Harms, Ilse/Schweibenz, Werner (2000): Usability Engineering Methods for the Web. Results From a Usability Study. In: Informationskompetenz - Basiskompetenz in der Informationsgesellschaft. Proceedings des 7. Internationalen Symposiums für Informationswissenschaft (ISI 2000) Dieburg 8.-10. November 2000. Hrsg. von Gerhard Knorz und Rainer Kuhlen. (Schriften zur Informationswissenschaft 38). Konstanz: UKV. 17-30.

Usability Engineering Methods for the Web

Results From a Usability Study

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Abstract

The paper presents the results of a study on usability methods for evaluating Web sites. It summarizes the "Heuristics for Web Communications," and reports the practical experiences with these heuristics, contrasting them with the "Keevil Index" and combining them with user testing with thinking aloud. It concludes that working with the "Heuristics for Web Communications" takes more time and effort than working with the "Kevil Index," but produces more consistent results. The heuristics proved to be applicable both in heuristic evaluation and in combination with user testing.

Zusammenfassung

Der Beitrag präsentiert eine Studie über Evaluationsmethoden zur Web-Usability. Er beschreibt die "Heuristics for Web Communications" und berichtet von den praktischen Erfahrungen mit den Heuristiken, die mit dem "Keevil Index" verglichen und mit Benutzertests mit lautem Denken kombiniert werden. Das Ergebnis zeigt, dass eine Evaluation mit den beschriebenen Heuristiken gegenüber dem "Keevil Index" mehr Zeit und Aufwand erfordert, aber konsistentere Ergebnisse bringt. Die Heuristiken haben sich sowohl in der experten-zentrierten Evaluation als auch in Kombination mit dem Benutzertest insgesamt als geeignete Evaluationsmethode erwiesen.

1 Usability Engineering for the Web

Usability engineering is one of the key concepts of human-computer interaction. Currently, the focus of usability engineering is on Web usability. The reason is that the World Wide Web is more and more used for commercial purposes and applications and therefore requires usable Web sites because "Usability rules the Web. Simply stated, if the customer can't find a product, then he or she will not buy it." (Nielsen 2000: 9). This explains the recent interest in evaluation methods for Web sites.

Dealing with Web usability, one has to consider two aspects. One aspect is the concept of usability and the other aspect is the complex graphical user interface of the World Wide Web and how it is applied by users. The demand for usability evokes the question what usability means for Web sites. In general, the usability of a product can be defined, according to EN ISO 9241-11: 1998, as the extend to which a certain user can use it to reach certain aims in a way which is effective, efficient and satisfying (for definitions of these terms see Krömker 1999: 23). EN ISO 9241 is a standard that refers to various kinds of ergonomic requirements for office work with visual display terminals and therefore represents more an ideal than a concrete list of requirements. In the context of the World Wide Web, "usability refers to how easy it is to find, understand and use the information displayed on a Web site" (Keevil 1998: 271). A general problem of usability is that it is "soft" concept, i.e. that it is hard to measure as it is based on subjective factors as user performance or the mental effort and attitude of users and that it has to take into account the context in which the product is used, e.g. the class of users being studied, the tasks they perform and the environment they work in. Another problem is that usability engineering is surrounded by an intimidation barrier and hardly used in practice due to perceived costs and intimidating complexity (Nielsen 1994). To describe the amount of complexity, the next section gives a survey of methods for usability engineering.

