What is Usability?

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Abstract

The paper relates different approaches to usability based on the product, the user, ease-of-use, actual usage and the context of use; and proposes that usability should be defined as the ease of use and acceptability of a product for a particular class of users carrying out specific tasks in a specific environment. Criterion levels for measure- ments of attitude and user performance determine whether the design of the product is successful in achieving usability. Diagnostic evaluation of usability problems may be based on analysis of user interaction or comparison of product attributes with guidelines.

1. DEFINITIONS OF USABILITY

The term usability was coined some 10 years ago in order to replace the term "user friendly" which by the early 1980s had acquired a host of undesirably vague and subjective connotations. However, in the intervening years, the word usability itself has become almost as devalued as the term it was intended to supplant. There are still many different approaches to making a product usable, and no accepted definition of the term usability. The definitions which have been used derive from a number of views of what usability is. Three of the views relate to how usability should be measured:

- the product-oriented view, that usability can be measured in terms of the ergonomic attributes of the product;
- the user-oriented view, that usability can be measured in terms of the mental effort and attitude of the user;
- the user performance view, that usability can be measured by examining how the user interacts with the product, with particular emphasis on either
  - ease-of-use: how easy the product is to use, or
  - acceptability: whether the product will be used in the real world.

These views are complemented by the contextually-oriented view, that usability of a product is a function of the particular user or class of users being studied, the task they perform, and environment in which they work.

For example, the definition given in the ISO standard for software qualities (ISO 1991b) is product and user-oriented:

> "a set of attributes of software which bear on the effort needed for use and on the individual assessment of such use ..."

The proposed ISO ergonomics definition (Brooke et al 1990) is usage, user and contextually oriented:

> "the effectiveness, efficiency and satisfaction with which specified users can achieve specified goals in a particular environment".

Eason's (1988) definition is ease-of-use oriented:

"the degree to which users are able to use the system with the skills,
knowledge, stereotypes and experience they can bring to bear".

   The position taken by the ESPRIT MUSiC project is that a complete definition of usability must encompass all these views. Usability is a function of the ease of use (including learnability when relevant) and the acceptability of the product and will determine the actual usage by a particular user for a particular task in a particular context. The current MUSiC definition of usability is:

      the ease of use and acceptability of a system or product for a particular class of   users
carrying out specific tasks in a specific environment; where 'ease of
use' affects user performance and satisfaction, and 'acceptability' affects
whether or not the product is used.

Ease of use determines whether a product can be used, and acceptability whether it will be used, and how it will be used. Ease of use in a particular context is determined by the product attributes, and is measured by user performance and satisfaction. The context consists of the user, task and physical and social environment. The relationship between these factors is shown in Figure 1.
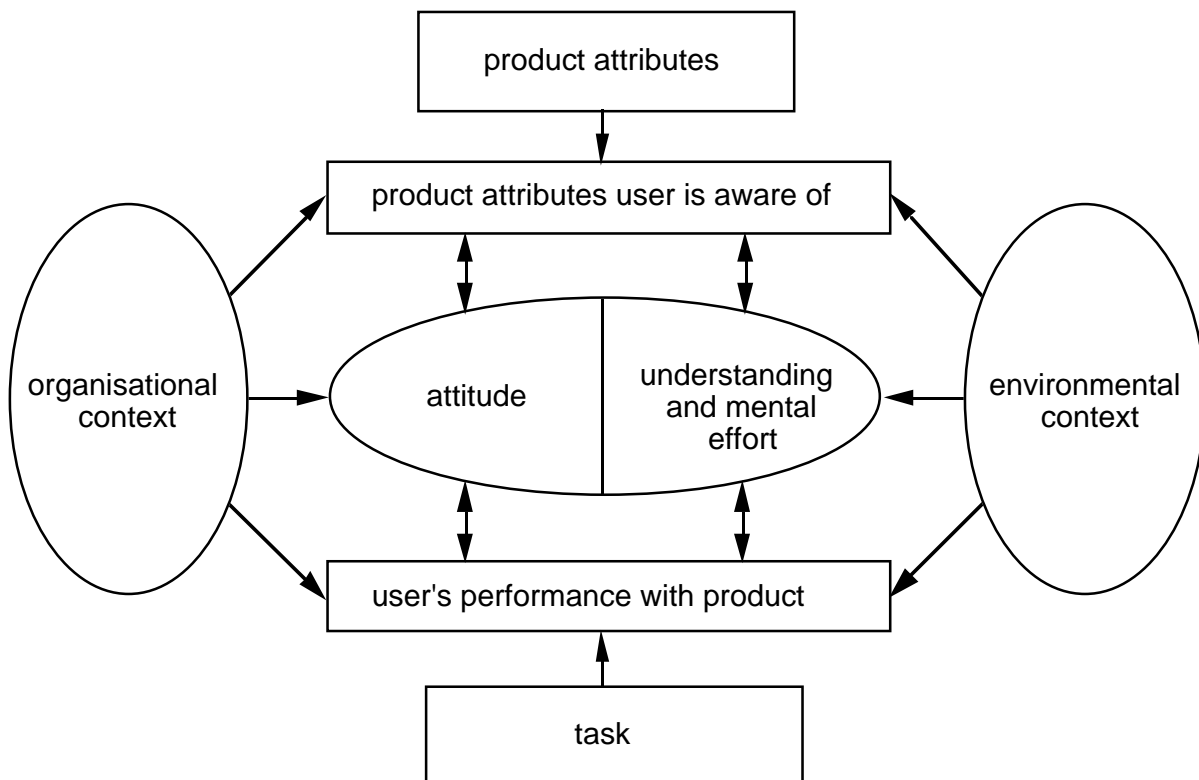

