Defining Usability Problems

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1 PUBLICATION   **2** CITATIONS

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Abstract

Usability evaluation methods rely, either explicitly or implicitly, on a definition of a usability problem to specify an evaluation scope and a usability problem report format. However, the majority of definitions are vague or fail to capture all relevant phenomena in the scope of human-computer interaction. This paper proposes the elaborate definition of a usability problem to address theoretical issues and guide a problem analysis strategy for various evaluation methods.

Author Keywords

Usability problem; usability evaluation methods; methodology; design theory.

ACM Classification Keywords

H.5.2. Information Interfaces and Presentation (e.g., HCI): User Interfaces.

Introduction: why define usability problems?

Every usability evaluation method, either empirical or inspection-based, is susceptible to instrumentation bias, i.e., systematic judgment errors about existence and severity of usability problems [5]. This makes it important for any researcher to explain their theoretical assumptions. An evaluator has to be very clear about *what exactly* they consider to be a problem, and *why*.

An explicit definition of a usability problem has several functions:

- *Filtering.* An evaluator deals with many observations and data pieces, and not all of them are problems. Also, not all problems are in the scope of human-computer interaction (HCI), and therefore are not usability problems. Whereas discriminating between them is generally obvious, in borderline cases an explicit criterion is needed.

- *Comparison.* To compare several evaluation methods (see [14] for example), we need a consistent analysis strategy and description format. Otherwise, similar problem sets would not be comparable because judgment and description are left to the researcher.

- *Communication.* Definition of a problem is important while teaching any evaluation method since it guides students' attention to relevant aspects of data, and helps explain a theory behind the method.

This paper argues that common definitions of a usability problem (used either in textbooks or research papers) do not fulfill these functions, and lead to judgment or communication errors.

Problems with definitions

Mixing a problem and a recommendation. According to [5]: "any aspect of the design where a change would lead to improved system measures on one or more usability measures should be counted as a usability problem". This perspective effectively requires to explain a problem in terms of missing solution. Therefore, (1) the problem only exists in an expert's

mind: if they can't find a better solution, then there is no problem. Consequently, inter-reviewer reliability cannot be achieved. (2) A problem expressed in such a way limits a designer or developer in their choice of a solution.

Including irrelevant problems. Authors of [13] state that "a usability problem was defined as anything that interfered with a user's ability to efficiently and effectively complete tasks". This one doesn't provide any filter to exclude facts that are out of the scope of HCI, e.g., judgment of users about the product cost or users' negative attitude toward a product's brand.

The same kind of definition is adopted by [10, 17].

Excluding actual problems. Some authors exclude problems that result only in users' dissatisfaction. For instance, "a user experiences a problem when that user cannot accomplish some task because of the software tool being used, or can only do so with more difficulty than is expected or is acceptable" [16]. The definition allows an evaluator to ignore a class of problems that are in the scope of HCI: for example, in enterprise software, user satisfaction problems are ignored because they are irrelevant to business goals, but they are still usability problems.

A similar view is adopted by [10, 13].

"Essentialism". This group of definitions assumes that problems are "built into" the interface or the user. Definitions like Nielsen's (see [14, 15]) imply that the interface is the only source of problems, instead of a combination of factors. Similarly, the notion of "user

error", in turn, makes the user the only cause of a problem [17].

Missing a definition. Some textbooks or papers on evaluation methods provide uninformative definitions of a usability problem, or skip the defining step altogether [3, 4]. This may lead to any kind of error mentioned above, and, in general, is not a good educational practice since it leaves students with only a set of examples helping to develop an analysis strategy.

Excluding relevant aspects of a problem. In the absence of a definition, authors may implicitly provide one through their format of a problem report. In this case issues with the problem report format are similar to the definition issues. For example, problem reports that are too general make it impossible for the reader to infer the cause of a problem, so the cause is effectively removed from the definition (e.g. [7]).

Definition Requirements

To resolve the issues mentioned above, we should adopt an explicit definition of a usability problem and consistently use it for data analysis and reporting. Such a definition should do the following:

1. *Include all HCI phenomena.* The definition should explicitly refer to broader definitions of usability and/or HCI, and guide a researcher's attention to events and facts related to user experience.