2 A Survey of Methods for Usability Engineering

According to Krömker (1999: 25), usability engineering is a set of methods to design user-friendly products and a process in which users, developers, and technical writers work together in order to integrate the knowledge and experience of all participants and enhance the quality of the product. The methods of usability engineering can be categorized in expert-focused and user-focused methods. Among the expert-focused methods are several variations of heuristic evaluation. According to Nielsen (1997a, 1543) "heuristic evaluation is a way of finding usability problems in a design by contrasting it with a list of established usability principles". The established usability principles are listed in guidelines or checklists like Keevil's Usability Index (Keevil 1998) or Molich and Nielsen's nine principles for human-computer dialogue (Molich & Nielsen 1990) or the "Heuristics for Web Communications." In the evaluation process, experts compare the product with these guidelines and judge the compliance of the interface with recognized usability problems. The advantage of expert-focused evaluation is that it is a relatively simple and fast process. A comparatively small number of five evaluators can find some 75 per cent of the usability problems of a product in

a relatively short time (for details see Levi & Conrad 1996). The disadvantages are that experts have to do the evaluation and that experts cannot ignore their own knowledge of the subject, i.e. they cannot "step back behind what they already know." So they will always be surrogate users (expert evaluators who emulate users) as Kantner & Rosenbaum (1997: 154) call them. In contrast to expert-focused methods, user-focused methods rely on actual users to test the usability of a product. This process is called user testing, and according to Nielsen (1997a: 1543) it "is the most fundamental usability method and is in some sense irreplaceable, since it provides direct information about how people use computers and what their exact problems are with the concrete interface being tested." There are various methods for user testing. One of the most popular and most effective method is the laboratory test with the thinking aloud method (Nielsen 1993: 195) which was used in our case study. The advantage of user-focused evaluation is that the tests supply a huge amount of qualitative data that show how actual users handle the product. The disadvantages are that the tests take place in a laboratory situation and that a lot of equipment and coordination is necessary to conduct the test which makes it laborintensive.

3 Description of the Usability Study

3. 1 The Process

In the winter term 1999/2000, the department of information science at the University of Saarland decided to evaluate different methods of usability engineering for the Web. In cooperation with the Stiftung Saarländischer Kulturbesitz, a foundation for cultural heritage, the Web site of the Saarland Museum (http://www.saarlandmuseum.de), the art museum of the federal state of Saarland, was evaluated. It is a graphically designed Web site of the third generation (Siegel 1999: 15) that went online in summer 1999. The project was carried out by sixteen graduate students, who all had already received a training in usability engineering in a research class, and two lecturers as coordinators. The study had two aims. The first aim was to

evaluate some evaluation methods, especially the "Heuristics for Web Communication," the second was to improve the usability of the Web site of the Saarland Museum. Therefore we decided to use a combination of heuristic evaluation and user testing as suggested in the research literature (Nielsen 1993; 1997a; Kantner & Rosenbaum 1997). Figure 1 illustrates how the two methods were applied.