Figure 1. Determinants of usability

The product attributes which contribute to usability include the style and properties of the interface, the dialogue structure, the nature of the functionality, and any other relevant properties such as system efficiency and reliability. Measures of attitude and performance provide the criteria which determine whether the design of the attributes is successful in achieving usability. In the future, analytical techniques may be able to predict attitude and performance from these attributes (Bösser 1991).

The distinction between product attributes and user performance leads to two very different approaches: either emphasis on the specification, design and evaluation of product attributes which determine usability, or concern with the specification and subsequent evaluation of criteria for the user's attitude and performance.

2. EVALUATION OF USABILITY BY ASSESSMENT OF USER INTERACTION

A further problem is to decide which performance should be assessed: performance determined by ease of use in a laboratory test, or actual usage in the real world. In many circumstances a user may have the discretion to choose not to use a system which has been shown to be perfectly easy to use in controlled conditions. To be used in the real world the system must be acceptable to the individual user (what Brooke 1991 refers to as 'utility') - the user must judge the benefits of use to be greater than any alternative means of achieving the task. Acceptability will depend on the context of use and the characteristics of the user, and could be influenced by factors such as cost, convenience, availability, pre-requisite training, dislike of computers or organisational constraints.

When evaluating usability, the performance of the user under controlled conditions will be determined by ease of use. If performance is measured in the laboratory, care must be taken that the context of use matches as closely as possible the intended context in the real world (types of users, tasks and environment). A controlled measurement always masks some aspect of the real working environment, and an indication of how actual usage may differ as a consequence of acceptability can be obtained through interview or questionnaire techniques.

2.1 Measurement of Usability
The usability of a product for a user carrying out a particular task in a particular environment can be measured by a combination of performance measures and assessment of the internal state of the user (including acceptability).

A survey of the literature (Rengger 1991) has identified four classes of performance measure: goal achievement (eg accuracy and effectiveness), work rate (eg productivity and efficiency), knowledge acquisition (eg learnability and learning rate), and operability (eg error rate and function usage). One objective of the MUSiC project is to identify metrics in these categories which are required to describe usability in a particular situation.

The internal state of the user is important not only in assessing acceptability, but in providing further evidence of ease of use. In some circumstances adequate performance may be achieved by the user only at the cost of considerable mental and physical effort. This can be assessed through the user's physical state (eg muscular or ocular fatigue), affective state (eg preference and confidence), and mental state (eg mental effort and fatigue). The nature of the task and system will determine which of these is relevant. Assessments of the user's internal state may be based on psycho- metric (Kirakowski et al 1988) or psychophysiological measures (Wiethoff et al 1991).