2. *Distinguish usability problems from problems in general.* The definition should provide a researcher with simple rules allowing to exclude irrelevant data and limit the scope of addressed problems.

3. *Distinguish a problem and its cause.* The definition should define the problem and its cause separately, and imply that identifying a cause is a necessary part of problem analysis.

4. *Imply a relational position on usability[1].* The definition should stress the importance of identifying a combination of factors, rather than a single one, as a cause of a problem.

5. *Distinguish a problem and a recommendation.* The definition should not refer to any solution and focus on describing actual or predicted interaction phenomena.

Definition of Usability Problem Concept

Based on the formed requirements we propose the following definition:

A usability problem is a set of negative phenomena, such as user's inability to reach his/her goal, inefficient interaction and/or user's dissatisfaction, caused by a combination of user interface design factors and factors of usage context.

Let's examine cause (a combination of factors) and effect (a set of negative phenomena) starting from the latter. We divided negative phenomena according to a definition of usability (see [8]) into three non-overlapping classes:

- *Effectiveness.* An interaction is terminated by a user or a system without reaching a specified goal, or

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[1] The term "relational position on usability" coined by Gilbert Cockton. See [1] for a more detailed discussion.

reaching a specified goal becomes impossible. If the goal is complex, i.e consists of sub-goals, we should assess the ability to reach them separately. Note that only activity goals (as opposed to tasks) are considered. User's inability to perform specific tasks or steps belongs to the efficiency class of negative phenomena.

- *Efficiency.* Breakdown while forming the intention, forming a sequence of actions, or executing an action (e.g user can't reach or activate a control); failure to perceive or interpret information (e.g. understand an unknown language); hesitation in decision-making. This class also includes a user action (or lack thereof) that immediately or eventually leads to undesirable and/or unexpected results. The user's action can be perceptual, cognitive, or motor. For instance, if the pilot perceives an indication of the pointer-type instrument that does not match the reality because of the pilot's angle of view (phenomenon of parallax), this perceptual action should be considered a negative usability phenomenon. It doesn't matter whether the user will correct their action later or not.

- *Satisfaction.* Negative sensations and negative attitudes towards the use of a product, including but not limited to emotions. Pain, discomfort, tiredness are examples of negative sensations; irritation or anger are examples of negative attitudes.

We intentionally avoid defining usability phenomena in terms of quantity (e.g. task completion time, level of negative emotions) rather than quality. A quantitative

approach requires setting an arbitrary threshold which we find problematic: what is the lowest/highest value
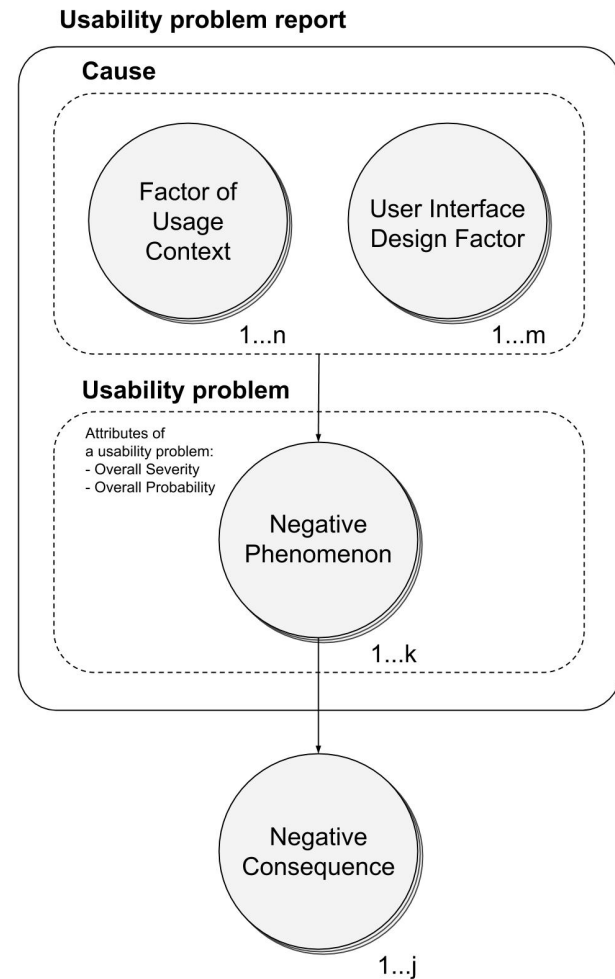
Figure 1: A model of all components of a usability problem.

of a usability metric that we consider normal, why this exact number, etc.