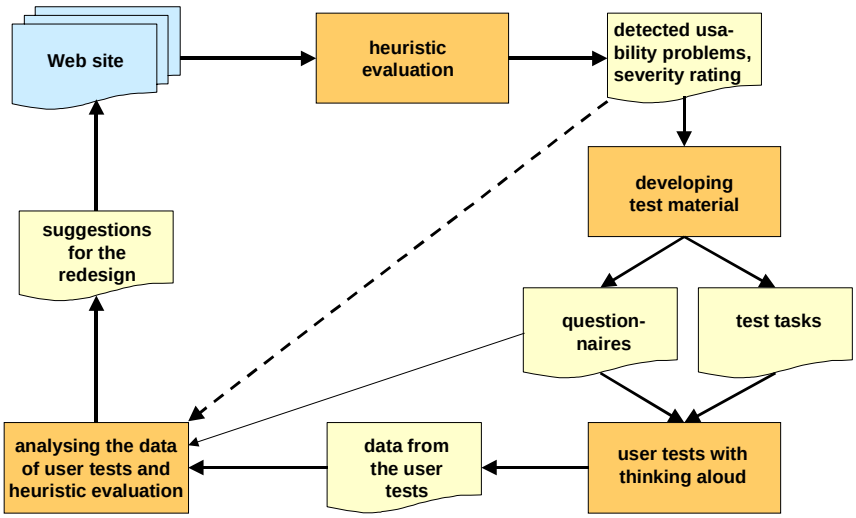

Figure 1: The evaluation process of the usability study

3.2 Heuristic Evaluation With the Heuristics for Web Communications

The first step was a heuristic evaluation. As mentioned above, there is a multitude of heuristics. Heuristics can be specific for a certain domain or generally applicable. They can be design-oriented or evaluation oriented or both. They can be based on research or on experience of practitioners. Therefore, heuristcs vary in extent and qualtiy. In our case study we used the "Heuristics for Web Communications," developed at the International Summer Workshop *Exploring a Communication Model for Web Design, Seattle, WA, July 10-17, 1999* (the heuristics used during the workshop are available on the home page of the workshop). The workshop was organized by the faculty of the Departments of Technical Communication of the University of Washington and the University of Twente, the Netherlands. The heuristics are based on research findings in technical writing and psychology. During the workshop the heuristics were tested by 40 participants and professional Web developers from various Web design companies in the Seattle area. The heuristics were revised according to the feedback of the participants and developers and were

published in a special issue of the Journal of Technical Communication in August 2000.

The "Heuristics for Web Communications" consist of five different heuristics, all based on profound research in technical communication. The five heuristics deal with all important aspects of Web sites: displaying information, navigation, text comprehension, role playing (i.e. author-reader relationship), and data collection for analyzing interaction. The content of the heuristics can be summed up as follows:

The heuristic *Displaying information on the Web* consists of guidelines for visuals, e.g.

- how to design and arrange display elements,
- how to ensure that text is readable
- how to use pictures, illustrations, icons and motion.

The *Heuristic for Web Navigation* deals with hypertext theory and offers guidelines for navigation and orientation, e.g.

- how to design orientation information on each page,
- how to coordinate navigation devices,
- how to design site-level orientation information.

The heuristic *Text Comprehension and the Web: Heuristics for Writing Understandable Web Pages* focuses on text comprehension and issues of text quality, e.g.

- how to select, design, and organize content,
- what style to use,
- what makes Web pages credible and trustworthy.

The heuristic *Role Playing on the Web* discusses the typical rhetorical roles of the implied author and reader of the Web pages and their rhetorical roles, e.g.

- how rhetoric is used to describe author roles and reader roles, and
- what kind of relation exists between author roles and reader roles.

The heuristics *Web Data Collection for Analyzing and Interacting with Your Users* focuses on analyzing the audience of a Web site and building a

relationship between either between you and your users or among the users themselves using for example

- server log data for analyzing the use of Web pages and their audience, and
- means to build a relationship and create a sense of community with the audience.

The four content-oriented heuristics (except the heuristics on *Web Data Collection* which was not applied due to access restrictions to log files) were applied according to Kantner & Rosenbaum (1997: 155). The graduate students, who had received an introduction to the heuristics in a research class, worked in teams of four. Each team conducted an evaluation of the same selected number of pages from the chosen Web site. In a two hour session of individual evaluation, the team members applied one of the four heuristics on the Web site. During the evaluation process they took notes of usability problems according to the various points listed in the heuristics. Then the team members gathered and discussed their findings. The usability problems detected in the heuristic evaluation were graded in a severity rating according to Nielsen (1997b) by each team. The rating ranged from 0 (no usability problem) to 4 (usability catastrophe and was conducted with respect to the frequency and persistence of the problems and the impact they have on users. At the end of the evaluation, the four teams presented their findings in a plenary meeting. The evaluation process took about five hours.

The most frequent usability problems were navigational and orientation problems as described in the *Heuristic for Web Navigation*, followed by general design problems as named in the heuristic *Displaying information on the Web*. Afterwards the two lecturers collected the written findings of the team members and the compiled lists of problems of the plenary session in order to draw up a list of all usability problems. The findings were used to design tasks for a user test in the laboratory.

3.3 User Testing in the Usability Laboratory With Thinking Aloud

The next step of the evaluation was a user test in the usability laboratory. Figure 2 shows a sketch of the laboratory in which the tests take place.

