Survey	Interviews Questionnaires	Experts / Users
Experimental	Software logging Questionnaires Interviews	Experts / Users

Other methods can also be applied such as: focus group, walk-through, paper and pencil evaluations, usability audit, field studies, and follow-up studies .There are two important points here: Firstly, the researcher should always keep in his or her mind that the selection of a method has to take into account the appropriate techniques for data collection. Secondly,

virtually any kind of usability test, whatever method(s) and technique(s) are utilized, will improve the product, as long as its results are fed back to the development group and acted on [21]. Moreover, the researcher believes that usability testing, like most methodological process improvements, will gain attention and devotees as its benefits emerge through use.

User Satisfaction As can be seen from Table 3.1, the observational, survey and experimental methods imply the presence of users. In addition, users' individual characteristics and differences are important issues for usability. 'User satisfaction' is mentioned as preference data represent measures of participant opinion or thought process, whereas user's 'performance data' correspond to measures of participant behavior, focusing on aspects such as 'efficiency and efficacy of use.' User satisfaction includes participant rankings, answers to questions, and so forth. Few authors point out some aspects to measure, for example, usefulness of the product, how well product matched expectations, ease of use overall, ease of learning overall, ease of set up and installation, ease of accessibility, usefulness of the index, table of contents, help, graphics, and so on. User satisfaction can also be measured through a comparison between two products or two versions of the same product [19].

3.7 Conclusion

User plays an important role in software success because no matter how efficient and good design of the system is or how it matches the requirement of the desired solution but if the users fail to use that system and cannot control the functionality of the system then that system is

useless. User gets frustrated when they cannot complete their tasks. User interfaces should be designed in the sense that a curious user can learn at least some of a system's functionality through experimentation, by trying out its operations to see the results. A good interface helps its users to perform their tasks and it increases the confidence level of the user. It affects the learning rate, productivity etc.

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