A single usability problem includes one or several negative phenomena (Figure 1), for example, one from the efficiency class and the other from the satisfaction class. Negative usability phenomena might be followed by negative consequences. They are not a part of a usability problem per se, but are essential to estimate the severity of the usability problem. The overall problem severity is a function of the severity of each negative usability phenomena and their consequences weighted by their probabilities. However, the overall problem probability only depends on probabilities of immediate (rather than consequent) phenomena.

An individual usability problem report is a way to describe causal relation between the negative phenomena and a combination of factors. According to the relational position on usability, the cause of the problem is a combination of user interface design factors and factors of a usage context. We refer to the definition of usage context given by A. Dey: "any information that can be used to characterize the situation of an entity. An entity is a person, place or object that is considered relevant to the interaction between a user and an application, including the user and the application themselves" [2]. It differs from the ISO standard [8] in one important way: it includes the system itself. According to Dey, the reality created by the past interaction includes the state of the system (all the data entered by the user and stored by the system), and also the state of the user interface.

User interface design factors include interface components, their groups, properties of components, and their behavior. Examples of these factors include organisation of screens, a web-page layout, the color of a control, its shape, and the size of interactive area of an icon. Examples of behavior include rules of transition between the screens, response time of a user interface, its animation, etc. We refer to the definition of user interface given in ISO 9241-110:2006: "all components of an interactive system (software or hardware) that provide information and controls for the user to accomplish specific tasks with the interactive system" [9].

In all cases a single usability problem includes at least one user interface design factor and one factor of the usage context. We argue that even in the most complex cases where, for instance, the user takes a residual erroneous action [6], at least one user interface design factor has to be analyzed and specified.

Conclusions

We identified a set of requirements that are necessary to avoid issues when analyzing usability evaluation data. The definitions and description frameworks cited and proposed model meet these requirements to various degree (see Table 1 on the next page).

While some definitions lead to significant theoretical issues [10, 13, 15, 17], others are theoretically plausible but lack detail or clear descriptions of certain aspects [12, 14, 16].

Requirements	Jeffries et al., 1991 [10]	Karat et al., 1992 [13]	Mack & Montaniz, 1994 [16]	Kahn & Prail, 1994 [12]	Nielsen & Mack, 1994 [15]	Lavery et al., 1997 [14]	Rubin & Chisnell, 2008 [17]	This paper
1. All HCI phenomena	No	No	No	Yes	Yes	Yes	Yes	Yes
2. Distinguish from general problems	No	No	Yes	*No info*	Yes	Yes	No	Yes
3. Analyse cause separately	*No info*	*No info*	Yes	Yes	Yes	Yes	Yes	Yes
4. Relational position	*No info*	*No info*	Yes	Yes	No	No	No	Yes
5. No recommendations	Yes	Yes	Yes	Yes	No	Yes	Yes	Yes

Table 1: Matching definitions of a usability problem against specified requirements

Considering these sources, the purpose of our definition is to elaborate and make theoretical aspects of a usability problem explicit, so that these aspects could be better communicated and taught.

Future work

There are several directions of future investigation. First of all, we need to elaborate an analysis strategy for raw usability data gathered during the discovery phase of evaluation methods. Then we will be able to assess the efficiency of our model for educational purposes by conducting a comparative study. Students who are learning usability evaluation methods can be given different sets of educational materials to test the hypothesis that teaching the specialists according to our model leads to higher quality of individual usability problem reports, in comparison with existing definitions and educational materials.

In this work we focused on the usability problem concept, but the problem report format is also important (see [11]). A set of heuristics and guidelines for different usability evaluation methods can be developed to increase effectiveness of communication across team members.

Acknowledgements

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