Figure 2: A sketch of a usability lab (omitted due to lack of space in the original paper)

In the lab, real users have to work on tasks while thinking aloud, i.e. they verbalize their thoughts and comment on their actions while they handle the computer. This "allows a very direct understanding of what parts of the dialogue cause the most problems" (Nielsen 1993: 195). During the test users

work on standardized test task and are supervised by a test manager. The tests are recorded on video by a technical assistent who operates two video cameras. One of the camera is focused on the face and the hands of the participant, the other one on the computer screen. The recordings of the two cameras are blended together on the video. In order to catch the details of interaction a digital screencam records the actions on the screen. In a laborintensive process, the findings are transcribed and categorized.

As we evaluated a museum Web site, it suggested itself to recruit participants with an interest in art. Therefore we asked students of the arts and science department and art teachers to participate. The teachers were chosen to increase the average age. The number of participants was arranged according to Virzi (1992: 468), who suggests at least 15 participants. In our study, 17 users participated. Five of them were teachers, 12 were students of the arts and science department. Seven participants were male, ten female. The youngest user was 19, the oldest 48, the average age being 27.

It takes some time and effort to design the test task scenario for the user test of a large informational Web site (cf. Kantner & Rosenbaum 1997: 154). The test tasks should be as representative as possible of the use to which the system will be put in the field and small enough to be completed, but not so small that they are trivial (Nielsen 1993: 185f). The test scenario, which had been discussed with the client of our case study, consisted of nine tasks that represented potential usability problems detected in the heuristic evaluation. Table 1 shows a selection of the test tasks.

Potential Usability Problem	Tasks (abreviated)
Links are hidden in graphical design (images).	1) Go from the splash screen to the core page.
Insufficiently linked information, the exhibition is not linked to the opening hours.	3) Look for the opening hours of a futur exhibition.
Insufficiently linked information, the exhibition is not linked to the service section where tours are offered.	4) Look for guided tours to the current exhibition.
All pages are titled the same. There are no individual title-tags on the different pages.	7) Use bookmarks to go back to certain page.

Table 1: A selection form the test tasks of the user tests

The user tests revealed that all assumed problems were usability problems for test users. The findings were grouped into several categories, e.g. problems handling the splash screen (task 1), insufficient use of links between related information (tasks 3 and 4) etc., and illustrated by lively quotes from the test protocols. For example, after finishing task 1 a participant stated: *"The first screen only shows a headline, a picture and an address but no link. (break) I*

click on the picture. It works!", another remarked: *"As an Internet beginner I honestly have a problem to get to the next page. I'm a little helpless because I prefer big arrows and buttons that say 'next page.' But I made it."* While struggling with task 4 the patience of a participant snapped and he said: *"Now I would try to get in touch with someone and write an email, if they offer a guided tour because all the searching takes far to long."* Trying to use the bookmarks in task 7 a participant said: *"Usually I would use the bookmarks. (clicks on bookmarks) Well, now I see that all the bookmarks have the same name."*, while another participant used sarcasm: *"That's really funny, because I have five bookmarks all named Saarland Museum Saarbrücken. That helps a lot. Great! (laughs)."*

Quotes like these make usability problems come alive and show the reactions of real users. From our experience, these reactions are much more convincing as dry statements of experts no matter how profound these statements might be and no matter on what kind of theory they are based.

The test time and performance of the users was influenced by their computer literacy, data which were collected in a questionnaire. The average test time was about 20 minutes and corresponds with the expected test time derived from three pre-tests. The duration of the test shows some connection between the computer liceracy and the amount of time needed to complete the tasks. The shortest test of 14 minutes was conducted with a user who used the Web for two years or longer and several times a week. The longest test of 30 minutes was conducted by a participant with little computer literacy. Further analysis did not seem necessary to us because the duration of a test is also influenced by other factors like interest in the subject and the medium and the method of thinking aloud.

4 Practical Experiences With the Different Methods

In our case study the theoretical foundations of the heuristic evaluation were the Heuristics for Web Communications. At the time of our evaluation the Heuristics for Web Communications were brand new. Revised versions, incorporating the experiences from the summer workshop, had been published for a limited audience just a few month before. Only little practical experience existed in applying the Web heuristics.