2.2 Diagnostic evaluation of user interaction
The information gathered to measure usability can often be studied in more detail to diagnose usability problems. (Operability measures are particularly useful.) There are a number of possible techniques which can be used:
• expert opinion: observation of the problems may enable a usability expert to make   immediate recommendations for improvements;
• detailed analysis of user interaction: the record of interaction can be analysed in   conjunction with the user's explanation of problems to enable actions to be   associated with goals and sub-goals, thus providing insight into why particular   aspects of the interface cause difficulty (Jeffroy and Lambert 1991);
• analysis of user interaction by checklist: users can fill in detailed checklists about   the acceptability of various aspects of the interface thus highlighting particular   types of problems (Ravden and Johnson 1989);

• analysis of expert interaction by checklist: usability specialists can evaluate the usability of the system for pre-defined tasks by assessing whether it meets detailed requirements given in checklists (Oppermann et al 1989).

The technique selected will depend on the stage in the design process and the time and resources available, but a combination of detailed analysis and expert opinion is likely to be most effective. The checklist approaches are useful guidance for the less experienced evaluator, but can give undue emphasis to the more superficial problems.

3. DIAGNOSTIC EVALUATION USING GUIDELINES FOR PRODUCT ATTRIBUTES

There are a number of collections of guidelines for the design of user interfaces. The best known is by Smith and Mosier (1986), and this formed the starting point for more rigorous guidelines which will be published by ISO as international standards (consisting primarily of recommendations) (ISO 1991a). Guidelines have the advantage that they can be applied early in design, and conformance to most guidelines can be assessed merely by inspection of the product without user testing. The weakness of guidelines is that they often generalise across a wide range of characteristics of users, tasks and environments, and it is very difficult to rigourously specify the limits of the context in which a guideline is applicable.

Guidelines specify attributes of a product which have been shown to improve usability. Some guidelines are at a surface level (eg screen layout of a menu), and others state higher level objectives (eg consistency). In many cases the usability of a product will be improved by redesigning the interface to be consistent with guidelines, but a much bigger improvement to the usability can often be made by considering whether the task can be carried out more effectively by a more fundamental redesign (eg avoiding the use of menus to search for information by supplying a unique key which gives direct access).

4. TECHNIQUES FOR SPECIFYING USABILITY

A usable product is one which meets specified minimum usability criteria (Whiteside et al 1988). In the most general case, the criteria will depend on the specific requirements of the user, task and environment of use. This often makes it difficult to specify the criteria accurately in advance. One solution is to make comparisons with other products or means of carrying out the same task, and specify that the effectiveness, efficiency and satisfaction must be as good as, or better than with existing methods. The choice of the measures and the criterion values depend on expert judgement, as no objective rationale for their selection has been proposed.

The intention of the MUSiC project is to define usability through a set of metrics, and provide guidance on which subset of metrics is relevant and how they can be measured in a particular context.

Another technique which can contribute to usability is to require a product to conform with established ergonomic requirements and guidelines. This approach is likely to gain in popularity as more parts of the ISO 9241 standard are published as agreed standards (Bevan 1991). Although conformance with these standards will normally contribute to usability, conformance cannot assure the usability of a product: the product may have ergonomic deficiencies not covered by the standards, or it may only be usable by a very narrow range of users for specific tasks. There may also be several alternative designs, all of which conform with the guidelines, but with large differences in usability.

5. CONCLUSIONS

Usability lies in the interaction of the user with the product or system and can only be accurately measured by assessing user performance, satisfaction and acceptability. Any change in the characteristics of the product or system, user, task or environment may produce a change in usability. A product is not itself usable or unusable, but has attributes which will determine the usability for a particular user, task and environment. These attributes include not only the specifically ergonomic characteristics but all the characteristics of the product which impinge on usage including those aspects of software quality (such as efficiency and reliability) which affect ease of use. For a software product, usability is the user's view of software quality.

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