Therefore we thought it useful to contrast the "Heuristics for Web Communications" with another heuristic evaluation tool, "Keevil's Usability Index." According to Keevil (1998: 271) the usability index is a "measure, expressed

as a per cent, of how closely the features of a Web site match generally accepted usability guidelines." The Usability Index consists of five categories (Keevil 1998: 273):

- Finding the information: Can you find the information you want?
- Understanding the information: After you find the information, can you understand it?
- Supporting user tasks: Does the information help you perform a task?
- Evaluating the technical accuracy: Is the technical information complete?
- Presenting the information: Does the information look like a quality product?

Judging from the 203 questions, Keevil's Usability Index seems focused on commercial Web sites. But it seemed adequate to use it for a cultural institution Web sites also, because Keevil (1998: 275) points out that the Usability Index is generally applicable: "Information Developers can use the checklist to measure how easy it is to find, understand, and use information displayed on a Web site."

In our case study, fifteen students (one didn't hand in the index) used the Keevil Usability Index to evaluate the Web site of the Saarland Museum. The results reached from 29% to 55%, the arithmetic mean being 47%. The deviation in the percentage of usability is remarkable. It is due to the bias of the evaluators in interpreting the questions. One reason is that certain sets of questions from the Usability Index did not fit for the Web site under evaluation. In this case some evaluators choose to vote for not applicable, while anothers voted for no. This explains the big differences between the 'N/A' votes and the 'No' votes and in the overall usability because the usability is calculated from the total number of yes answers divided by the total numbers of yes and no answers. Another reason is that the checklist, like every checklist, is open to interpretation. Keevil (1998: 275) was aware of this problem and tried to reduce it by only allowing the answers 'not applicable,' 'yes,' and 'no.' But still, there is considerable room for interpretation. Apart from the problem of interpretation, there is another disadvantage of the Usability Index. It gives a number in per cent and some hints on usability problems that can be derived from the 203 questions but hardly identifies concrete usability problems.

The identification of concrete usability problems and suggestions on how to improve usability are the practical advantages of the "Heuristics for Web Communications." The heuristics are not simply checklists that can be answered by 'not applicable,' 'yes,' and 'no'. They are guidelines designed as statements and questions that guide the evaluator to identify concrete usability problems by asking guiding questions like "Can you decipher all of the elements in the display easily? If not, consider making them larger." or "Which of the organization's values should be emphasized?" or giving hints like "Make sure the most important links appear high enough on the page to be visible without scrolling, regardless of the resolution of the user's monitor. When pages must scroll, provide visual cues to encourage users to scroll down to links that are below the scroll line." By contrasting these established usability principles with the Web site under evaluation the evaluator or information designer can decide if and what kind of usability problems exist and how they can be removed. This is the big advantage of the heuristics.

The disadvantage of the Heuristics for Web Communications is that they are very detailed and complicated compared with general heuristics like the ones of Molich & Nielson. Molich & Nielson suggest nine basic items of usability (Molich & Nielson 1990: 338) (Table 2).

1 Use simple and natural language	6 Provide clearly marked exits
2 Speak the user's language	7 Provide shortcuts
3 Minimize the user's memory load	8 Provide helpful error messages
4 Be consistent	9 Prevent errors
5 Provide feedback	

Table 2: Molich & Nielson's nine basic items of usability

Although it is possible to do a successful evaluation with these nine basic items of usability, users might need more guidance in the evaluation as it is offered in the Heuristics for Web Communications. These heuristics support the evaluator by providing a structured "guided tour" for the evaluation process that takes into consideration both the big picture and important details. They help the evaluator to consider all substantial usability issues and to focus on the important points. Moreover they generate a profound impression of the overall quality of a Web site. This makes the Heuristics for Web Communications a valuable tool in Web usability engineering.

The four content-oriented heuristics (the fifth heuristic was not applied due to restrictions on log file access) are very different as far as their ease of application and the level of background knowledge are concerned. We found that the heuristic *Displaying information on the Web*, the *Heuristic for Web Navigation*, and the heuristic *Text Comprehension and the Web* can be successfully

applied if the evaluators have an average level of knowledge in information design and Web design. The evaluators in our case study, all graduate students of information science, had no difficulties to apply them. The heuristic *Role Playing on the Web* requires some special knowledge in hypertext theory as it is based on the quite complicated author-reader relationship in hypertext (Michalak & Coney 1993). Although it is very interesting and provides promising results, the evaluators in our case study had some difficulties to apply it.

As expected from research literature (Nielsen 1992: 378f), the heuristics detected a great number of minor usability problems, which is no disadvantage at all because user testing is not an adequate means to detect such minor problems. Minor problems were, for example, inconsistent use of link colors, no text messages for graphic links, complicated sentences, deficits in page structure and organization, lack of informative titles, overuse of bold and italics, meaningless animation, flaws in the author-reader relationship etc. Although being real usability problems, such minor problems are not observable in user testing, because average users do not realize that this kind of deficiences cause problems because they lack the background knowledge in Web design and technical communication.

The user tests in the usability lab were very laborintensive for several reasons: the technical equipment had to be arranged, the test scenario had to be designed and tested, participants had to be recruited and tests had to be conducted with two experimenters who had to be present all the time to supervise the participants and the technical equipment. The anaysis and evaluation of the test data was also time-consuming because the data had to be transcribed and categorized. The big advantage of this method was that the recordings, especially the screencan files, show cursor movements that help to identify problems in navigation and orientation. This is especially helpful when discussing the findings and suggestions for the redesign with the client. There is also a simplified method of thinking aloud testing, in which the experimenters simply take notes of their observations is less laborintensive than videotaping and transcribing the tests. But from our experience, it is difficult for one or two experiments to follow the course of the test and take notes at the same time if the test consists of more than some basic functions. Therefore video taping or screencam recording is essential. An alternative to transcribing whole test sessions would be to transcribe only the most important sequences.

An important point we noticed when comparing answers in the questionnaires with courses of the tests is that answers about the test experience are often not very reliable. The answers about the statisfaction with the Web site did often not correspond with the actual experience of the participants. For example,

several participants stated that they had no problems with navigation and orientation although they had had serious problems during the test. The reasons for this gap between behavior and statements cannot be discussed here. From our experience it is important to remark that a questionnaire alone cannot provide reliable results. This is not new but confirms the phenomenon that impressions of the own behavior and the behavior in the situation of social reality show a certain deviation. Despite of this fact, from our experience questionnaires or interviews are necessary to give the participants the opportunity to comment on the course of the test. Test user appreciate this opportunity and the results can be used to derive additional information about the acceptance of the Web site.

5 Conclusion

The evaluation method used in usability engineering depends of the subject that is evaluated and the goals of the evaluation. Although the combination of heuristic evaluation and user testing provides good results, it is costly as far as time and resources are concerned. With respect to the cost-benefit ration, in many cases the heuristic evaluation is sufficient to detect a reasonable number of minor and major usability problems.

In our case study, the Heuristics for Web Communications proved to be applicable tools for heuristic evaluation. The heuristics support a structured evaluation and help both to find and to solve usability problems. In contrast to simple checklists, they give the evaluators some scope for interpretation while offering guidence at the same time. The drawback of the heuristics is that they cannot be applied by novices. The evaluators need some background knowledge in Web design and evaluation. The heuristics were helpful in pointing out critical points in the Web site that were evaluated in the user test. Compared to user testing, the heuristc evaluation was less laborintensive. Nevertheless, user testing is a very valuable tool for usability engineering because actual users give and impression how the Web site will be used in practice. This focus on the actual users and the vivid and expressive statements they give justifies the much higher expense in certain cases. From our experience, the combination of both heuristic evaluation with the Heuristics for Web Communications and user testing with thinking aloud is a very useful method of usability engineering.

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